LONG ISLAND BIOLOGICAL ASSOCIATION

ANNUAL REPORT

OF

THE BIOLOGICAL LABORATORY

COLD SPRING HARBOR

LONG ISLAND, NEW YORK

1936

LONG ISLAND BIOLOGICAL ASSOCIATION

INCORPORATED 1924

ANNUAL REPORT

OF

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To the Officers and Members of the Long Island Biological Association:
Gentlemen:

I have the honor to submit the following report for the year 1936.

RESEARCH

The all-year-round research in physiology has been principally concerned with further investigations of the microscopically thin membranes surrounding cells, a subject which is one of the most fundamental in biology because the properties of the living cell, as opposed to the dead one, are closely bound up with properties of the surface membrane. The principal property is that of "selective permeability." Certain substances such as gases, water, some salts, sugar, etc., pass readily into the cell interior, whereas other substances are held back by the membrane so long as the cell is alive, but when it dies all substances pass freely from its environment into its interior, and vice versa. The structure of the membrane which can thus distinguish between one substance and another has been a source of controversy ever since the existence of cell membranes was known. Some physiologists have thought of it as a liquid film of fat-like material (lipoids) in which some substances can dissolve while others cannot; others have thought of it as having a protein framework, the interstices of which are filled with lipoid, much as a balloon consists of a canvas framework into the pores of which oils and varnishes are rubbed, and still others have thought of it as a mosaic, areas of lipoid and protein existing side by side in a pattern of great complexity. There have even been physiologists who have denied that surface membranes exist at all. In view of these differences of opinion about the cell membrane, the conclusions which workers of the Laboratory have reached this summer are of unusual importance, for by the use of polarized light it has been shown that even simple membranes such as those surrounding the red cell and the nerves of invertebrates possess an "ultrastructure" or orderly arrangement of molecules in a definite pattern. It has always been known that both proteins and lipoids enter into the composition of cell membranes, but these recent observations show what the arrangement of the molecules is. The lipoid molecules are arranged in rows perpendicular to the membranes, whereas the protein molecules are in rows at right angles to these again; a rough idea of the arrangement can be gotten by thinking of a line of soldiers drawn up two deep and then imagining that the men in the front lie down on their faces. The latter position would be like that of the lipoid molecules, while the position of those standing would be like that of the protein molecules. In all probability not two rows are involved, but many, so that the surface membrane is both orderly and complex. A similar ultrastructure can be observed in red cells, various types of nerve, and the membranes surrounding the eggs of sea urchins. It thus appears that this ultrastructure is something common to cell membranes in general. How the peculiar permeability properties depend on this molecular arrangement remains to be discovered.

The electrical properties of these cell membranes have been under investigation by Dr. Fricke and his assistants for a number of years, and

his measurements of the electrical capacity and resistance of cells are impossible to account for unless we suppose a cell membrane to exist. Within the last year, however, an altogether new light has been thrown on the meaning of these results, for the electrical properties arise in a much more complex way than has hitherto been thought, and very similar electrical properties can be found under suitable conditions at surfaces of inanimate substances such as glass and quartz. Previously the electrical evidence pointed to the cell membrane being only a few molecules thick; the newer interpretation, however, is compatible with the idea of a thicker membrane than this, and so is in accord with the results obtained by the use of polarized light.

Another problem with respect to which a milestone has been reached is that of red cell fragility, which is a measure of the extent to which red cells can swell before bursting (hemolysis) and which is widely used in clinical diagnosis of blood diseases. The factors which determine this fragility have been under investigation by Dr. Ponder and his collaborators for the last eight years, first at New York University and since 1934 at the Biological Laboratory. This year the investigation has reached completion in the sense that each one of the factors has been separately measured and the whole phenomon reduced to quantitative terms. The completion of one problem, however, usually means the beginning of another, and this is the case in connection with cell fragility because of the remarkable discovery of Dr. Gordon and Mr. Kleinberg, two of Dr. Ponder's collaborators, that the fragility of the red cells of the blood is greatly altered after removal of the spleen. It has long been suspected that the spleen has an important influence on red cell production and destruction, and because we have now such a complete knowledge of the factors involved it is possible for us to investigate this effect in detail. What the results will be is unpredictable, but a quantitative study of the effects of the spleen on blood cell production and destruction would open up a new field in blood physiology.

Dr. Fricke is continuing his investigations of the chemical effects of X-rays with very interesting results, and is now irradiating and producing chemical changes in a number of complex substances of physiological importance. Within the last few weeks these irradiation experiments have been extended to cells, the rate of breathing of which can be studied before and after dosages of X-rays. The dosages required to effect the respiration of the cells is surprisingly large (thousands of times the doses usually used clinically), but can be obtained from the powerful X-ray equipment in the Biophysics Laboratory.

Studies of oxygen consumption and carbon dioxide production of various tissues have been a major part of the physiological investigations carried out at the Laboratory during the last year, and we now have very excellent equipment for this type of work. The breathing of the cells is measured by placing them in small glass vessels from which oxygen is progressively used up as the cell breathes, and measuring how much oxygen is utilized by observing the position of an oil drop which moves like a piston in a narrow tube attached to the vessel. Our equipment now enables us to use eight of these vessels (respirometers) simul-

taneously, thereby greatly increasing the number of experiments which can be done at one time. The particular problems for which this apparatus has been used are described in detail in the report appended to this one, and have principally been concerned with the effects of narcotics on blood cells, frog skin, etc.

Exclusive of the all-year-round staff research, 35 visiting investigators carried on research during the summer months. The reports of the individual workers are appended to this, and cover such wide subjects as: the calcium-binding power of proteins; the base-binding power of protein in relation to its electrical mobility; the ion exchange between red cells and their environment in hypotonic serum, plasma, and saline; the effect of narcotics on the permeability of artificial membranes; the design of a new type of electrophoresis cell;; the characterization of tuberculin fractions by electrophoresis; introduction of drugs into the skin by iontophoresis; the study of the physical chemistry of allergic wheals; the composition and structure of plant communities in various parts of Long Island; synergism between magnesium salts and such drugs as acetylsalicylic acid; study of the toxicological effects of food dyes; the toxicological effect of benzene and related cylic compounds; experimental work on the activity of local anaesthetics and cardiac glucosides; the resistance and capacity of giant nerve fibres, of Nitella, of pollen of Datura, and of various parts of the central nervous system; the assay of prolactin and the male hormone; the capacity and resistance of injured muscle and the effect of drugs on the injury potential; the electrical properties of the membrane surrounding grasshopper eggs; the polarization optics of giant nerve fibres; the ultrastructure of red cell membranes; the genetics of the wax-moth; studies on the geographical distribution of the Ephemerida; electrophoresis of the white cells of insects; responses of the oyster heart to stimulation.

Dr. Grout's work on the Moss Flora of North America has continued during the past year, and Volume 1, part 1, was issued in October. (The volumes do not appear in numerical order.) Dr. Grout reports that there is enough material written for another part, and that it is likely that the entire Flora can be finished by 1938 or early 1939, instead of in 1940 as originally planned. The work has been very well received by botanists both in this country and abroad, and the majority of the principal colleges and universities in the United States are subscribers.

SYMPOSIUM ON QUANTITATIVE BIOLOGY

The fourth of the Cold Spring Harbor Symposia on Quantitative Biology was held at the Laboratory from June 23rd to July 24th. The value and interest of these meetings are growing from year to year, as is apparent from the increasingly large number of scientists who take part in them. The subject of this year was that of Excitation Phenomena, particularly in muscle and nerve, and is a subject upon which physiologists, chemists, and physicists can meet upon common ground and suggest future lines of research to each other. Thirty-six papers were read, and the number of participants, including those who took part in the

discussions, was fifty-four; at the same time the meetings were largely attended by scientific visitors, with the result that the audience would usually number between fifty and seventy persons. An unusually large proportion of those taking part in the Symposium were in residence at the Laboratory for the greater part of the time, and this had a great deal to do with its success.

