LONG ISLAND BIOLOGICAL ASSOCIATION

ANNUAL REPORT
OF
THE BIOLOGICAL LABORATORY

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LONG ISLAND BIOLOGICAL ASSOCIATION

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ANNUAL REPORT

OF

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IN MEMORIAM

REGINALD GORDON HARRIS, 1898-1936

Director of The Biological Laboratory, 1924-1936

The last official act in 1935 of the late Dr. Harris was the meeting of the Scientific Advisory Committee of the Long Island Biological Association held at Princeton on December 30. He returned to his office for only a few hours on January 2, 1936; so that his life and activities as Director practically closed with the year under review. It seems fitting to replace the general section of the Director's Report by a statement of the part that Dr. Harris played in the development of the Long Island Biological Association and its Biological Laboratory at Cold Spring Harbor.

Dr. Harris was born at Medford, Mass., July 18, 1898, the son of Rev. Benjamin Robinson and Agnes Adella (Wilder) Harris. After attending Brown University, from which he graduated in 1918, he, like many other Brown biologists, attended the Biological Laboratory at Cold Spring Harbor as a student and was for a while assistant in the nearby department of the Carnegie Institution of Washington. From that department he went on an Entomological Expedition to South America with Dr. Chester Bradley of Cornell University. During this expedition he traversed South America from east to west and returned in 1920 somewhat weakened by tropical disease. He then attended the University of Paris as a student of Prof. Caullery and did there an outstanding piece of research on the extraordinary methods of reproduction of the fly, **Miastor.** After marrying Jane Joralemon Davenport at Cold Spring Harbor in 1922 he again returned to Paris as an American Field Service Fellow in Biology. He studied further at the University and then returned to the United States in 1923 in order that he might receive his doctor's degree from Brown University.

In August of that year he was elected acting Laboratory Director of the Biological Laboratory which had by this time been taken over from the Brooklyn Institute of Arts and Sciences by the Long Island Biological Association. At the first meeting of the Board of Directors of the new corporation, held in February, 1924, Dr. Harris was elected Laboratory Director serving under Colonel Timothy Williams, the then president of the corporation. With Dr. Harris' election, the Laboratory began a new policy of having the Director in residence at the Laboratory throughout the year, occupied with executive duties and research. That change in the nature of his office was the first step toward making the Laboratory of use to biologists throughout the year instead of merely in the summer months.

In 1925 Dr. Harris urged the acquisition of the available land adjacent to that leased to the Laboratory by the Wawepex Society. This was acquired in 1926 and the land has proved of inestimable value in the expansion of the Laboratory that followed. In raising these funds for the purchase of this land, Dr. Harris showed his remarkable capacity for inter-

preting the work of the Laboratory to the neighborhood which has resulted in the extraordinary support which the Laboratory has had since.

The year 1927 brought the Laboratory a new building, funds for which were contributed by Mr. and Mrs. Acosta Nichols in memory of their son, George Lane Nichols. This Laboratory has since served as administrative headquarters and provides for a number of the investigators. Dr. Harris called attention in his report of 1927 to the fact that contributions to the Laboratory had increased since 1923 six or seven fold and the number of persons engaged in research had increased in even larger proportion, while the number of contributors had increased twenty fold. The income of the Laboratory had now become $28,000 a year. At this time also a Scientific Advisory Committee of the Laboratory was established to examine critically the work of the Laboratory and to guide its activities as a research center. Dr. Harris also formed a special Advisory Committee on General Physiology and Biophysics; and partly as a result of its recommendations Dr. Hugo Fricke was appointed in 1928 as resident investigator in Biophysics. Mrs. Walter B. James, widow of a former President of the Association, provided a building for biophysical research that was erected in memory of Dr. James.

By 1931, Dr. Harris had become convinced, as a result of discussions with investigators of the Biological Laboratory and elsewhere, that one of the greatest needs in science was contact between the biologists on the one hand, physicists and chemists and mathematicians on the other. He envisioned the bringing together of workers in these different fields for the promotion of biology. His vision included the gathering together at Cold Spring Harbor, during a month or six weeks, of representatives of these different sciences for the purpose of a Conference-Symposium upon some topic in biology. In his report for 1932 Dr. Harris stressed the need of forming such a group. This ambition was realized in 1933 and there was published by the end of that year the first volume of the Cold Spring Harbor Symposia on Quantitative Biology. It was directed toward the topic of electrical phenomena of cells and cell walls. The preparation of this volume of 239 pages involved a large amount of work in which Dr. Harris spared no pains to secure accuracy in the text and proper illustrations.

The publication of the first Symposium created a fine impression among the biologists and, although the book was highly technical, it had a wide distribution. In pursuance of his plan, Dr. Harris organized a Symposium for 1934 which was centered around growth and again in 1935 around the topic of the effect of visible radiations on organisms. This last volume comprising 359 pages, the equivalent of 700 pages as books are ordinarily printed, was pushed through to completion by Dr. Harris in about three and one-half months, and the vast amount of work which he did upon this volume may have contributed to a reduced resistance to the disease which was the cause of his death.

Dr. Harris had already secured in 1935 assurance of further support from the Rockefeller Foundation for the Symposia and he had laid plans for the Symposium in 1936 on electrical phenomena in muscles and nerves —plans which will be carried out.

In the twelve years in which he was Director, Dr. Harris completely made over the Laboratory. When he came, it was a summer institution giving courses in biology, mostly to college undergraduates or normal school graduates and providing facilities for a small amount of research. This had been a useful function, but conditions had changed so as to make this service less valuable to biology than it had formerly been. Dr. Harris created a new institution which draws to it each summer a distinguished group of workers in biology. Its principal activity is now as a research center and not as a teaching center. It does still conduct summer instruction but the students are now almost all graduate students in biology, carefully selected and limited to about the same number as the research workers at the Laboratory. There is also conducted research on a year-round basis in the George Lane Nichols and Dr. Walter B. James Memorial Laboratories. By this and its Symposium the Laboratory at Cold Spring Harbor serves biology in a way not common to other biological stations and both of these are the product of Dr. Harris' imagination and industry.

The major fruits of his creative work are still to be harvested.

As a neighbor, friend and co-worker Dr. Harris was always a joy and inspiration. He had traveled far and wide both in mind and body. Every winter when his work would permit, he would visit the tropics where he could study somewhat intensively the people and biological phenomena. His hobbies were the study of primitive people, primitive art, weapons and the collection of orchids. He had traveled in Mexico, Central and South America, and North Africa. He was of the type of mind that was at home equally with the natives of the jungles of Darien and the natives of New York—a gentleman and a scholar. He was also an altruist. He began his career devoted to research in which if men succeed they make personal reputations. When he saw that he could do perhaps a greater service to biology by building an institution in which other men might do the research, he gave up his personal career. And the building of that institution did not narrow his vision to that. He was interested in the progress of biology anywhere. He was a member of the Board of Trustees of the Mount Desert Island Biological Laboratory and one of the corporation of the Bermuda Biological Laboratory. He entered so wholeheartedly into the work of the Woods Hole Laboratory that many of the Symposia reports were first published in "The Collecting Net", the journal of that institution.

ARTHUR W. PAGE.

Report of the Director

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

Gentlemen:

I have the honor to submit the following report for the year 1935.

Research in Physiology

Doctor Eric Ponder and his assistants have continued their investigations into the properties of the cell membrane and the action of substances upon it. If a red blood cell is taken from the blood plasma and placed in a solution, e. g., of common salt, so as to make a solution of less concentration than the plasma, then the red blood cell undergoes a destructive change known as hemolysis. The hemolyzed cell is known as a ghost. The problem is what happens during hemolysis at the cell membrane. Doctor Ponder's work shows that the occurrances at the cell membrane are much more complex than has been hitherto supposed and that the combination of the hemolytic agent with the material of the cell envelope is of the type found in the dyeing of wool rather than in simple chemical reactions.

While the action of hemolytic agents on red cells is strikingly visible, through loss of color, this is not true of the white blood cells. Accordingly a different criterion of hemolysis has to be used for them, and so loss of oxygen consumption is used as an index of diminished vitality. It appears that all the simple hemolysins that attack the red cell membrane attack white blood cells also and apparently in exactly the same way. Also it appears that the oxygen consumption of the cells varies inversely with the amount of hemolytic substance combined with the cell, which supports the view that these substances adhere to the surfaces which were the seat of oxidative processes.

Now the rate of hemolysis of the red blood cell under various conditions can be measured by the rate of loss of the coloring matter (hemoglobin) from the cell. Cinematography has been used to advantage in this study. The study of this phenomenon throws light on the question whether the loss occurs through "holes" in the cell membrane or as a result of a general "leak". Since the speed with which the hemoglobin is lost through the cell membrane varies with the concentration of the surrounding fluid, the "hole" hypothesis is not supported.