The papers and discussions have been published as Volume IV of the Cold Spring Harbor Symposia, with the title "Excitation Phenomena." This volume is larger than its predecessors, there being 370 pages exclusive of the index. Because of the number of records which had to be reproduced in half-tone, the cost of printing the volume has been unusually great; the demand, on the other hand, is steadily increasing, for the volumes are now being sold to libraries and investigators in all parts of the world. It is interesting to know that 900 copies of Volume I have already been sold out of the original printing of 1,000 copies, which makes the circulation of the books larger than the circulation of many scientific journals.

The subject of the Symposium to be held in 1937 is that of Internal Secretions, and the arrangements for the program are already relatively far advanced. It has always been the policy of the Laboratory to select the subjects on the basis of their being those in which rapid advance has recently taken place along quantitative lines, and the field of internal secretions, with the advance which has taken place in the chemistry of the hormones, is certainly one which answers the specifications.

INSTRUCTION

The number of students at the Laboratory last summer was 27, which is about the same number as there has been for the past several years. The course in Surgical Methods in Experimental Biology was again under the direction of Dr. George W. Corner of the University of Rochester School of Medicine and Dentistry, assisted by Dr. E. W. Blanchard of Bryn Mawr College. The course was essentially the same as it has been for the past two years, but it is becoming so well known for its excellence that we are able to select a higher and higher standard of students from those applying to take it. This year eight of the students were graduates, and three were Ph.D.'s and faculty members.

The course in Plant Sociology was given by Dr. Stanley A. Cain of the University of Tennessee, and while the registration was small, a surprisingly large amount of research work was done by Dr. Cain and his collaborators. As Dr. Cain says, "The expansion of the plant sociological work at Cold Spring Harbor will be materially assisted as researches from there begin to appear in the literature. My 1936 report lists five published papers bearing wholly or in part on the work at the Laboratory, and work finished in 1936 will lead to three papers on Long Island vegetation by persons connected with the course. One may assume that this research program is highly desirable, and it would seem desirable to offer some financial support to prospective investigators." It should be borne in mind that plant sociology is a specialized and relatively advanced subject which is not ordinarily taught at universities,

and that the environment of Cold Spring Harbor is almost ideal for the study of plant communities. Since it is a wise policy for the Laboratory to encourage undertakings for which it is uniquely fitted, the work in plant sociology ought certainly to be encouraged and expanded.

The course in Marine and Fresh Water Zoology was again instructed by Dr. Herman T. Spieth of the College of the City of New York, Dr. William A. Castle of Brown University, and Dr. H. J. Van Cleave of the University of Illinois. Here again we had a small number of students, but the standard of work done was very high. A number of universities are now demanding as an entrance requirement towards a Ph.D. degree that the students take a course in marine biology, and it seems to me that we can look for a considerable increase of registration within the next few years, without in any way lowering our existing standards.

The course in General Physiology was conducted along the same lines as it was in 1935, with some small differences as shown in Dr. Taylor's report. Unfortunately, Dr. Taylor is to be unable to give the course again for several years, and it also happens that several others on the staff of the course are to be unable to take part in teaching it. In considering what to do under the circumstances, I have been influenced by two facts. It is impossible to cover the entire field of physiology in a period of six weeks except on a very elementary scale; if only one branch of physiology is to be taught, the branch which can be taught most successfully is surely one which is closely related to the Symposium subject for the year. Since the Symposium subject for 1937 is to be that of Internal Secretions, the course to be offered in place of general physiology would logically be a lecture and laboratory course in Experimental Endocrinology, and the Scientific Advisory Committee, after considering the situation, has recommended that this be done. From the standpoint of integration of the work of the Laboratory, the offering of a course in Experimental Endocrinology will have another advantage, in that the subject is so closely related to the material offered in Dr. Corner's course of Surgical Methods in Experimental Biology, and it is of some significance, as well as of historical interest, that the course in Surgical Methods itself arose out of the course in Endocrinology given by Dr. Swingle and his colleagues some ten years ago. Experimental Endocrinology is a subject which is not generally taught in universities, and it may very well be that the demand for it will be such that it may be advisable to continue it from year to year; on the other hand, it may be better in 1938 to replace it with a course in the branch of physiology which is considered in the Symposium for that year. The situation is one in which one must be guided by events.

This does not mean that the Laboratory will not offer instruction in other branches of physiology. For several years past the course in General Physiology has laid great emphasis on teaching special methods whereby the properties of living material may be exactly measured. Thus in 1936 the main phases dealt with by lectures and laboratory work were the electrical properties of cells and surfaces (directed by Dr. Abramson), osmosis and osmotic pressure and respiration of cells and tissues (directed by Dr. Ponder), measurements of radiation (directed by

Dr. Fricke), electrical conductivity of cells and tissues (directed by Dr. Cole), and hydrogen-ion and oxidation-reduction properties (directed by Dr. Taylor). We hope next year to have at the Laboratory experienced investigators who can direct advanced students in specialized techniques of this description, so that students may, over an extended period, obtain a mastery of the experimental techniques which are so important in research in quantitative biology.

LIST OF EVENING LECTURES

June 23rd—Dr. Eric Ponder, The Biological Laboratory—"The Act of Blinking."

June 30th—Dr. George W. Corner, University of Rochester School of Medicine and Dentistry—"The History of the Discovery of the Lymphatic System."

July 7th—Mr. E. H. Anthes, Bausch and Lomb Optical Company—"The History and Development of the Microscope."

July 14th—Dr. R. W. Gerard, University of Chicago—"Brain Waves."

July 21st—Dr. A. F. Blakeslee, Carnegie Institution of Washington—"Differences Between People in Thresholds for Taste and Smell."

July 28th—Dr. J. Rudolph Katz, Massachusetts Institute of Technology —"Submicroscopic Structure of Starch."

August 4th—Dr. Max Poser, Bausch and Lomb Optical Company—"Scientific Microscopy."

August 18th—Dr. H. K. Svenson, Brooklyn Botanic Garden—"Coastal Plain Flora of Long Island."

LIBRARY

The library of the Laboratory, although still small, has been steadily growing for several years, and the small amount of money available for library purposes has been largely expended on subscriptions to current journals in physiology, physics, and physical chemistry. At the same time the policy of collecting and cataloging reprints has been continued, and the total is now in the neighborhood of 20,000.

There is no question but that our library is weak as a general biological library, but the sum which would be required in order to make it adequate, from the standpoint of our large number of visitors, with their diversified interests, is far greater than we have any prospect of being able to set aside from the annual budget. In 1934 the report of the Scientific Advisory Committee referred to the hope that special money could be obtained to house the library in another building and to buy back numbers of the more important periodicals; until this happens we must be content to keep the collection steadily growing.

INSTITUTIONS REPRESENTED

The following institutions were represented last summer, either by students, investigators, or people taking part in the Symposium, who were actually in residence at the Laboratory.

Brown University
Bryn Mawr College
Clark University
College of the City of New York
College of the Ozarks
Columbia University, College of Physicians and Surgeons
Cornell University Medical College
Duke University
General Electric Company Research Laboratories
Harvard Medical School
Harvard University
Institut de Physiologie, Liege (Belgium)
Johns Hopkins University
Johns Hopkins University School of Medicine
Massachusetts Institute of Technology
Medical College of Virginia
New York University, College of Medicine
New York University, Washington Square College
Ohio State University
Oxford University (England)
Pembroke College
Phipps Intsitute
Princeton University
Rockefeller Institute for Medical Research
St. Ambrose College
St. John's College
St. Lawrence University
Simmons College
Stanford University
State University of Iowa
Temple University
Training School (Vineland, N. J.)
Tulane University
University of Chicago
University of Illinois
University of Lund (Sweden)
University of Michigan
University of Minnesota
University of Paris (France)
University of Pennsylvania
University of Pennsylvania School of Medicine
University of Pittsburgh
University of Rochester School of Medicine and Dentistry
University of Tennessee, Knoxville
University of Tennessee, Memphis
University of Toronto (Canada)
University of Vermont
University of Virginia Medical School.
University of Wyoming
Vassar College

Vickery (Texas) High School
Washington University
Washington University School of Medicine
Worcester Academy
Yale University
Yale University School of Medicine

EXHIBITS

In October of this year an annual exhibition of the work of the Laboratory was given for the second time, and neighbors and others were invited to it. The exhibition was an unquestionable success, and although it was open for one evening and the following morning only, over 300 people visited it and were interested in the material shown. The exhibit was given in the dining hall of Blackford Hall, and the evening exhibit was arranged to coincide with the annual meeting of the Long Island Biological Association. President Page and Dr. Stuart Mudd spoke, and Dr. Ponder gave an account of the activities of the Laboratory. The visitors then went into the dining hall where were shown some eight or ten demonstrations, the majority of which had been shown at one time or another either to the Physiological or Physical Societies.

Dr. Fricke demonstrated methods of measuring the intensity of radiation, Dr. Goldsmith gave a demonstration of the recording of sound by the cathode ray oscillograph, and Dr. Abramson showed a series of colored moving pictures of skin reactions obtained in studies of hay fever and other allergic conditions. Dr. Climenko very successfully repeated the now celebrated experiment which shows that nerves produce their effects by means of chemical substances which they liberate, and Dr. Curtis demonstrated the electrical changes in nerve with the cathode ray oscillograph. Dr. Ponder showed how small objects such as hairs, wires, and cells can be measured by means of their diffraction patterns. Dr. Spieth set up an exhibit of various interesting invertebrates found in the neighborhood of Cold Spring Harbor and used as material for the course in Marine and Fresh Water Zoology, and Dr. Davenport showed a number of charts illustrating various phases of growth in children. A demonstration of the measurement of conductivity in cells and tissues, again with a cathode ray oscillograph, was given by Mr. Spencer. Mr. MacLeod showed the circulation of the blood in the goldfish's tail, projected on a screen, and the program was completed by a demonstration of interesting microscopical objects kindly loaned to the Laboratory by Mr. Anthes, together with a series of botanical photographs given by Dr. Cain.

It is hoped that these exhibits will be a permanent feature of the Laboratory in future years, and our best thanks are due to all those who so willingly undertook to make them a success.

LABORATORY BUILDINGS

For several years it has been becoming apparent that our space and equipment would have to be improved if the Laboratory was to derive

full advantage from the increasingly large number of its scientific visitors. The Walter B. James Laboratory for biophysics, and the George Lane Nichols Memorial Laboratory, now occupied by the all-year-round workers in physiology, are adequate in themselves, but during the summer months the overcrowding is extreme. Last summer considerable improvements were effected in the Davenport Laboratory where the class in Experimental Surgery is taught, and it will be a comparatively simple matter to complete the improvements by the installation of plumbing throughout the building and an animal room in the basement, so that the laboratory can be used for the class of Experimental Endocrinology as well. Mr. Charles Roh has kindly donated the paint required.

An even more valuable use of our existing space could be made by remodeling the interior of the John D. Jones Laboratory, which was originally used as an auditorium and later divided into a number of small rooms. The interior of the building is very large and would lend itself admirably to division into eight research rooms, entered from two large hallways running the length and breadth of the building respectively. The building is already fitted with gas, electricity, fresh water and sea water, and it would not be difficult to install hot water and a sufficient number of laboratory sinks. The wider of the two hallways is sufficiently large to be used as a small lecture room and to contain a small museum of the Laboratory's permanent specimens.

In September last year arrangements were made with the Calco Chemical Company at Bound Brook, New Jersey, to lease to them the Wawepex Laboratory for the use of Dr. David R. Climenko, who is associated with the Calco Chemical Company, and who had been renting laboratory space from us for some fourteen months previously. Under the agreement the Wawepex Laboratory was renovated and remodeled, supplied with oil heat and generally equipped as a working laboratory for research in pharmacology. The building now contains two large animal rooms and six laboratories for chemical, histological, and pharmacological work.

During the past year Mrs. Harris has been in charge of work on the houses and grounds, and she gives the following report of what has been done during the year: "A game room in the basement of Blackford Hall has been furnished, and equipped with a pool table (which was a gift of the late Dr. Harris), card tables, books, etc. The lower terrace has been furnished with porch furniture and a ping-pong table, and an effort has been made to secure privacy by planting of trees and shrubs. Three guest rooms in Blackford Hall have been painted, more conveniently aired, and refurnished. The furniture in the men's dormitory has been repainted. In front of Blackford Hall the sand bank has been cut back and a retaining fence erected to allow more facilities for parking of cars. In front of the Jones Laboratory a parking field has been leveled and surfaced, and a stone retaining wall built. This will care for the parking of the many cars which are here during the summer months. Gravel paths have been made to service the main buildings. Other improvements to the grounds include improving roads, starting a small nursery, removing unsightly trees, new planting of

grounds, clearing the dump, building a woodshed, and improving the garages. Much of this work has been made possible through gifts from the Women's Committee and other friends."

ACKNOWLEDGMENTS

The work of the Laboratory has been made possible only by the generous support of certain foundations, by the gifts of members of the Association, by the Wawepex Society, and the officers and members of the Women's Committee, and by the readiness of many scientists and laymen to advise on its problems.

The National Research Council through its Committee on Radiation has again provided equipment for biophysics and funds for carrying out special investigations. The Ella Sachs Plotz Foundation provided a grant for the study of white cell metabolism. The John and Mary Markel Foundation has given a grant for general purposes, and the Rockefeller Foundation has given two grants, one for general purposes, and one towards the expenses of the Symposium. The Women's Committee has contributed money and furniture, and the Laboratory is under a special debt to Mrs. Merle-Smith and the officers of the Committee for the interest taken in the arrangements for the Exhibit, and for many ways in which they have helped us meet problems relative to the Laboratory houses and grounds. Our special thanks are also due to Dr. Charipper of the Department of Biology in New York University, and to Mr. Anthes of the Bausch and Lomb Optical Company, for these gentlemen have been willing at all times to lend us apparatus and materials.

ERIC PONDER.

REPORT OF THE SCIENTIFIC ADVISORY COMMITTEE

A meeting of the Scientific Advisory Committee was held on December 29, 1936, in the Hotel Haddon Hall, Atlantic City, New Jersey.

The committee is of the opinion that the Symposia held by the Biological Laboratory are extremely useful and should be continued in the future since no other scientific agency has thus far been able to bring together such a group of scholars and others interested in the borderline fields of experimental biology and medicine. It is also the opinion of the committee that the bound volumes of the reports of the Symposia are of very great interest indeed and that they have met with real enthusiasm on the part of scientific people and others interested in these fields. The committee strongly feels this to be one of the outstanding contributions thus far made to experimental biology in this country.

The committee also recommends support of the suggestions of Dr. Ponder concerning needed alterations in the Jones Laboratory especially as these would make available much needed additional research facilities.

Problems concerned with the teaching of a course in General Physiology were discussed and reviewed and it was the concensus of opinion that a regular course in Physiology was perhaps not advisable, but that in its place there might well be substituted opportunities for persons interested in special techniques in these fields to carry on work.