In a dilute surrounding fluid the hemoglobin passes out through the cell membrane rather freely. But if the fluid is now restored to the concentration of blood plasma there is a "reversal of hemolysis", and the hemolyzed ghosts return to their original size and the membrane of the blood cell becomes, as it were, "repaired" and is no longer readily permeable.

Working with Doctor Harold F. Blum, Doctor Ponder found that in the presence of certain dyes in the surrounding fluid, the red blood cells, which are flat, like coins, become spherical. This fact may be used to

investigate the problem why red blood cells have such a peculiar flat shape. Though changes in shape of the cell causes the area of the cell membrane to increase, yet the membrane does not get thinner. This supports the hypothesis that the membrane is only a few molecules thick.

Biophysics

The researches of Dr. Fricke, conducted in the Doctor Walter B. James Laboratory for Biophysics fell, during the year under review, under three principal topics: (1) the effect of X-rays upon aqueous solutions of certain salts and acids and the interpretation of such effect; (2) the activation of water by light of the shorter wavelengths; (3) the electrical properties of aqueous interphases or surfaces of certain solid particles and the liquid in which they are suspended. These properties prove to be similar to those found at cell membranes.

Conference-Symposia on Quantitative Biology

A third and still more augmented volume embodies the conference-symposia held at Cold Spring Harbor in 1935. As the Director, Dr. Harris states, the topic of the volume might be given as: The Interaction of Ourselves and Things Around Us with Light. Doctor Harris writes further: "Viewed in this way the contents have a unity which they certainly have in nature but which they are, perhaps, not permitted to enjoy in the usual university curriculum or scientific meeting. Dividing any part of natural science into component parts is like dividing a region of land into fields. In such divisions of land, it usually happens that fences or stone walls are built. Weeds, shrubs and trees gain a footing in natural succession along the walls and fences; then it becomes difficult to look from one field to the next, and absolutely impossible to see into a field two or three fences away.

"Fortunately there is a tendency developing in the natural sciences to cut down the hedgerows at least, and, as fast as possible, to remove the fences. The interaction of light with ourselves and things around us is particularly interesting in this connection because the process of removing the boundary trees has progressed farther here than in many other fields."

This volume shows that knowledge from the different fields of science was brought together in such a way as to throw a new and varied light upon the problems of the biologists and physical chemists. Especial attention was paid to leaf-green, chlorophyll, that marvellous substance that makes use of the sunlight to manufacture starch from carbon dioxide and water. One great problem is the molecular mechanism by which this work is done and the conditions under which it works. In the last analysis, we humans, like all other animals, depend for our existence upon this property of chlorophyll.

"Similarly," writes Doctor Harris, "in other aspects of photobiology, there is ample evidence in this volume that up to date chemical and

physical methods are being used comparatively extensively and successfully.

"Nevertheless, those who look at this time for an unobstructed view into all fields concerned, will be disappointed. One difficulty will be found to be the fact that present knowledge and theories of photochemistry developed by physicists and chemists are concerned primarily with gases, while we, and many of the things around us, are primarily aqueous systems. Furthermore, by no means all photobiologists and medical men have yet made adequate use of existing chemical and physical knowledge, a fact which is pointed out many times in this volume, and which is apparent in many ways, perhaps particularly in the thus far limited use of monochromatic light."

Bryology

Dr. Grout has continued his work on "Moss Flora of North America North of Mexico". During the last year, part 2 and part 3 of Volume II were published. Further details of the progress of this work will be found in Dr. Grout's report.

As in past years, Dr. Grout received research students in bryology at his laboratory at Newfane, Vermont.

Research of Summer Visitors

The reports of individual workers, appended to this report, include brief descriptions of the researches conducted by visiting investigators during the summer. For this reason, only the subjects of the researches will be given at this time. They are: ratio of electro-osmotic and electrophoretic mobilities for protein surfaces; electrical charge of mammalian red blood cells; reversibility of adsorbed oxidation-reduction indicators; introduction of drugs through the skin by means of electric current; plant associations of Cold Spring Harbor and vicinity; study of red maple swamp forest type on basis of unistratal association; sampling technique and statistical study of oak forest; electrical impedance of starfish and sea urchin eggs; oxidation-reduction potentials of heterogeneous systems; oxidation of substrates and its relation to bio-electric potentials; extraction and purification of glucose dehydrogenase from liver; effects of ovarian grafts upon seminal vesicles and prostate of male rats; study of glomeruli in frog kidney by means of the fluorescence microscope; effects of certain bands of electromagnetic radiations on living tissues; effects of ceratin salts in different concentrations upon dissociation constant of brom thymol blue; lytic effects of certain photodynamic dyes in absence of light; effects of light and of dilution of dyes on rate of hemolysis; observations on swelling of muscles from normal and from adrenalectomized rats in hypotonic solutions; pituitary-adrenal relationships; phosphate diffusion in rat muscle; hormonal control of oestrus, ovulation, and mating in female rats; effect of adrenalectomy on blood cholesterol; action of salts and drugs on activity of intact uterus in adrenalectomized rabbits; effect of chemical compounds related to phloridzin upon sugar excretion of mammalian kidney; accessory adrenal cortical tissue in rat; lactation in adrenalectomized rats;

effect of nutrition on longevity of Cladocerans; water absorption by eggs of certain species of turtles; quantitative study of effects of X-rays on salivary chromosomes of **Drosophila melanogaster;** rate of respiration of rabbit leucocytes and of yeast cells after irradiation with X-rays; effects of irradiation with X-rays on **Galleria mellonella;** giant chromosomes from salivary glands and malphigian tubules of larvae of **Galleria mellonella;** measurements of alternating current impedance on oyster heart held in different degrees of contraction; protoplasmic fusion in certain marine amebas; establishment of pure line cultures of certain amebas; spiral movement in certain amebas; crystals and crystallizable products in paramecia and other protozoa; nuclear events in some marine amebas; gemmipary in Crassulaceae; survey of material for work in parasitology; certain chemicals in relation to agranulocytosis; magnesium synergism; pharmacological analysis of some food dyes.

Instruction

The number of students at the Laboratory during the summer has been maintained constant for the last several years at very approximately thirty-five. This seems to be as many students as we can possibly accommodate with present facilities and in view of the other work of the Laboratory.

Meanwhile the quality of the students seems to be constantly improving. This is in part due to the fact that with only a small number of students admitted, we are justified in exercising considerable restriction. Furthermore, the work of the Laboratory in general, the conference-symposia and other factors combine to make the laboratory attractive to students of more than ordinary perspicacity.

Of the thirty-four students this summer, two were already professors or instructors in colleges and held doctor's degrees in medicine or science; eighteen were graduate students or graduate assistants and students; fourteen were specially recommended undergraduates.

The course in Plant Sociology was under the leadership of Dr. Stanley Cain of the University of Tennessee. Details of the scope of the course and the extent to which the work of the course increased the herbarium of the Laboratory are included in Dr. Cain's report.

The course in Marine and Fresh Water Zoology was instructed by Dr. H. T. Spieth of the College of the City of New York, and Dr. William A. Castle of Brown University. Dr. Emil Witschi of the State University of Iowa was in residence during a part of the period of the course, and assisted in the lectures, field and laboratory work. An outline of the course is included in the report of Dr. Spieth.

General Physiology was conducted along the same general lines as it was in 1934, with some additions, as indicated in Dr. Taylor's report.

The course in Surgical Methods 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 was the previous year.

List of Evening Lectures

Dr. A. F. Blakeslee, Acting Director, Department of Genetics, Carnegie Institution of Washington—"Chromosome and Gene Mutations in Datura."

Dr. Harold F. Blum, Assistant Professor of Physiology, University of California Medical School—"Another Approach to the Problem of Evolution."

Dr. Stanley A. Cain, Associate Professor of Botany, University of Tennessee—"Some Problems and Methods in the Plant Sociology of the Great Smoky Mountains."

Dr. George W. Corner, Professor of Anatomy, University of Rochester School of Medicine and Dentistry—"Artists and Anatomists."

Dr. Charles B. Davenport, Research Associate, Carnegie Institution of Washington—"The Machinery of Development."

Dr. Wanda K. Farr, Associate Cotton Technologist, U. S. Department of Agriculture, Boyce Thompson Institute—"Formation and Structure of Cellulose Membranes."

Dr. Stuart Mudd, Professor of Bacteriology, University of Pennsylvania School of Medicine—"Parasitism and Epidemic Disease."

Dr. William T. Penfound, Associate Professor of Botany, The Tulane University of Louisiana—"The Vegetation of Louisiana."

Dr. Eric Ponder, Investigator in General Physiology, The Biological Laboratory—"Red Cell Metabolism and the Hattenberg Effect."

Dr. Emil Witschi, Professor of Zoology and Experimental Embryology, State University of Iowa—"Parabiosis in Rats."

Dr. P. W. Zimmerman, Plant Physiologist, Boyce Thompson Institute—"Recent Advances and Discoveries Concerning Growth Substances in Plants."