The work of Dr. Grout on the mosses of America was considered important enough for the continuance of subsidization by the Laboratory for a period of another year in order to permit the publication of the more important parts of the monograph now under way and practically ready for publication. It was also pointed out in this respect that the contribution made by the Laboratory to this work is proving of great value and that in the near future the monographs issued will be a real credit not only to Dr. Grout but to the Laboratory as well.

The report of Dr. Ponder concerning the plans for the coming year was reviewed and favorably passed upon by the committee.

It was with deep regret that the committee realized this to be their first meeting at which their esteemed friend, the former director of the Laboratory, Dr. R. G. Harris, was absent. His passing has indeed proved a most serious blow to the Biological Laboratory and it was the desire of the Scientific Advisory Committee that a record be made to this effect and be spread upon the minutes of the meeting of this committee.

J. H. BODINE.

REPORTS OF INVESTIGATORS

Mr. Julius C. Abels' Report

New York University College of Medicine

The work I engaged in during my tenure of the John D. Jones Scholarship last summer was as follows:

a. The calcium-ion binding power of proteins. When such proteins as egg albumin are allowed to come in contact with calcium it is readily shown that a certain amount is rapidly bound. I prepared various protein derivatives such as deaminized, acetylized, benzoylated, and benzyl-sulfonated proteins, and dialysis experiments using these preparations indicated that the hydroxyl group of the albumin and gelatin was most active in this role of calcium binding. The amino group showed no activity.

b. I worked with Dr. Ponder on the correlation of ion shift from and to the red cells (when subjected to hypotonic and hypertonic media) with the R-values found in such media. In hypo- and hypertonic serum and plasma, NaCl, and phosphate buffer, the R value assumed could be explained in a large measure by the gain or loss of K of the red cells.

c. I also had opportunity to study the effect of narcotics such as the urethanes on the permeability of artificial membranes to various ions. Collodion treated with the homologous urethanes appears to show a unique decrease in permeability to SCN ion; other ions studied, NO_3, SO_4, K, Na, MnO_4, CI, Br, I, etc., were in no way effected. Artificial membranes in which were incorporated lecithin, cholesterol and various mixtures of the two, were also investigated for this phenomenon.

Dr. Harold A. Abramson's Report

College of Physicians and Surgeons, Columbia University

The teaching of part of the physiology course dealing with surface phenomena was assisted by Dr. L. S. Moyer. Dr. Moyer's experience with botanical aspects of surface chemistry enabled the work to be developed further along botanical lines.

Dr. Andre Voet (Netherlands Research Fellow) spent several weeks learning the technique of the measurement of electric mobilities. He assisted in a study of a new type of electrophoresis cell and made preliminary measurements on silver chloride crystals.

Dr. Florence Seibert of the Phipps Institute of Philadelphia also learned the electrophoresis technique, making a preliminary survey of the possibility of employing this method to characterize more closely certain tuberculin fractions.

Miss Armine Alley assisted in a new program of research concerned with the movements of drugs into the skin by means of an electric field. It was found that histamine can be introduced by iontophoresis and by electroosmosis into the human skin.

An unsuccessful attempt was made to measure the electrokinetic

potential of the ragweed pollens. Qualitative data revealed that these pollens are negatively charged and that their proteins are easily absorbed by quartz. It is planned to study further their electrical properties.

A continuation of previous investigation of the physical chemistry of the histamine and allergic wheals was made simpler by using dyestuffs of different molecular weights.

Dr. Stanley A. Cain's Report

The University of Tennessee

The month of July, preceding the opening of the class in Plant Sociology, was spent at the Laboratory on completion of manuscript and illustrations of the family Archidiaceae for Dr. Grout's "North American Moss Flora," and in botanical reconnaissance on the Long Island vegetation. The class work continued the study of Long Island vegetation types while considering sociological concepts and methods in the study of community analysis and description. During the latter part of the summer the work was materially assisted by the botanical knowledge and enthusiasm of Professor William T. Penfound of Tulane University and Dr. Dorothy Parker of Brenau College.

Dr. Parker worked out the composition and structure of the plant communities of Long Pond near Wading River, Long Island. The vegetation of this glacial lake is interesting floristically but especially so ecologically because of the fluctuating water level. The data will be prepared for publication early in 1937.

With the assistance of Miss Mary Nelson, Tulane University, who held the Dorothy Frances Rice Scholarship, and Mr. Walter McLean, University of Pittsburgh, who held the Colembola Scholarship, work was completed on the vegetation of the Hempstead Plains, Long Island. The Hempstead Plains were originally dominated by an edaphic climax grassland of some fifty square miles extent occupying a glacial outwash plain of unusual soil type. Encroachments of civilization have destroyed, in the last few decades, the virgin grassland vegetation except for isolated stands. Six of these virgin sod areas were intensively studied producing for the first time an accurate description of this interesting and unique type of plant community. Especial attention was devoted to a study of statistical methods of vegetational analysis and description. These data are being prepared for publication by the senior author.

In 1935 a study of the red maple swamp forest vegetation was initiated. This was brought to completion in 1936 with the assistance of Professor Penfound who devoted some three weeks to the study of the moss and liverwort communities of this forest type. The complete study includes a statistical analysis of the communities on five stands of this phytocoenosis, giving separate descriptions of the tree, shrub, herb and bryophytic synusiae. The data are being prepared for publication by the senior author.

It is hoped that in future years investigators may be further encouraged to use the Biological Laboratory as a base for their ecological and

sociological researches.

During the summer, numerous collections were added to the herbarium. Especial effort was made to have the collections represented by sheets of all the species of the regions and plant communities which were studied intensively.

Dr. David R. Climenko's Report

Pharmacological Laboratory, Calco Chemical Company

I. Magnesium synergism. The question as to whether the magnesium ion is capable of synergizing or potentiating the action of certain depressant drugs has been debated for the last twenty years. The principal reason for this dissension depends on the fact that no objective measurable reaction has been employed as a criterion for estimating the depressant activity. This objective criterion has been achieved in the present study by the simple procedure of studying the effects of drugs and combinations of drugs on the lowering of a standardised experimental fever in large number of rabbits and dogs. As a result of this study crucial evidence is presented to demonstrate that the magnesium salts do synergize or potentiate the action of such drugs as acetysalicylic acid, phenyl cinchoninic acid, and the methylethyl ester of phenylcinchoninate. For example, a dose of 50 mg/kg of acetylsalicylic acid or 50 mg/kg of magnesium oxide, when administered alone, has no effect on the fever resulting from the intravenous injection of 0.1 cc/kg of typhoid toxin. When administered simultaneously, however, the antipyretic action is as great as that produced by a dose of 100 mg/kg of acetylsalicylic acid. The practical significance of this finding is seen in a corollary of the experiment which shows that the toxic level of one drug is not affected by the presence of the other drug.

A preliminary report of the results of this study has been published in the Proc. Soc. Exp. Biol. and Med. (1936, 34, 807), and the completed study will be submitted to the J. Pharm. Exp. Therap. for publication in the near future.

II. Oil soluble food dyes. A series of synthetic, oil-soluble dyes such as toluidine-b-naphthol, xylidine-b-naphthol, and cumidine-b-naphthol have been used for the artificial coloring of foods. The question has arisen as to whether or not these substances are capable of producing deleterious changes in the organism, and they have accordingly been subjected to an intensive pharmacological and toxicological study which has now extended over a period of eighteen months and has included more than one thousand experimental animals. The results of this study are being submitted to the Bureau of Foods and Drugs of the United States Department of Agriculture for review.

III. The pharmacologic and toxicologic action of benzol and other simple cyclic compounds. The simple cyclic compounds such as benzol and aniline are well known industrial hazards and even today, in spite of all engineering precautions, a certain unknown number of casualties occur amongst workers who are in contact with these substances. However, the fact that these cases of accidental intoxication may produce symptoms

which can not be distinguished from a group of spontaneously occurring blood diseases of unknown aetiology is not sowell known. An investigation has been undertaken to study the effects of these substances on the blood and the blood forming mechanism of experimental animals. An apparatus has been designed and built for maintaining experimental animals in atmospheres containing known concentrations of the compound under study in circulating air. The results of this investigation are not sufficiently advanced to justify any statement.

IV. Local anaesthetics. Through the cooperation of Dr. Hill of Yale University, a number of synthetic compounds of the morpholine and ethanol series have been examined for their pharmacological activity. While these substances show an interesting gradation of local anaesthetic properties, they have been found to be too irritant for therapeutic purposes.

V. Cardiac glucosides. A study has been carried out on one of the digitalis bodies (Urginin) obtained in a crystalline form from the squill Urginea maratima. Almost 100 bio-assays have been performed on as many samples of the drug in order to demonstrate the uniformity and stability of the preparation. Experimental work is under way which will compare the activity of this drug with the more commonly known cardiac glucosides such as digitalis or strophanthin. At present it may be stated that the emetic action of Urginin is considerably less than that of the other cardiac glucosides and that the cumulative effect is not as pronounced.

Report of Drs. Kenneth S. Cole, Howard J. Curtis and Mr. Joseph Spencer

College of Physicians and Surgeons, Columbia University

The alternating current resistance and capacity of a number of different biological materials were measured at frequencies from 30 to 2,500,000 cycles per second.

With the aid of Dr. John Z. Young, preliminary measurements were made on the giant single axon of the Squid mantle nerve. The results seemed to indicate that the membrane impedance is of the polarization type.

Measurements on Nitella indicate that the membrane has a very high resistance, and a static capacity of 0.7 microfarads per square centimeter. The conductivity of the cell sap is approximately that of sea water.

Preliminary measurements on pollen from Datura and from corn indicated that the cell is surrounded by a non-conducting membrane having a capacity of approximately 0.5 microfarads per square centimeter and a specific resistance of the cell sap of the order of 500 ohms-centimeters.

Working in conjunction with Drs. Margaret Rheinberger and Howard L. Andrews, the electric impedance of cat brain and overlying tissues was measured to determine their effect upon measured cortical potentials. Separate measurements were made on grey matter, white matter, pia

mater, dura, cranium and scalp. In each case it was found that the series reactance down to 30 cycles per second was entirely negligible as compared with the series resistance, and until there is experimental evidence to the contrary it may be assumed that even at very much lower frequencies any capacitative effect may be ignored in the analysis of cortical potentials.

Theoretical investigations were carried on to determine (1) the feasibility of explaining a polarization impedance in terms of a distribution of cell sizes and membrane capacities, and (2) the paths of current flow and impedance of a single nerve fiber.

We wish to thank Dr. A. J. Derbyshire of Ohio State University and Mr. Malcolm MacKenzie of Cooperstown, N. Y., for assistance in some of this work.

Dr. Bert Cunningham's Report

Duke University

Although Miss Huene and I arrived at the Laboratory earlier than last year we were unable to take any considerable number of turtles or terrapins with eggs. Apparently a warm spell in May brought them out and they had completed their laying activity before our arrival. The peak laying period of the previous summer was the latter part of June. It was impossible therefore to make any of the projected studies on water-relation in the eggs.

However, pituitaries and testes were taken in sufficient quantities to permit assays for the gonad-stimulating hormone prolactin and the male hormone. These assays are now being made and they promise interesting results. We appreciate the kindness of the Laboratory in furnishing the facilities for this study and hope that this work may, along with the studies of water-relations in the eggs, be continued next summer. We also appreciate the excellent co-operation of the Wyandanch Country Club and its employees in securing many specimens for study.

Dr. Hugo Fricke's Report

Biological Laboratory

In our earlier work the chemical reactions produced by the X-irradiation of solutions of organic substances were studied by an analysis of the gases obtained. In many cases this left considerable doubt as to the nature of the reactions occurring and for certain compounds a more complete study has now been made; these include carbon monoxide, methyl alcohol, and several aldehydes. All of these reactions have also been studied with ultraviolet light as the water-activating agent.

The work on wavelength dependance of genetic effects, carried out in cooperation with Dr. M. Demerec of the Carnegie Institution of Washington, was finished during the early part of the year. These studies have led to interesting conclusions as to the mechanism of the action of X-rays on cells; these will be published during the coming year.

An accurate method for measuring the dielectric constant and elec-

tric conductance of biological materials between 16,000,000 and 64,000,000 cycles per second has been developed, making it now possible to carry out measurements of these two quantities over the whole frequency range between 250 and 64,000,000 cycles per second. The method has been used in a study of various amino-acids, including glycine, alpha-amino butyric acid, gamma-amino butyric acid, and epsilon-amino caproic acid, from which a determination of the effective sizes of these molecules has been found possible. Measurements were also carried out on solutions of gelatine, at different concentrations and at different values of the hydrogen ion concentration. Although the dielectric constant is only slightly higher than that of water, there is nevertheless a strong conductance dispersion which appears to be due to a kind of Debye-Falkenhagen effect. A good deal of attention has been given to the explanation of the dielectric properties of cell membranes. We found last year that at all water-dielectric interfaces dielectric phenomena are present which are so similar to the dielectric phenomena at cell membranes that there can be no doubt that they are of the same origin. A more complete study of these interfacial dielectric properties has now been made, particularly by measurements on suspensions of spherical Pyrex. A preliminary study has also been made of the way in which the interfacial properties are modified when the aqueous phase is a few molecules deep only, as realized experimentally in certain artificial membranes or at solid surfaces exposed to humid atomspheres.

Dr. Thomas T. Goldsmith's Report

Biological Laboratory

With the aid of a special grant, a research problem begun while a graduate student in the Department of Physics at Cornell University was brought to completion at the Biological Laboratory. The work completed a Doctor's problem, a complete description of which can be found in the Doctor's Dissertation on file at Cornell University. The title is "The Refractive Index of Water for Electromagnetic Waves Eight to Twenty-four Centimeters in Length." Wavelengths were measured in air and water for continuous waves produced by magnetron and positive grid oscillators. Although high in absolute value, the index of refraction thus determined shows a decrease with increasing frequency, indicating a start of the drop toward the infra-red value.

A short paper containing the essential results of the work has been prepared under the same title and has been accepted for publication in the Physical Review.

Dr. A. J. Grout's Report

Biological Laboratory

Work on the principal project, The Moss Flora of North America, has made good progress. Volume I, part 1 was issued in late October. It is the most copiously illustrated of any part yet issued. There is enough manuscript written for another part, but it consists of portions

of what will be issued in three of the remaining four parts. Dr. W. C. Steers of the University of Michigan has completed the Ms. and illustrations for the Calymperaceae and is at work on the genus Barbula. Dr. T. C. Frye of the University of Washington has nearly completed the manuscript for the Polytrichaceae. This was to have been issued as a part of Vol. I, pt. 1, but there was unexpected delay in finishing the monograph. Dr. A. LeRoy Andrews finds the genus Bryum a difficult proposition, and consequently the manuscript for Vol. II, pt. 4 will not be ready until late in 1937. Dr. Andrews has been an authority on this group for a long time and there is every reason to believe his monograph when finished will be authoritative. Mrs. H. A. Haring, who has worked with me for portions of two summers, is at work on the genus Tortella. Dr. Seville Flowers, besides furnishing the original drawings for species not previously illustrated, has prepared a monograph of the Encalyptaceae. I expect to finish the manuscript for the remaining genera of the Dicranaceae and for the Family Leubryaceae during the winter, so that Vol. I, pt. 1 should be ready early next summer.