Library

The library of the Laboratory has been modestly, though steadily, growing for several years. Every effort is being made to make the library as useful as possible with the small amount of money available for library purposes. The library consists at present of over eleven hundred volumes, a large percentage of which are sequences of bound scientific periodicals. The policy in subscribing for scientific periodicals is to avoid duplication of publications being received by the Department of Genetics of Carnegie Institution of Washington, whose library consists of some fourteen thousand volumes. The Biological Laboratory now currently subscribes to a very appreciable part of the leading journals of physiology, physics and physical chemistry, including a large number of foreign ones.

Partly as a result, and in answer to the needs, of the conference-symposia, the Laboratory is building up a valuable collection of separates. During the past year, the number of these increased by about ten thousand, bringing the total to well over eighteen thousand. These are cata-

logued and filed according to authors, and a cross-reference subject index is under way.

Indications of Widespread Influence of the Laboratory

It is, of course, impossible to measure the total direct and indirect influence of the Laboratory and its work. The following facts, however, give indication that it is very extensive indeed.

Fifty-seven different colleges, universities, medical schools and research institutions were represented at the Laboratory last summer by persons actually in residence, i. e., students, research workers, or participants in the conference-symposia. The institutions are: Adelphi, Agricultural Experiment Station (New Brunswick, N. J.), Albany Medical, Alfred, Antioch, Biological Laboratory, Brown, Bryn Mawr, Calco Chemical Co., California Institute of Technology, Carnegie Institution of Washington Department of Genetics, College of Charleston, College of City of New York, College of P. and S. (Columbia), College of Ozarks, Connecticut, Columbia, Cornell, Cornell Medical, DePauw, Duke, George Washington, Harvard, Hopkins Marine Station, Indiana, Institutum Divi Thomae (Cincinnati), Johns Hopkins, Mead Johnson and Co., New York University Medical, New York University Washington Square, Oberlin, Pembroke, Princeton, Randolph Macon, Rutgers, Research Associates Incorporated, Stanford, State University Iowa, Swarthmore, Temple, Tulane, Tulane Medical, U. S. Bureau of Mines, U. S. Department of Agriculture, University Buffalo Medical, University California, University California Medical, University Chicago, University Michigan, University Minnesota, University Pennsylvania Medical, University Pittsburgh, University Rochester Medical, University South Dakota, University Wisconsin, Vassar, Yale, Yale Medical.

In addition to persons in residence, men communicated papers or discussion to the conference-symposia from the following institutions not listed above: Cambridge, Carnegie Institution of Washington Division of Plant Biology, Eastman Kodak Research Laboratories, Mayo Clinic, Nobelsinstitute of Academy of Science (Sweden), Oxford, Rijkslandbouroproefstation (Groningen, Holland), Rudolf-Virchow Krankenhaus (Berlin), Smithsonian Institution Division of Radiation and Organisms, Union, University Allahabad (India), University Berlin, University Copenhagen, University Leipzig, University Maryland, University Vienna, Western Reserve.

The Symposia volumes are sold in thirty-two foreign countries. Approximately 700 copies of Volume I, 600 of Volume II, and 400 of Volume III have been sold, many of which are from standing orders for all volumes as they appear.

In the course of the summer 114 people made use of the Laboratory for a week or more, while 91 used it for the entire summer season.

Exhibits

In September the experiment was tried out for the first time of pre-

paring an exhibition of the work of the Laboratory and inviting neighbors and others to examine it. The success of the plan was due not only to the cooperation of the biologists who exhibited their work but also to the enthusiastic aid given by the Women's Committee, which provided a luncheon at Blackford Hall for about 100 invited guests. At the end of the luncheon, President Page spoke and Doctor Ponder and Mr. MacLeod demonstrated by means of a loud speaker the variation of the strength of the electrical phenomena in the skin and in a contracting muscle, like that of the beat of the heart of a frog. Also there were similarly demonstrated the electric currents that pass along a nerve during stimulation by contact and by other agents. Particularly striking was a record of the electric beats that pass along the nerve of the eye when light is thrown upon the lens.

Exhibits of Doctor Fricke's work showed how the X-rays act chemically upon the fluids of the cells of the body; and how a sample of a particular chemical solution that had been acted on by a physician's X-ray machine for a given time might be sent to the biophysical laboratory for a report as to the strength of the X-rays produced. The effect of such X-rays in causing changes in germ cells with the development of new mutations or inheritable bodily modifications was also shown. There were shown the applications of electricity to the measurement of the thickness of cell membranes, to the study of the thickness of an invisible membrane, to the determination of the freshness of milk, to the diagnosis of malignant tumors.

Professor A. A. Schaefer and associates demonstrated the tendency for all migrating organisms to move in circles whether on foot, in vehicles or in the air. This demonstration has saved many lives by showing that in a fog the air pilot must rely upon his instruments and not upon his "sense of direction".

Other demonstrations were of Doctor Swingle's discovery of the cause of Addison's disease and its cure; Doctor Harris' contributions to research concerning the maintenance of pregnancy in mammals; the effects of feeding thyroxin to tadpoles upon their development; and all available publications from the Laboratory.

Between two and three hundred persons attended the exhibition.

Acknowledgments

The work of the Laboratory is rendered possible only by the generous support of certain institutions, by the continued gifts of members of the Association, by the Wawepex Society, by the enthusiastic support of the officers and members of the Women's Committee, and by the helpful advice of laymen and men of science.

The National Research Council, through its Committee on Radiations, has provided funds and equipment for Biophysics. The Rockefeller Foundation has made a grant to the general purposes of the Laboratory and has especially supported the Symposia. The Women's Committee

headed by Mrs. Merle-Smith, has contributed money and furniture, and at the time of the Exhibition gave a luncheon for about a hundred neighbors in an attempt to gain new members for the Association. Also to the scientists who aided at the time of the Exhibition by their preparations and their demonstrations especial thanks are due.

It is thrilling indeed to work in a community which has adopted the support of the Laboratory as a part of its civic and social service. While the impulses of charity lead us to give to those who are physiologically inept, it is believed that research into normal physiological laws, which are the laws of God, will increase the proportion of those who function fully and get that fullest enjoyment which comes from living in consonance with those laws.

ERIC PONDER.

REPORT OF THE SCIENTIFIC ADVISORY COMMITTEE

The Scientific Advisory Committee held a meeting on December 30, 1935, at Princeton. It enthusiastically approves of the third volume of the Cold Spring Harbor Symposia on Quantitative Biology and is gratified at the large support offered by the Rockefeller Foundation to the symposium for 1936 on the properties of nerve and muscle with particular reference to their irritability.

The Committee recognizes the immediate need of enlarged quarters for the Library, especially in view of the ever enlarging rate of increment of publications received. However, it finds that provision for expanding the biophysical research next year should take precedence over any other new plans for building.

J. H. BODINE,
Chairman.

LUNCH AT BLACKFORD HALL

October 24, 1935.

The work of the eminent biologists of the Cold Spring Harbor Laboratory having afforded so much interest to those laymen who had come into contact with it, Mrs. Van Santvoord Merle-Smith, as president of the Women's Committee, inaugurated a plan whereby a wider group could also be informed of its activities.

Mrs. Paul Hammond, as chairman, assumed the responsibility of assembling seventeen hostesses for a buffet lunch to be held at Blackford Hall on October 24, 1935. A very enthusiastic gathering met that day and viewed with great interest the various scientific exhibits on display at the Laboratory. After having lunched, they listened to a short interesting talk by Mr. Arthur Page, and saw two experiments done by Dr. Eric Ponder and Dr. Kenneth S. Cole. Many asked if the lunch would be repeated another year because they wanted to come again, and felt that others should have a similar opportunity to "discover" the Laboratory and the important quality of scientific work done in our own community.

There were one hundred and thirty-five people present, and one table consisted entirely of prospective junior members headed by Miss Polly Weeks.

In addition to Mrs. Merle-Smith, to whom we were indebted for originating this plan, and Mrs. Hammond, who so ably and successfully captained it, the other hostesses were:

Mrs. F. Huntington Babcock
Mrs. Henry E. Coe
Mrs. Alvin Devereux
Mrs. Fairman R. Dick
Mrs. George Franklin
Mrs. Reginald Harris
Mrs. George Hornblower
Mrs. Walter Jennings
Mrs. Russell C. Leffingwell
Mrs. Ray Morris
Mrs. Acosta Nichols
Mrs. Henry Taylor
Miss Polly Weeks
Mrs. Willis Wood

MRS. FAIRMAN R. DICK.

THOSE TAKING PART IN SYMPOSIA AND IN DISCUSSIONS (1935)

Abramson, Harold A.—Assistant Professor of Physiology, College of Physicians and Surgeons, Columbia University.

Albers, Vernon M.—Associate Professor of Physics and Research Physicist, C. F. Kettering Foundation, Antioch College.

***Appleman, C. O.**—Dean of Graduate School and Professor of Botany and Plant Physiology, University of Maryland.

Arnold, William.—Sheldon Travelling Fellow in Biology, Harvard University.

***Baeckstrom, Hans.**—Nobelinstitut of the Academy of Sciences, Stockholm.

Bates, John R.—Associate Professor of General and Physical Chemistry, University of Michigan.

***Bergmann, Werner.**—Research Associate, Department of Chemistry, Yale University.

Bills, Charles E.—Research Director, Mead Johnson and Company.

Blum, Harold F.—Assistant Professor of Physiology, University of California Medical School.

***Bonhoeffer, Karl.**—Professor of Physical Chemistry, The University, Leipzig.

***Boysen Jensen, P.**—Professor of Plant Physiology, The University, Copenhagen.

Brackett, F. S.—Research Associates Incorporated, Washington.

***Briggs, G. E.**—Lecturer in Biology, St. John's College, Cambridge.

Burk, Dean.—Associate Physical Chemist, Bureau of Chemistry and Soils, United States Department of Agriculture.

Castle, E. S.—Assistant Professor of Physiology, Harvard University.

Chase, Aurin M.—Instructor in Biophysics, Columbia University.

***Clark, Leonard B.**—Assistant Professor of Biology, Union College.

Climenko, David.—Lecturer in Pharmacology, Cornell University Medical College.

Cole, Kenneth S.—Assistant Professor of Physiology, Columbia University.

***Cole, William H.**—Professor of Physiology and Biochemistry, Rutgers University.

Curry, James.—Research Assistant, Department of Botany, Columbia University.

Davenport, Charles B.—Research Associate, Carnegie Institution of Washington.

Demerec, M.—Investigator, Department of Genetics, Carnegie Institution of Washington.

***Dhar, N. R.**—Professor of Chemistry, University of Allahabad.

***Ellinger, F.**—Privatdozent fur Strahlenkunde, The University, Berlin.

Emerson, Robert.—Associate Professor of Biology, California Institute of Technology.

Eyring, Henry.—Research Associate in Physical Chemistry, Princeton University.

Forbes, George Shannon.—Professor of Chemistry, Harvard University.

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* Discussion communicated by mail.

French, C. S.—Laboratory of General Physiology, Harvard University.

Fricke, Hugo.—In Charge of Dr. Walter B. James Laboratory for Biophysics, The Biological Laboratory, Cold Spring Harbor.

Giese, A. C.—Instructor in Biology, Stanford University.

Haig, Charles.—Laboratory of Biophysics, Columbia University.

Hardy, James D.—Research Associate, Russell Sage Institute of Pathology, Cornell University Medical College.

Harris, Reginald G.—Director, The Biological Laboratory, Cold Spring Harbor.

Hart, Edwin J.—Chemist, Dr. Walter B. James Laboratory for Biophysics, The Biological Laboratory, Cold Spring Harbor.

Hartline, H. Keffer.—Fellow in Medical Physics, Eldredge Reeves Johnson Foundation for Medical Physics, University of Pennsylvania Medical School.

***Harvey, E. Newton.**—Professor of Physiology, Princeton University.

***Hausmann, Walther.**—Laboratorium fur Lichtbiologie, Physiologischen Institut, The University, Vienna.

Hecht, Selig.—Professor of Biophysics, Columbia University.

Inman, O. L.—Professor of Biology and Director of C. F. Kettering Foundation, Antioch College.

***James, W. O.**—Professor of Botany, The University, Oxford.

Janes, Robert B.—Instructor in Physics, University of Wisconsin.

Kassel, Louis S.—Physical Chemist, United States Bureau of Mines, Pittsburgh.

Kistiakowsky, George B.—Associate Professor of Chemistry, Harvard University.

Knorr, H. V.—Associate Professor of Physics and Research Physicist, C. F. Kettering Foundation, Antioch College.

Kohn, Henry.—General Education Board Fellow, Stockholm Hogskola.

Korr, Irvin M.—Proctor Fellow in Biology, Princeton University.

***Laurens, Henry.**—Professor of Physiology, The Tulane University of Louisiana Medical School.

***Leermakers, John A.**—Research Chemist, Eastman Kodak Research Laboratories.

***Leighton, Philip A.**—Associate Professor of Chemistry, Stanford University.

Lineweaver, Hans.—Junior Chemist, Bureau of Chemistry and Soils, United States Department of Agriculture.

***Mackinney, Gordon.**—National Research Council Fellow, Division of Plant Biology, Carnegie Institution of Washington.

Marshak, Alfred.—Biological Laboratories, Harvard University.

Mayerson, H. S.—Associate Professor of Physiology, The Tulane University of Louisiana Medical School.

***McAlister, E. D.**—Associate Physicist, Division of Radiation and Organisms, Smithsonian Institution.

Mestre, Harold.—Department of Public Health, Yale University School of Medicine.

Meyer, Karl.—Assistant Professor of Biochemistry, College of Physicians and Surgeons, Columbia University.

Moyer, Laurence.—Sterling Fellow, Yale University School of Medicine.

***Norrish, R. G. W.**—Humphrey Owen Jones Lecturer in Physical Chemistry, The University, Cambridge.

Noyes, W. Albert, Jr.—Associate Professor of Chemistry, Brown University.

Pettit, Horace.—Instructor in Bacteriology, University of Pennsylvania School of Medicine.

Ponder, Eric.—Investigator in General Physiology, The Biological Laboratory, Cold Spring Harbor.

Rollefson, G. K.—Associate Professor of Chemistry, University of California, Berkeley.

Rothemund, Paul.—Assistant Professor of Biochemistry and Research Chemist, C. F. Kettering Foundation, Antioch College.

***Shlaer, Simon.**—Laboratory of Biophysics, Columbia University.

***Sheard, Charles.**—Professor of Biophysics, Mayo Foundation.

Singer, Edward.—Instructor in Anatomy, College of Physicians and Surgeons, Columbia University.

Smetana, Hans.—Assistant Professor of Pathology, College of Physicians and Surgeons, Columbia University.

***Smith, Emil L.**—Laboratory of Biophysics, Columbia University.

Smith, T. L.—Professor of Biology, College of the Ozarks.

***Spoehr, H. A.**—Chairman, Division of Plant Biology, Carnegie Institution of Washington, Stanford University.

Starkey, R. L.—Associate Professor of Soil Microbiology, Rutgers University, and Associate Soil Microbiologist, Agricultural Experiment Station, New Brunswick, N. J.

Strain, William H.—University Research Fellow in Chemistry and Experimental Pathology, University of Rochester School of Medicine and Dentistry.

***Taylor, Hugh S.**—David B. Jones Professor and Head of Department of Chemistry, Princeton University.

***van der Paauw, F.**—Rijkslandbouroproefstation, Groningen.

van Niel, C. B.—Associate Professor of Microbiology, Hopkins Marine Station, Stanford University.

Wald, George.—Instructor and Tutor in Biology, Harvard University.

Walzl, Edward.—Brooks Fellow in Zoology, Johns Hopkins University.

Weintraub, Robert L.—Graduate Council, George Washington University.

Winsor, C. P.—Laboratory of General Physiology, Harvard University.

Winter, Charles.—Instructor in Physiology, University of Buffalo School of Medicine.

***Wohlgemuth, J.**—Professor Direktor Chemische Abteilung, Rudolf-Virchow Krankenhaus, Berlin.

Wolf, Ernst.—Lecturer in General Physiology, Harvard University.

Zscheile, F. Paul, Jr.—Research Associate in Chemistry, University of Chicago.

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* Discussion communicated by mail.

TABLE OF CONTENTS OF COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY, VOLUME III, (1935).

Chemistry of Photosynthesis
N. R. Dhar
The Kinetic Mechanism of Photosynthesis
Dean, Burk and Hans Lineweaver
The Evolution of Oxygen in the Process of Photosynthesis
O. L. Inman
The Absorption of Radiation by Leaves and Algae
Harold Mestre
An Analysis of Oriented Movements of Animals in Light Fields
Harold F. Blum
Photic Excitation and Phototropism in Single Plant Cells
E. S. Castle
Intensity Discrimination
Selig Hecht
Nature of Intermittent Stimulation by Light
Selig Hecht, Simon Shlaer, Emil Smith
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H. Keffer Hartline
The Chemistry of the Visual Purple System
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Ernst Wolf
The Mechanism and Kinetics of Bioluminescent Reactions
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Basis of Radiation Measurements
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Henry Laurens
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H. S. Mayerson
Photosensitization of Living Systems
Harold F. Blum
The Multiple Nature of Vitamin D
Charles E. Bills
Photosensitized Oxidation of Ethylenic Double Bonds
Karl Meyer

Partial List of Publications by Members of the Staff and Others Who Worked at the Laboratory. (In addition to Volume III of Cold Spring Harbor Symposia on Quantitative Biology.)

Abramson, Harold A. and Laurence Moyer

*"Electrical Charge of Mammalian Red Blood Cells." Journal of General Physiology, in press.