It thus seems probably that the Flora can be finished in 1938 or early in 1939, instead of 1940, as originally planned.

A majority of the principal colleges and universities of the United States have subscribed to the work.

Several valuable works have been added to the library during the year, so that workers in the summer will find the principal references for checking citations.

Students in the summer were Mrs. H. A. Haring; Miss Farida Wiley of the Museum of Natural History, New York, Miss Mary Jo. Cobb, instructor in Adelphi College, Garden City, N. Y., and later of the San Francisco College for Women; and Prof. Lena B. Henderson of the Randolph-Macon Women's College, Lynchburg, Virginia. These were all the present laboratory facilities at Newfane could accommodate.

Hundreds of specimens from various institutions and private students have been identified and the increasing familiarity with the North American moss flora has made it possible to determine many difficult sterile plants and extend the ranges of many species as well as add many new species to our flora.

Students of Plant Sociology have become increasingly aware of the necessity for considering Bryophytes in any studies of the subject, and are heartily welcoming a manual that will render their determination relatively easy. It has been a pleasure to assist such work by determining difficult specimens.

Exploration of the fields and jungles of Florida will be continued and will doubtless uncover more species of a subtropical range and possibly some more new to science.

Miss Rita M. Guttman's Report

College of Physicians and Surgeons, Columbia University

Working on the same apparatus as, and in conjunction with, Drs. Kenneth S. Cole and Howard J. Curtis, impedance measurements were

made on the sartorius muscle of the frog under a variety of different conditions. Using the capacity and resistance of the muscle as an indication of death, it was found that certain drugs, such as saponin and sodium taurocholate, have an optimum concentration for killing the muscle, and that either larger or smaller concentrations than this optimum are less effective in causing death. Cutting a muscle does not change its electrical properties, and it appears that membranes form over a cut surface which show a different susceptibility to drugs than the normal membranes.

Dr. Theodore L. Jahn's Report

State University of Iowa

Working on the same apparatus as, and in conjunction with, Dr. Kenneth S. Cole and Mr. Joseph Spencer, impedence measurements which had previously been made at 1000 cycles per second on the grasshopper egg membrane in different stages of development were extended over a frequency range from 30 to 2,500,000 cycles per second and to media of various specific conductivities. Up to about the 6th day of development the membrane is composed almost entirely of protein, after which a cuticular and a chitinous layer are formed. It was found that both young and old membranes are equivalent to a polarization impedance in parallel to a resistance. The capacity per square centimeter at 1000 cycles per second is 0.03 microfarads for the protein and 0.1 microfarads for the cuticular layer. The former has a resistance per square centimeter of about five times the specific resistance of the medium which surrounds it, while the latter has a resistance per square centimeter of approximately 45,000 ohms which is independent of the surrounding medium. The phase angle of the membrane of the young embryo is 81° and that of the older stages is 85°. The chitinous layer is apparently freely permeable.

Dr. Laurence S. Moyer's Report

University of Minnesota

In addition to giving laboratory instruction in electrokinetics in the course in General Physiology, several investigations were undertaken. A vertical microelectrophoresis cell with non-polarizable elecrodes was perfected for use with rapidly settling particles, in collaboration with Dr. H. A. Abramson and Dr. Andr. Voet (Fellow of the Netherland-American Foundation). Many experiments were performed to demonstrate the complete agreement between data obtained with this cell and with other types of instruments. This work has been published in the Journal of the American Chemical Society for November 1936.

A review for the symposium on "Electrical Methods in Biology and Medicine," held by the American Electrochemical Society at its Philadelphia meeting, was written with Dr. Abramson. This review, which deals with recent methods in the investigation of electrokinetic potentials, will appear in the Transactions of the American Electrochemical Society.

In collaboration with Dr. Ponder, several attempts to measure the electric mobilities of rabbit and human red blood cells, both in their normal and spherical states, met with difficulties due to hot weather so that further work had to be postponed.

With Mr. Jules Abels, the investigation of the electric mobility and acid (base) binding curves of solutions of egg albumin in media of constant ionic strength was carried out. Abramson had shown that the charge on the protein molecule calculated from electric mobilities of protein-coated quartz particles was close to values of the charge obtained from acid (base) binding data. It was felt that better agreement might be secured if both sets of data were obtained at the same time and under conditions of constant ionic strength. Values of pH were measured with the glass electrode by the assistance of Dr. Taylor. Electrophoretic measurements of the purified protein coated on quartz particles were done at the same time. The results are in much closer agreement than any reported before. Further experiments are in progress and it is expected that this work will be published.

Dr. Eric Ponder's Report

Biological Laboratory

The work which I and my collaborators have done during the last year is best reported on under the heads of the papers in which it is being published.

1. Respiration and potential of frog skin. Lund and others have accounted for the potential difference across frog skin as arising from oxidative processes in the tissues, and experiments were carried out by Mr. MacLeod and myself to see whether the potential and the oxygen consumption are depressed by narcotics in a parallel manner. Since it is not feasible to measure the potential and oxygen consumption of the same piece of skin simultaneously, we carried out the determinations separately on large numbers of skins, the respiration being measured in Fenn respirometers in the usual manner, and the potential by a very simple method in which the skin was made to separate two volumes of Ringer connected to half-cells, potentiometer and galvanometer. Ethyl, propyl, butyl, and amyl carbamates were added in various quantities to the solutions bathing the skin, and the potential and oxygen consumption remaining after 30 minutes were obtained. In this way we were able to plot curves showing the relation of the potential and of the oxygen consumption to the concentration of carbamate added. The results show very clearly that the parallelism of effect is far from complete. There is invariably a concentration of carbamates which effects the respiration without effecting the potenial, and a higher concentration which completely abolishes the potential while leaving the oxygen consumption at about 20 per cent of its initial value. The curves, in fact, cross one another.

From the data, we are able to investigate the applicability of Traube's rule to the narcotic effects of the carbamates, and the rule does not seem to apply. We were also able to measure the extent to which the narcotics

are concentrated at the surface of the skin, and the relations are very like those for adsorption.

These results led us to try the effect of adding lysins to the skin, since the lysins and the narcotics have a number of properties in common. These substances have quite a remarkable effect, for in proper concentrations they completely abolish the potential, while they have no effect on the respiration except a possible tendency to increase it. These results, accordingly, lend little support to Lund's theory, although because the seat of the oxygen consumption may be spatially different from that of the potential difference, they do not disprove it. (J. Gen. Physiol. 20, 433, 1937).

2. Injury potentials in muscle. It is well known that the uninjured surface of a muscle is positive to a cut surface, and this difference is usually interpreted as being closely related to the resting potential difference across the cell membrane. We were much surprised to find that when a muscle is immersed in saponin, or almost any other of the related lysins, the cut surface becomes positive to the uninjured surface, the potential difference thus passing from about 30 m. v. positive, through zero, to as much as 100 m. v. negative, as the concentrations of the lysin are increased. This reversal of potential is invariably associated with contracture.

The negative potential observed after treatment with the lysins, however, has properties which are quite different from those of the familiar injury potential, particularly in that it varies almost linearly with interelectrode distance. The negative potential obtained in a given concentration of lysin, moreover, seems to be quite independent of the injury potential of the untreated muscle. Lastly, whether the reversal of potential is obtained or not depends upon which end of the gastrocnemius muscle is cut. If the cut is made at the upper end of the muscle the reversal is obtained, while if the cut is made at the tendon end it is not. In either case, however, the potential is linear with interelectrode distance instead of being virtually independent of the distance, as in the case of the injury potential. These observations point to diffusion potentials of relatively enormous magnitude being set up under the action of the lysins, the potential differences observed being largely determined by the position at which the cut is made. It is perhaps for this reason that the reversal of potential is not regularly observed in the sartorius muscle, although sometimes it occurs as a more or less transient phenomenon. (J. Physiol. 87, 67P, 1936).