*"Electrokinetic Phenomena. XII. Electro-osmotic and Electrophoretic Mobilities of Protein Surfaces in Dilute Salt Solution." Journal of General Physiology, in press.

Blanchard, E. W.

†*"The Effect of Adrenalectomy on Blood Cholesterol."

Bozler, Emil, see **K. S. Cole.**

Cain, Stanley A.

"Bald Cypress, **Taxodium distichum** (L.) Rich., at Hovey Lake, Posey County, Indiana." The American Midland Naturalist, volume 16, page 72, 1935.

"Ecological Studies of the Vegetation of the Great Smoky Mountains. II. The Quadrat Method Applied to Sampling Spruce and Fir Forest Types." The American Midland Naturalist, volume 16, page 556, 1935.

"Studies on Virgin Hardwood Forest. III. Warren's Woods, a Beech-Maple Climax Forest in Berrien County, Michigan." Ecology, volume 16, page 500, 1935. (In No. 3, The Henry C. Cowles "Festschrift".)

Climenko, David R., see report by D. R. Climenko, page 36.

Cole, Kenneth S.

"Electric Impedance of Hipponoe Eggs." Journal of General Physiology, volume 18, page 877, 1935.

and Emil Bozler

*"Electrical Impedance and Phase Angle of Muscle in Rigor." Journal of Cellular and Comparative Physiology, volume 6, page 229, 1935.

Conard, Henry S.

*"Plant Associations of Central Long Island." The American Midland Naturalist, volume 16, page 433, 1935.

Crescitelli, Frederick, see **I. R. Taylor.**

Cunningham, Bert.

"The Endocrine System." South Atlantic Quarterly, volume 34, page 384, 1935.

Curtis, Howard J. (Also see **H. Fricke.**)

*"Changes in Thickness of the Red Blood Corpuscle Membrane." Journal of General Physiology, in press.

*"Electrical Impedance of Injured and Sensitized Red Blood Corpuscles." Journal of General Physiology, in press.

Fricke, Hugo

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* Reference made to the Laboratory in the title.

† Paper presented at the joint meeting of the Genetics Society of America and the American Society of Zoologists held at Princeton, December 1935.

‡ Paper presented at the annual meeting of the American Association for the Advancement of Science held at St. Louis, December 1935.

*"Decomposition of Hydrogen Peroxide by Irradiation of its Aqueous Solution with X-rays." Journal of Chemical Physics, volume 3, page 354, 1935.

*"Chemical Properties of X-ray Activated Molecules with Special Reference to the Water Molecule." Cold Spring Harbor Symposia on Quantitative Biology, volume 3, page 55, 1935.

*"Chemical-physical Foundation of the Biological Effects of X-rays." Contribution to the volume published in honor of Prof. A. H. Roffo.

and Howard J. Curtis

*"Electrical Impedance of Suspensions of Leucocytes." Nature, volume 35, page 436, 1935.

*"Dielectric Constant and Resistance of Colloidal Solutions." Physical Review, volume 47, page 974, 1935.

*"Electrical Impedence of Hemolyzed Suspensions of Mammalian Erythrocytes." Journal of General Physiology, volume 18, page 821, 1935.

*"Electrical Conductance of Colloidal Solutions at High Frequencies." Physical Review, volume 48, page 775, 1935.

*"The Determination of Surface Conductance of Suspensions." (In press.)

and Edwin J. Hart

*"Oxidation of Ferrous to Ferric Ion by Irradiation with X-rays of Solutions of Ferrous Sulfate in Sulfuric Acid." Journal of Chemical Physics, volume 3, page 60, 1935.

*"Oxidation of the Nitrite to the Nitrate Ion by Irradiation of its Aqueous Solution with X-rays." Journal of Chemical Physics, volume 3, page 365, 1935.

*"Decomposition of Water by X-rays in the Presence of the Iodide or Bromide Ion." Journal of Chemical Physics, volume 3, page 596, 1935.

*"Oxidation of Ferrocyanide, Arsenite and Selenite Ions by Irradiation of Aqueous Solutions with X-rays." Journal of Chemical Physics, volume 3, page 596, 1935.

Gaunt, Robert, Jo H. Gaunt, and Charles Tobin

*"Colony Differences in Survival of Adrenalectomized Rats." Proceedings of the Society for Experimental Biology and Medicine, volume 32, page 888, 1935.

*"Survival of Salt-Treated Adrenalectomized Rats." American Journal of Physiology, volume 111, page 321, 1935.

Grout, A. J.

*"Moss Flora of North America North of Mexico." Volume 2, parts 2 and 3.

*"North American Musci Perfecti." Fascicle 8, numbers 276-300.

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* Reference made to the Laboratory in the title.
† Paper presented at the joint meeting of the Genetics Society of America and the American Society of Zoologists held at Princeton, December 1935.
‡ Paper presented at the annual meeting of the American Association for the Advancement of Science held at St. Louis, December 1935.

Harris, Reginald G.

*"Mathematics in Biology." The Scientific Monthly, volume 40, page 504, 1935.

Hart, Edwin J., see **H. Fricke**

Moyer, Laurence, see **H. A. Abramson**

Pfeiffer, Carroll, see **E. Witschi**

Ponder, Eric, see report by **E. Ponder**, pages 46-50.

Schaeffer, Asa A.

†"Circular and Spiral Drift in Cutaneous Tactile Fields."

†"Chart of Taxonomic Relationships of Free-Living Amebas."

Smith, T. L.

†"Synopsis of Work on the Biology, Culturing Methods and Genetics of **Galleria mellonella**, Linn."

Taylor, I. R. and F. Crescitelli

†"The Heat Production of Pupae of **Galleria mellonella** Throughout Development."

†"A Method for the Measurement of the Heat of Production of Small Organisms."

Tobin, Charles, see **R. Gaunt**

Walzl, Edward

†"Action of Salts on the Heart of the Oyster."

Witschi, Emil

†"The Hormonal Control of Secondary Sex Characteristics in Finches."

‡"Cycles of Hypophyseal Activity and the Control of Plumage Characters in Birds."

and Carroll Pfeiffer

*"The Hormonal Control of Oestrus, Ovulation and Mating in the Female Rat." The Anatomical Record, volume 64, page 85, 1935.

and Allan J. Stanley

†"Studies on the Embryology and Anatomy of the Reproductive System of Iowa Hawks."

and R. P. Woods

†"Nuptial Colorations of the Bills of Birds and Their Control by Sex Hormones."

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* Reference made to the Laboratory in the title.

† Paper presented at the joint meeting of the Genetics Society of America and the American Society of Zoologists held at Princeton, December 1935.

‡ Paper presented at the annual meeting of the American Association for the Advancement of Science held at St. Louis, December 1935.

REPORTS OF INVESTIGATORS

Doctor Harold A. Abramson's Report

College of Physicians and Surgeons

The part of the course in General Physiology concerned with electrokinetics had the voluntary assistance of Dr. L. S. Moyer, who is well-known for his researches in this field. The course itself was modified, more emphasis being placed on the immunological aspects of the subject.

With Dr. Moyer two topics were investigated: (1) the ratio of electro-osmotic and electrophoretic mobilities for protein surfaces, (2) the electrical charge of mammalian red blood cells. Reports covering both of these investigations will appear in the Journal of General Physiology.

With Professor I. R. Taylor a series of investigations on the reversibility of adsorbed oxidation-reduction indicators was undertaken.

A new and important part of the research and teaching program was an experiment with the introduction of drugs, such as histamine, through the skin by means of an electric current. Thus wheals, characteristic of the wheals found in allergic skin sensitatization, can be formed without injection. By this means the physiology of the wheal is being investigated.

Doctor E. W. Blanchard's Report

Includes work done by Sylvia B. Rouse and Eleanor H. Yeakel

Bryn Mawr College

The Effect of Adrenalectomy on Blood Cholesterol. In an endeavor to check possible relationships between adrenal cortical function and lipid metabolism, total, free, and combined cholesterol were determined for both whole blood and plasma in normal, unilaterally operated, and bilaterally adrenalectomized cats. This work, a continuation of that being carried out at Bryn Mawr, was done with the assistance of Miss Rouse. The results, which will be reported in brief at the Christmas meetings of the American Society of Zoologists, indicate that following the removal of one adrenal gland little change occurs in the blood cholesteral, but that in bilaterally adrenalectomized cats there is a change in the cholesterol partition, the cholesterol content of the cells increasing with, in some cases, a simultaneous decrease in plasma cholesterol. These changes are not terminal but begin soon after the removal of the second gland. This shift in cholesterol seems particularly significant from the standpoint of cell and tissue permeability. With an increase in cell lipid it seems reasonable to assume that some alteration in cell permeability may occur. If a similar shift takes place in the lipid content of the endothelial tissues a possible mechanism might be recognized which would explain, in part at least, the abnormal fluid shift which takes place across these membranes following adrenalectomy.

Miss Sylvia B. Rouse carried on her investigations upon the action of salts and drugs on the activity of the intact uterus in adrenalectomized

rabbits. Uterine fistulae were put in and the contractions of the uterus recorded by the method of S. R. J. Reynolds. This work is being continued at Bryn Mawr this year and the results, too fragmentary to report here, will appear some time in the early part of 1936.

Miss Eleanor H. Yeakel studied the effect of chemical compounds related to phloridzin upon the sugar excretion of the mammalian kidney. This work will be continued at the laboratory at Bryn Mawr but results already indicate that many synthetic compounds related to ploretin will cause the kidney to excrete glucose. The effect, at the present time, has been studied qualitatively, but quantitative determination will be made to determine the relative efficiency of sugar excretion under the influence of these several substances in an endeavor to determine the active group or system of groups responsible for the physiological activity of phloridzin.

Doctor Harold F. Blum's Report

University of California, Medical School

Investigation of the lytic properties of certain photodynamic dyes in the absence of light, and the property possessed by these dyes of altering the shape of the mammalian erythrocyte were carried out in collaboration with Dr. Eric Ponder, who describes them elsewhere in more detail. The findings have important bearing upon the problem of photodynamic action, with which I have been occupied for several years, since they serve to confirm my hypothesis that the photodynamic phenomenon is primarily a lytic phenomenon not associated with light to which is added an increase in lytic effect due to a photochemical reaction. The credit for these experiments is entirely due to Dr. Ponder, whose intimate knowledge of the red blood cell made them possible, and who actually performed the major part of the work.

In addition, preliminary studies were made of the effects of light and dilution of dye on the rate of hemolysis, using a method based on Dr. Ponder's. The effect of HCN was examined and it was found that this substance had a very slight effect, if any, on the rate of photodynamic hemolysis. This finding would appear contradictory to that of Bier and Rocha e Silva, and to previous findings in the writer's laboratory, so that it has seemed wiser to obtain further evidence before this work is published. Since leaving Cold Spring Harbor, the writer has constructed special apparatus for continuing such work, and it is hoped that results will be obtained which will be of importance in elucidating the mechanism of photodynamic action. Whatever the future developments of this work may be, they will owe much to Dr. Ponder and the Cold Spring Harbor Laboratory.

Professor Stanley A. Cain's Report

University of Tennessee

The Plant Sociology Class under the direction of Professor Stanley A. Cain continued the study of the plant associations of Cold Spring

Harbor and Vicinity initiated by Professor Henry S. Conard and summarized in his paper "The Plant Associations of Central Long Island," The American Midland Naturalist, vol. 16: 433-516, 1935. 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.

This year the course work continued the policy established by Professor Conard of making detailed observations on the plant communities of the region, together with practice in the identification of species in most of the plant groups: marine and fresh water algae, mosses and liverworts, ferns and flowering plants. In the course of the class work the students became familiar with over forty of the associations listed by Professor Conard, including nearly all of his classified associations. In a number of these associations, representing a wide range of types, work was done along statistical lines emphasing concepts of community structure and organization. Especial attention was given to methods of community analysis. The new emphasis on these latter aspects of the work, which are designed to familiarize the student with critical methods and attitudes, should enable them to carry on independent quantitative investigations in plant sociology along the most recent lines. It is perhaps this emphasis which makes the course at the Biological Laboratory unique in American ecology.

Early in the season Director Harris approved the plan to develop a Sociological Herbarium of the plant communities of Cold Spring Harbor and vicinity. The idea of the sociological herbarium is to collect, press, mount and label (or otherwise preserve) plants of the natural communities in the customary manner, with the innovation of filing them according to communities rather than the customary phylogenetic sequence. As statistical analyses of the plant communities by the sample plot method are best carried out on natural groups of the greatest uniformity as to life-form it seemed practical to organize the herbarium on a basis of these one-layered units. Thus, in any complex plant community such as a forest the student or investigator deals separately with the arborescent layer (which may include a tall tree layer and a small tree layer), the shrub layer, the herb layer and the cryptogamic synusiae of mosses, liverworts and lichens found growing on soil, peat, bark, logs, etc. Consequently, in the sociological herbarium each of these one-layered communities is treated as a unit and all the species (herbarium sheets) from one layer are filed together in one folder and the folders of a natural complex (a phytocoenosis as an oak woods) are grouped together as a section. For example, the red maple swamp forest type (Acer carolinianum phytocoenosis) which is found along small streams and about lakes was worked up in the herbarium with the following folders:

Acer Carolinianum Phytocoenosis

Folder 1, containing statistical data, species lists from different stands

of the same community, photographs, diagrams, etc.
Folder 2, the tree layer, containing the dominant trees **(Acer rubrum, Acer carolinianum)** and associated trees.
Folder 3, the shrub layer, containing the dominant shrubs **(Clethra alnifolia, Viburnum Canbyi,** etc.) and several associated species.
Folder 4, the herb layer, containing the dominant herbaceous plants **(Osmunda cinnamomea, Spathyema foetida, Unifolium canadense,** etc.,) and some thirty to forty other species.
Folder 5, the cryptogamic synusiae, containing some twenty to thirty mosses, liverworts and lichens on various substrata.
Folder 6, the aquatic species, containing those characteristic plants of the small slow streams along which the forest type occurs (as **Nymphaea advena, Callitriche, Fontinalis,** etc.)

Other phytocoenoses, as the oak woods, pine woods, etc., have their appropriate sections and folders for the life-form groups (one-layered associations).

A slightly different but equally practical treatment was made of the one-layered communities of salt marshes, of the coastal beaches and dunes, etc. In such cases the communities which are closely related ecologically and physiographically but which are relatively simple (when compared with forest types) were grouped on a physiographic basis. For example:

Communities of Beach and Dune

Folder 1, The beach rocket community (Cakile edentula) of the middle beach.
Folder 2, The beach grass community (Ammophila breviligulata) of the upper beach, dunes and blowouts.
Folder 3, The low shrub community (Hudsonia tomentosa) which replaces the Ammophiletum on stabilized sand.
Folder 4, The pioneer plants of blowouts.
Folder 5, The interdunal basin communities, including peat-forming bogs with cranberry and sphagnum, fresh water marshes, etc.

The first season saw the start of the work with the addition of about four hundred species. A few seasons of application can bring this collection to reasonable completion. This new type of herbarium has already demonstrated its value in teaching and investigation of plant communities. It should also become of value to persons interested in landscape work as the species occurring on natural habitat types are grouped together and one can see those suitable for planting as well as avoid the mistake of attempting to grow plants on soils and under conditions for which they are not suited.

As the Biological Laboratory had no herbarium before the donation in 1935 by Carnegie Institute of Washington (Department of Genetics) of a Cold Spring Harbor herbarium collected by Professor George Shull

of Princeton University in 1905, a report of progress follows:

Specimens 1 to 793—The Shull Herbarium of flowering plants mentioned above.

Specimens 794 to 912—Moss Collection, donated by Dr. A. J. Grout of the Biological Laboratory and Professor Henry S. Conrad of Grinnell College.

Specimens 913 to 1610—General collections (1934 and 1935) by Stanley A. Cain.

The Shull collection came to us mounted and labeled together with two long cases for its housing. The moss collection was named but was placed in standard packets and labeled during the summer. The Cain collections were identified, mounted (or otherwise preserved), labeled and accessioned during the summer. About 250 of these plants are cryptogams, the remainder flowering plants. Perhaps half of this work was done by the following persons: Elizabeth Huene (employed by the Laboratory for one month), my students Mr. J. R. Steck, Jr. and Mr. Herbert McCullough, and by Mildred S. Cain, to all of whom thanks and appreciation are extended.

During the two months of my residence preceding the course some investigations were carried on. Especial study was made of the red maple swamp forest type at Third Lake, Massapequa, the Santapoque River and Wyandanch on a basis of the unistratal association. Additional work next season will lead to publication on this forest type. The fine oak forest west of First Lake was used for a study of sampling technique. This research, which compares the statistical results obtained by use of three widely used sampling methods, will be published in 1936.

Doctor David R. Climenko's Report
Calco Chemical Company

Agranulocytosis

For some time it has been suspected that certain chemical substances, having a benzene nucleus as their basic structure, and which are used as therapeutic agents, might have an etiological relationship with an extremely severe blood dyscrasia which is usually described as 'acute agranulocytosis' or 'agranulocytic angina'. This is a disease which is characterized by a sudden fall in the number of granulocytes in the peripheral circulation. The disease runs an acute course and is fatal in a large number of instances. One of the therapeutic agents which have been suspected of giving rise to this disease is amidopyrine. Experimental attempts to reproduce the disease in animals by the administration of this substance or similar substances have not been successful up to the present time. It is pointed out that while it might not be possible to produce the disease as such, certain pathological changes might be produced by the continued administration of relatively large doses of the drug. This has been done and the effect produced on the leucogenic tissues has been described. These changes, in brief, are as follows: (a) hyperplasia of the

haematopoietic tissues in general, (b) hyperplasia of the leucogenic tissues, (c) degenerative changes in the leucogenic tissues characterized by focal areas of necrosis, (d) generalized degenerative changes of the haematopoietic tissues.