3. Narcotics and permeability of collodion membranes. Mr. Abels and I had occasion to reinvestigate an effect originally described by Anselmino, who found that collodion membranes made so as to permit a slow passage of thiocyanate ion have a lower permeability to this ion after they are treated with urethanes. The conclusion drawn from these observations was that the urethanes "clog up" the pores of the membrane. Using propyl, butyl, isoamyl and phenyl carbamates, we were able to confirm this statement with respect to the thiocyanate ion, but with respect to this ion only; chloride, sulphate, nitrate, iodide, permanganate, ferrocyanide, ferricyanide, ferrous, ferric, and finally potassium ion passes

through the collodion membranes as well when the membrane is treated with the carbamates as when it is not. Collodion membranes incorporating lecithin were then prepared, and for these we found the narcotics to increase the diffusion of thiocyanate ion, but to have no effect whatsoever on the diffusion of sulphate, permanganate and ferricyanide. Apparently the effect of narcotics on the diffusion of thiocyanate ion is unique, and cannot be used as a basis for a general theory of narcotic action.

4. The swelling of red cells in hypotonic solutions. The problem of why individual red cells of the same animal show different "fragilities" in hypotonic solutions and the similar problem of why the red cells of different mammals should show different fragilities has now been under investigation for several years, and this year I have made a large number of measurements of the area and volume changes which occur when the cells are placed in hypotonic media. The results show that the swelling of the cell is accompanied by a change of shape, the form becoming progressively more spherical, so that a greater volume is contained within the surface membrane without the area of the latter increasing. Under ideal circumstances, the cell might become completely spherical, in which case no further increase in volume would be possible without an increase in surface, and such a condition is nearly attained in hypotonic serum. In hypotonic NaCl, on the other hand, lysis occurs while the volume is still smaller than could be accommodated within a sphere of the same surface area as the cell had originally; thus we have a clear case in which the "critical volume" at which the cell hemolyses depends on the nature of the suspension medium.

If the critical volume at which the cell hemolyses is that of a sphere with the same surface area as the cell has initially, it will be clear that cells which have a large length-breadth ratio will be able to reach greater critical volumes than those which have a small length-breadth ratio, and the former will thus hemolyse at lower tonicities than will the latter. Since the length-breadth ratio for the cells of different animals is different in proportion to the resistance of the cells to hypotonic solutions, the different fragility observed in the case of cells of different mammals can be accounted for primarily on the basis of variation in shape. The different fragility of the cells of the same animal can be accounted for in a very similar way, for the length-breadth ratio for different red cells is far from constant. It is a comparatively easy matter to put these considerations into quantitative form, and the relations which result provide a complete solution of the problem of red cell fragility from the standpoint of the variables which enter into the osmotic equations. (J. Exp. Biol. 14, 1, 1937.)

5. The ultrastructure of the red cell membrane. When Dr. Schmitt was working with his polarization microscope here this summer, he and Dr. Bear and I availed ourselves of the opportunity to examine red cell membrane with polarized light, the hemoglobin having first been removed from the cells by hemolysing them by freezing and thawing. A marked positive birefringence can be observed in the membranes surrounding these ghosts, and this can be converted to a negative form birefringence by extracting with lipoid solvents. The polarization optics, in fact, are

identical with those for the sheath of invertebrate nerve, where we have the additional advantage of being able to obtain an X-ray diffraction pattern. The results indicate that the red cell membrane has a definite ultrastructure, probably consisting of lipoid molecules arranged radically and protein molecules arranged tangentially. (J. Cell. Comp. Physiol. 9, 89, 1936).

6. The spleen and red cell fragility. Dr. Gordon and Mr. Kleinberg, working at Washington Square College, recently made the observation that after removal of the spleen in the guinea pig the resistance of the animal's red cells to hypotonic saline is greatly increased. The effect comes on slowly and reaches its maximum about six weeks after the operation. The resistance then slowly returns to the normal figure. This increase in resistance might be due to a large number of factors which enter into the osmotic equations, but by eliminating these one by one we were finally able to show by diffraction measurements that the increase in resistance is due to the cells being able to attain a larger critical volume before hemolysing. The manner in which this change occurs is still obscure, but the most obvious suggestion is that in the absence of the spleen the marrow produces red cells, the membranes of which are modified; alternately, the cells in the normal animal may be acted upon by substances from the spleen which prepare them for destruction. That the membrane is modified in some way is clearly shown by the action of taurocholate before and after splenectomy. The cells of the splenectomized animal show a very great increase in resistance to bile salt lysis.

7. The effect of lysins in hypotonic systems. One might expect that "chemical" lysins such as saponin, bile salts, and the soaps would be more lytic for cells in hypotonic media than for cells in isotonic media, because the membranes of the former would already be subject to stress, and also one might expect that cells which had previously been acted on by sublytic doses of the chemical lysins would show an increased fragility towards hypotonic hemolysis. As a matter of fact, the lytic effects of the chemical lysins and of hypotonic solutions are not additive. Cells treated with sublytic doses of a number of lysins show a slightly increased resistance to hypotonic solutions, a phenomenon similar to that observed by Jacobs and Parpart for cells treated with sublytic quantities of narcotics. The effect can be accounted for either on the basis of injury to the cell membrane, or on the basis that the narcotics and lysins are absorbed on the membrane, diminishing the size of the hypothetical pores through which the pigment escapes at the time of lysis. The effect, at all events, seems to be characteristic of lysins rather than narcotics, and it may be observed that all the narcotics with which this increase in resistance has been observed (there is quite an extensive literature) have been substances which are themselves lytic in proper concentrations.

Contrary to expectation, saponin and the bile salts are no more lytic for cells in hypotonic systems than they are for cells in isotonic systems. The deformation of the surface membrane which occurs in hypotonic media apparently does not render the cell more easily hemolysed by a substance such as saponin. (Protoplasma. In the Press).

8. Interspaces in muscle. The validity of methods for meas-

uring the intercellular spaces in muscle arose as a problem during Dr. Winter's work on rat muscle last summer, and he and I carried out a number of determinations on rat muscle by means of the phosphate diffusion method. In many cases the method gave impossible results, and we came to the conclusion that the assumptions as regards the diffusion of phosphate, upon which the method is based, are not sound. (Proc. Soc. Exp. Biol. and Med.)

9. Salt leakage from red cells. In order to account for the volume changes of red cells in hypotonic solutions, I and my collaborators have had to postulate a loss of salts from the cell simultaneously with the intake of water. In 1934 Dr. Robinson and I demonstrated that such a loss occurs by measuring analytically the loss of K from the rabbit red cell in hypotonic solutions. The results which we obtained, however, were not in very good accordance with the theoretical values, and this summer Mr. Abels and I made a large number of determinations on the volume changes and salt losses in rabbit cells in various suspension media. The results of these determinations were in accord with Dr. Robinson's earlier ones, but the agreement between the calculated and the observed salt losses was very much better.

10. Lytic effects of the benzene derivatives. Working in collaboration with Dr. Climenko, who is investigating the toxic effects of benzene and its derivatives, I have examined the lytic effects of benzene, aniline and toluol on rabbit red cells, and their effect in accelerating the action of the bile salts and saponin. The substances themselves are virtually nonlytic when saturated in saline, but they all act as very powerful accelerators, 0.65 per cent benzene, 2 per cent aniline, and 0.01 per cent toluol, having about equal accelerating effects for sodium glicocholate and sodium taurocholate. Curiously enough, aniline has no accelerating effect on saponin hemolysis, although benzene and toluol have.