While these changes are taking place it may be demonstrated by means of the animal's reaction to nucleic acid that the normal capacity of the leucogenic tissues to respond to stimuli has been inhibited.

These results have been reported in the Proceedings of the Society for Experimental Biology and Medicine, The Journal of the American Medical Association, and The Journal of Laboratory and Clinical Medicine.

Magnesium Synergism

For some time it has been known that magnesium possesses certain anesthetic and inhibitory properties. It has also been suggested by the work of Gwathmey that the combined action of magnesium, together with some other narcotic or depressant drug such as ether or morphine, produces an effect which is much greater than the algebraic sum of the two compounds. This question has been subjected to careful analysis, using as test material the response of rabbits and dogs to the antipyretic action of magnesium compounds following the intravenous administration of typhoid toxin. The results of this investigation will appear shortly in the Proceedings of the Society for Experimental Biology and Medicine and will be reported in detail at the annual meeting of the American Medical Association.

Food Dyes

From a practical point of view it has been found necessary to develop an oil-soluble dye which is to be used in the processing of citrus fruits. At the present time no such substance is available which has been subjected to a pharmacological or toxicological analysis. The Research Department of the Calco Chemical Company has developed two such substances and an intensive investigation into their pharmacological or toxicological property is now under way. The result of this investigation will be submitted to the Bureau of Food and Drugs of the Department of Agriculture with the view of having one or both of these substances certified as a food dye.

Published Papers

I. The Inhibition of Leucogenic Activity in the Rabbit by means of certain cyclic compounds.—The Proceedings of the Society for Experimental Biology and Medicine, 1935, 32, 823.

II. The relative toxicity of phenylcinchoninic acid and the phenylcinchoninic derivatives.—A report to the Council on Pharmacy and Chemistry of the American Medical Association.

III. The modification of haematopoietic function in the rabbit by certain cyclic compounds.—The Journal of Laboratory and Clinical Medi-

cine (In press).

IV. Influence of magnesium on the toxicity of sodium barbital.—The Proceedings of the Society for Experimental Biology and Medicine. (In press).

Report of Doctor Kenneth S. and Robert H. Cole

College of Physicians and Surgeons, and Harvard University

The alternating current resistance and capacity of suspensions of unfertilized starfish and sea urchin eggs and fertilized sea urchin eggs were measured at frequencies from one thousand to sixteen million cycles per second.

The plasma membranes of the unfertilized eggs show static capacities, 1.1 microfarads per cm^2 for the starfish and 0.73 microfarads per cm^2 for the sea urchin, which are independent of frequency. The suspensions show a frequency dependent capacity at low frequencies which may be attributable to surface conductance.

The measurements on the fertilized sea urchin eggs indicate that the fertilization membrane has a capacity of 3.1 microfarads per cm^2 and is separated from the plasma membrane by a space 1.5 micra thick which has the conductivity of sea water.

The specific resistance of the cytoplasm is about the same in all cases, approximately five times that of sea water.

At frequencies above one million cycles there is definite evidence of another element which may be the nucleus. If so, its capacity would be of the order of 0.1 microfarads per cm^2 in all cases.

These measurements were made with the conductivity equipment of the Walter B. James Laboratory of Biophysics through the courtesy and cooperation of Dr. Hugo Fricke and Dr. Howard J. Curtis.

Doctor Bert Cunningham's Report

Duke University

(Includes work of Elizabeth Huene and Faith Conklin)

In a study of the eggs of the painted turtle **(Chrysemys marginata)** the senior author failed to find any evidence of water absorption during early development; on the other hand he found a considerable absorption of water by the eggs of the diamond-back turtle and one of the sea-turtles.

It seemed desirable to extend these studies, so the land "terrapin" or box turtle **(Terrapena carolina)** and the painted turtle **(Chrysemys picta)** were selected for investigation. The former occurs abundantly in the neighborhood of the Laboratory and through the efforts of the Laboratory we had available the facilities of Wyandanch Country Club where there is an abundance of the latter species.

The work consisted largely in trying out artificial incubation methods which had been previously used by the senior author; and while but few data worth publishing were secured during the summer's work, foundations

have been laid which should make possible the completion of a study of these two species in a subsequent summer.

It should be pointed out that the snapping turtle **(Chelydra serpentina)** also occurs abundantly in this region and it should be added to the species to be studied another year.

The group wishes to thank the Laboratory for the facilities and courtesies extended, and hopes that arrangements may be made to complete the work during the coming summer.

Doctor Hugo Fricke's Report

(Includes work of Doctors Howard J. Curtis, Edwin J. Hart, Robert Janes, Samuel Katzoff and Mr. Darius M. Gallagher.)

Studies of the chemical effects of X-rays have been continued and aqueous solutions of acetic acid, butyric acid, potassium salts of iodine, bromide, chloride, nitrite, nitrate, ferrocyanide, ferricyanide and iodate, sodium salts of nitrite, sulfite, arsenite, selenite, vanadate, chlorate and perchlorate, phosphorous and phosphoric acids have been irradiated. A few of the results obtained may be indicated. The nitrite, arsenite, and selenite ions give particularly simple reactions, which are the same for all, and consist in the transference of an oxygen atom from the water with the subsequent liberation of hydrogen from the water. It was earlier found that X-rays do not decompose water. However, in the presence of traces of iodide or bromide, X-rays do decompose water, while the chloride ion does not bring about this effect. In acid solutions, hydrogen and hydrogen peroxide are formed, while in neutral and basic solutions hydrogen and oxygen are the products; in either case, no change in the halide ion concentration can be detected. This decomposition of the water is independent of iodide concentration to 10 micromols per liter. At lower concentrations, the decomposition decreases. This decrease appears to be due to the limited life of the activated molecules. The irradiation of potassium iodate and potassium ferricyanide causes the reduction of these molecules, the liberated oxygen appearing as hydrogen peroxide in acid solution.

From a comparison of the reactions which have thus far been studied in aqueous solutions, it becomes apparent that two types of activated water molecules are especially concerned. One, produced in the amount of 0.55 micromols per 1000 cc. per 1000 r, is responsible for the oxidation of nitrite, arsenite, selenite and ferrocyanide ions. The other, produced in the amount of 2.2 micromols per 1000 cc. per 1000 r, has the property of transferring oxygen to its reactive states and of decomposing formic acid and numerous other organic molecules. This latter type is, for example, responsible for the increased oxidation of the ferrous ion observed when gaseous oxygen is added to the irradiated solution.

For further information on the activation of water, we may look to the absorption of light in water. The various possible types of activation of the water molecules are shown as bands in the absorption spectrum. In the ultraviolet portion of the spectrum, water has two absorp-

tion bands, one setting in at about 1900 A., and the other at 1400 A. The idea presents itself, that the two types of activated water molecules discovered in the X-ray work may be those produced by light inside these two bands. This does not necessarily mean that X-rays raise the molecules to these two states, but probably the X-ray activated molecules rapidly degenerate to either of these more stable activated states; the chemical reactions occurring being therefore primarily caused by activated water molecules in these two states. However, and there are indications that this is true, by working with high concentrations of the reacting molecules, we may be able to get the activated water molecules to react before they have lost their original high energy and reactions more difficult to produce may be obtained. Work along this line has been done with ultraviolet light. Intense light sources (condensed sparks, arcs and mercury vapor lamps) have been constructed and it has been shown that it is actually possible to produce chemical reactions which are due to the activation of the water with wavelengths inside the 1900 A. absorption band. So far, it appears that all the reactions produced by the second type of X-ray activated water molecule (2.2 micromols per 1000 cc per 1000 r.) can be produced by the water molecule activated by this 1900 A. band, while we cannot, with the light in this band, produce any of the reactions obtained by the other type of X-ray activated molecule.

Although the work with ultraviolet light is limited in certain respects because of the difficulty of eliminating, or correcting for, reactions caused by the activation of molecules other than water in the irradiated system, nevertheless such work has been of the greatest value in explaining X-ray effects. With light, we are working with only one activated water molecule, giving corresponding simplicity in the reactions. Furthermore, by varying the wavelength, the water molecule can be raised to any of its different electronic states, which, by suitable reactions, may be studied and a systematic basis for the explanation of the X-ray reactions may thus be gained. We are beginning to be able to determine the length of life of the activated water molecule. This promises to be a valuable characteristic of the activated molecules. Finally, we may state that the work with light gives striking instances of the activation of other ions and consequent chemical activity. The sulfate ion, when present in solution, is not transformed by light, but light absorbed by this ion may nevertheless be effective in causing the usual type of reactions occurring at this wavelength. All molecules and ions, when properly excited, may thus contribute to the course of the photochemical reaction. Hence a study of the reactions produced by the activation of the ions usually present in biological systems, appears to be necessary for the understanding of the effect of X-rays on these systems.