LABORATORIES. A considerable number of additions in the way of apparatus have been made during the last year. We have obtained a completely new equipment for respirometry, using Victor's modification of Fenn respirometers, and with a water bath large enough to enable us to use 8 instruments simultaneously. We can thus carry out measurements of oxygen consumption, R. Q., aerobic, and anaerobic metabolism, etc., on as large a scale as can be handled by one person, and much of our work in the future will lie along these lines. We have also added considerably to our optical equipment, and now have recording and stimulating apparatus for use in experiments on narcosis of muscle and nerve. All three laboratories on the upper floor of the Nichols building are now in use, and were used this summer by visiting investigators.

Report of Drs. F. O. Schmitt, R. S. Bear, and J. Z. Young

Washington University, and Magdalen College (Oxford)

The method of polarized light analysis used to determine the fine structure of other invertebrate axons was applied to the giant axon of the squid, Loligo pealii. As in crustacean nerves, the giant axon was found

to possess a metatropic sheath containing lipoids oriented radially and proteins oriented tangentially. The nuclei corresponding to those of the Schwann sheath lie inside rather than outside the myelin-containing sheath. Because of its large size this fiber is particularly well suited to an investigation of the ultrastructure of the axis cylinder. The axis material, which can be studied either in the intact fiber or extruded from the fiber in sea water, has a birefringence of 5.7×10^{-5}. This double refraction is due both to eigen birefringence of micellae oriented longitudinally in the axis cylinder and to form birefringence. The contribution of both factors has been considered quantitatively.

The polarized light method provides a sensitive means for the detection of molecular orientation in cell membranes. Application of the method in an investigation of the ultrastructure of the limiting membrane of red cells revealed the presence in this envelope of lipoids oriented radially and proteins oriented in concentric lamellae, the optic axes of both components being directed radially.

Dr. T. L. Smith's Report

College of the Ozarks

The work on the genetics of the wax moth, Galleria mellonella, was continued throughout the summer. During this time 86 males were treated with sub-sterile doses of X-rays. These will be bred out to the second and third generations and close observations will be made of all the offspring in search for further mutations or other hereditary variations.

Preliminary work was done on the transplantation of imaginal eye buds from mutant stocks onto the abdoma of wild larvae. More extensive experiments are to be carried on along this line during the coming school year.

Dr. Herman T. Spieth's Report

College of the City of New York

The Marine and Fresh Water Zoology course followed the general plan of the previous year, namely, the fulfillment of the following three objectives:

1. To acquaint the students with marine and fresh water faunas.
2. To have each student bring living material into the laboratory and maintain it in a healthy condition.
3. To give students an insight into experimental methods by having them perform a number of experiments upon the various animals which were collected by the class.

The teaching staff consisted of Dr. William A. Castle, Dr. Harley J. Van Cleave, and Dr. Herman T. Spieth.

Nineteen field trips, 12 marine, and 7 fresh water trips were taken to various representative habitats scattered over the entire area of Long Island. Thanks to good roads and the flexibility of modern automobiles,

it is entirely feasible to follow such a procedure. In addition, due to the location of Long Island, it is possible to acquaint the students with geographical as well as with ecological faunas. For instance, the Montauk region has many northern forms, while the south shore of the island and also the Cold Spring Harbor area have southern elements in their fauna.

About one and one-half hours were spent in the laboratory to every hour in the field. The laboratory periods were given to the identification and care of the living material, various experiments and lectures by the staff members. Dr. Cain contributed a special lecture on plant sociology. The staff also presented lectures to a Colloquium which was held by the combined Zoology and Plant Sociology courses.

In connection with my own research with the Ephemerida, an 8,000 mile collecting trip through Indiana, Illinois, Missouri, Arkansas, Kansas, Colorado, Wyoming, Montana, North Dakota, Minnesota, Wisconsin, Michigan and southern Canada was taken during June and July. The specimens collected numbered between five and six thousand individuals, both nymphs and adults. The adults were prepared for study during my stay at the Biological Laboratory and are being studied at the present time. In connection with the material previously collected from the eastern, southeastern, and mid-western part of the country, the 1936 collections and studies are proving extremely helpful in determining the geographical ranges of the various species and geographical subspecies.

Dr. Ivon R. Taylor's Report

Brown University

The course in General Physiology received a part of my time during the season. In accordance with the practice of the past few years, several men were on the staff of instruction to offer special work, largely of a quantitative nature, to the class. The staff consisted of Dr. H. A. Abramson, Dr. Eric Ponder, Dr. K. S. Cole, Dr. L. Moyer, Dr. E. Walzl and Dr. I. R. Taylor. In the absence of Dr. Fricke, Dr. H. Smith and Mr. D. Gallagher took charge of the course work on X-rays, etc. offered at the biophysics laboratory. Mr. John MacLeod assisted Dr. Ponder with his part of the course. The class received an unusually fine series of lectures, the success of which was due, in large measure, to special lectures given by members of the Symposia on Quantitative Biology. Those who contributed in this manner were Dr. H. A. Blair, Dr. C. C. Speidel, Dr. F. O. Schmitt, Dr. M. Cattell, Dr. Voet, Dr. H. Hoagland, Dr. I. Sizer, Dr. R. Katz, Dr. H. Jasper and Dr. A. J. Derbyshire. The kindness of these men in presenting the lectures is greatly appreciated. In addition, the class had the opportunity to attend four of the sessions of the Symposia on Quantitative Biology.

As a part of my research program, measurements were made on the electrophoresis of white cells of Galleria mellonella. This opportunity is taken to thank Dr. Abramson, Dr. Moyer and Mr. John MacLeod for helpful suggestions received from them during the preliminary part of the work. Since the work is still in progress the results will be reported at a later date.

Dr. Edward Walzl's Report

Johns Hopkins University Medical School

At the completion of the course in Physiology an attempt was made to confirm the conclusions arising from some previous experiments made at the Biological Laboratory on the heart of the oyster, viz. that calcium affects mainly the excitatory mechanism, and potassium, the contractile mechanism, of this tissue. The method employed was to measure the threshold of excitation of the heart to condenser discharges while it was perfused with solutions containing different concentrations of these salts. The results obtained are in accord with the previous conclusions.

In the preliminary experiments certain anomalous responses of the oyster heart to electrical stimulation were observed. An effort was made to define the nature of and to find an explanation for these effects. The results of these experimentts will appear shortly.

PARTIAL LIST OF PUBLICATIONS FROM THE BIOLOGICAL LABORATORY

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Abramson, Harold A. and Laurence S. Moyer

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"The Determination of Surface Conductance from Measurements on Suspensions of Spherical Particles." Journal of Physical Chemistry, volume 40, page 175, 1936.

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and Homer P. Smith

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Grout, A. J.

"Moss Flora of North America North of Mexico, volume 1, Part 1."

Marshak, A.

"A Rapid Method for Making Permanent Mounts of Drosophila Salivary Gland Chromosomes." American Naturalist, volume LXX, July-August, 1936.

MacLeod, John, see **Eric Ponder.**

Moyer, Laurence S., see **Harold A. Abramson**

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"Solvent Water in Mammalian Erythrocytes." Journal of Physiology, volume 86, page 147, 1936.

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and Charles A. Winter

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"The Optical Properties of the Red Cell Membrane." Journal of Cellular and Comparative Physiology, volume 9, page 89, 1936.

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Hudson Hoagland

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G. H. Parker

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