A considerable part of the work on electric conductance and dielectric constant has been concerned with following up the finding that aqueous interphases are the seat of electrical properties similar to those found at cell membranes. The similarity is so pronounced that there can be no doubt that the phenomena in both instances are derived from similar pro-

cesses. A rather complete study has been made of this discovery by measurements on suspensions and colloids, over a wide range of frequencies, and under different conditions in respect to a number of the variables of the systems, including volume concentration, particle size, composition of surface, hydrogen ion concentration and ionic strength of suspending solution. A few of the most interesting results may be noted. 1) The interphase shows a high dielectric constant, the value of which increases as (or very nearly as) the inverse first power of the frequency. This is the same law as was found for the membrane of the red corpuscle and of the yeast cell at low frequencies. The same type of variation was also found for the collodion membrane. 2) The interphase has a high conductance, which increases markedly at high frequencies. The presence of electric conductance at aqueous interphases is already known and referred to as surface conductance, but has hitherto been measured only at low frequencies. The present measurements show that the surface conductance does not satisfactorily characterize the interphase, but should be replaced by a complex impedance which has to be given as a function of the frequency. The increase in conductance which we find at high frequencies is similar to (although much greater than) that known to be present in strong electrolytes (the Debye-Falkenhagen effect) and due to the electrostatic forces between the ions. The rise observed for suspensions may have a similar cause, the suspended particles, due to their electric charges, acting as ions of high valence. The low frequency surface conductance appears to be perfectly accounted for as due to the conductance of the ions of the diffuse double layer. Due to the large surface of fine suspensions, surface conductance measurements can be made on them with great precision. We have carried out two series of measurements, one on spherical glass and another on spherical kaolin, varying the particle size, the zeta-potential of the interphase and the ionic strength of the suspending solution, all over considerable ranges. The agreement with the formulae derived from the diffuse double layer theory is very good. Without going into detail, we should note that the results described have important bearing on a number of physico-chemical phenomena related to interphases such as electric polarization, permeability, membrane potentials, and absorption (conductance measurements at high frequencies record the absorbed electrolytes).

Impedance measurements were made, early in the year, on suspensions of leucocytes, and bacteria, showing the presence of a membrane similar to that found around the red blood cell.

During the summer Drs. Robert Janes and Samuel Katzoff carried out researches, on special fellowships. Dr. Janes took part in the work on the activation of water with ultraviolet light. Dr. Katzoff worked on the wavelength dependence of genetic effects of X-rays. This work, for which **Drosophila melanogaster** was used, was carried out in cooperation with Dr. M. Demerec of the Department of Genetics of Carnegie Institution of Washington, and extended from 0.6 A. to 2.1 A. The results so far indicate no dependence on wavelength, although the material is too small to allow final conclusions to be drawn. Through the support of the Radiations Committee of the National Research Council, the work will be con-

tinued during the coming year, and extension to light in the short ultraviolet region will be made.

During the summer, a set of experiments in biophysics was given to the students of the Physiology course. Drs. Hart, Janes, and Katzoff, and Mr. Gallagher were in charge. The experiments included measurements of X-ray absorption with special consideration of X-ray protection, determination of effective wavelengths of X-rays, and measurements of X-ray dosage in the r-unit; furthermore ultraviolet dosimetry, with absorption measurements on such materials as ordinary window glass, vita-glass, quartz, water, serum; comparison of different light sources, particularly the sun, the carbon arc lamp with different types of carbons, and the quartz mercury lamp; measurements of dosage required for erythema with different light sources; finally, experiments in gas analysis and electric titration.

Report of Robert Gaunt, Charles E. Tobin, Jo Howland Gaunt and Hall T. McGee, Jr.

The College of Charleston, Charleston, S. C.

I. Accessory Adrenal Cortical Tissue in the Rat.

Observers disagree completely concerning the mortality that follows adrenalectomy in the rat, but the authors have established that different colonies of rats show consistently different survival figures after adrenalectomy. This indicates that more accessory adrenal tissue was present in some colonies than others—an assumption not as certain as plausible. These facts indicate a need for a study of the general morphology of such accessory tissue in this species, its histology, distribution, frequency of appearance, possibility of surgical removal, etc.

Two methods of approach to the problem were used: First, 20-day-old rats were killed and the tissues in which adrenal accessories reputedly occur were sectioned for histological study. Results were not satisfactory as accessories in such animals are difficult to identify, often being indistinguishable from embryonic fat cells, and are never of the characteristic, three-layered, true cortical type. They could not be identified in the percentage of animals in which survival studies indicated that they existed.

In a second series adult, adrenalectomized animals were used. Their lives were extended, sometimes for several months, by treatment with salt solutions. At death or after being killed for autopsy sections of tissues were made as above. The authors had previously shown that such extension of life facilitates the hypertrophy of accessory tissue and increases the percentage of survival. Again, however, accessories were not found in more than two-thirds of the cases in which the survival period indicated that they must have been present, and clumps of cells of doubtful kind oftentimes prevented sure identification.

Other approaches to the problem are now being made.

II. Lactation in Adrenalectomized Rats.

One of a series of studies on this subject was carried out this summer.

Partly as a test of the hypothesis that there is a separate hormone in the adrenal cortex essential for lactation, attempts were made to produce lactation experimentally 7 days after adrenalectomy. Lactation was induced by the method of Collip: the ovaries were highly luteinized by injections of pregnancy urine extracts begun before and continued after adrenalectomy. Five days after adrenalectomy the luteinized ovaries were removed—such removal in normal animals always resulting in profuse lactation about two days later. In adrenalectomized animals lactation occurred in 6 of 11 cases. The administration of salt solutions increased the amount of milk present.

It is indicated that lactation can occur in the absence of the adrenals.

Doctor A. C. Giese's Report

Stanford University

A. C. Giese, besides attending the Symposia, gave the section on "Photobiology" in the General Physiology course. In this section were included experiments on the effects of heat, visible light (chiefly studies on photodynamic sensitization), and ultraviolet light upon organisms.

Doctor A. J. Grout's Report

During the year Volume two, parts two and three of the Moss Flora of North America have been completed and published at a cost considerably over two thousand dollars, part 2 in May, part 3 just coming out in late December. This has been made possible through the cooperation of Dr. A. LeRoy Andrews of Cornell University, Miss Geneva Sayre of the University of Colorado, Dr. William C. Steere of the University of Michigan and Dr. Seville Flowers of the Carbon Co., Utah, High School. All of these persons have contributed manuscript and Dr. Flowers has made all the original drawings except a very few by Dr. Steere. This is the first time two parts have been issued in one calendar year.

Dr. Andrews has in preparation manuscript for part four of volume two, completing the volume. Prof. A. J. Sharp of the University of Tennessee is at work on two families for volume one, part one; Dr. T. C. Frye of the University of Washington is at work on the Polytrichaceae for the same part. I have completed the manuscript for the Fissidentaceae, 25 species, for this part and during the winter expect to write up enough of the Ditrichaceae and Dicranaceae to finish this part, so that the publication of two more parts is in prospect for 1936.

The contributors mentioned above have all worked without financial remuneration.

As the work progresses and its completion seems more probable, more of the larger institutions become interested and are subscribing to it. If financial conditions again become normal, a much larger volume of subscriptions can confidently be expected.

Dr. Conard reports favorable comments on the "Flora" from the botanists he met at the International Botanical Congress in Amsterdam last

summer.

Fascicle eight, nos. 276-300 of the N. American Musci Perfecti were issued in September to about thirty educational institutions and several more to private collections.

I have also made considerable collections in Florida, Vermont, and the Great Smokies in Tennessee. Hundreds of specimens have been identified for private individuals and institutions, among the latter are the U. S. National Museum, Yale University and the University of Michigan.

These institutions and the National Museum of Canada, the New York Botanical Garden as well as several others at home and abroad have cordially assisted with information and the loan of specimens. Due largely to this assistance several new species and varieties have been discovered and described.

Mrs. H. A. Haring of Woodland, New York, a cultured lady of leisure and means, was the only student at Newfane this summer. She had recently taken an A. M. at Vassar and was asked to accept a teaching position there, but prefers to act as a free lance. She has joined the Sullivant Moss Society and has taken over a new and very promising department, that of exchanges, similar to that of the British Bryological Society. This is expected to be of great value in encouraging the study of bryophytes.

I have turned over to Dr. Harris reviews of the "Flora" which will be available to any one interested.

Miss M. Catherine Hinchey's Report

Temple University and University of Pennsylvania

Considerable work has already been done by a number of investigators on the nuclear events of a number of species of parasitic amebas. A comparatively small amount of work has been done on free living species. On the other hand, a large amount of physiological work has been done on free living amebas, and comparatively little has been done on parasitic species. Then again, the main stages in the life histories of a number of parasitic amebas have been worked out, while the life histories of free living amebas are comparatively little known.

The summer was spent in fixing and staining several species of free living amebas for study of the nuclear events. Pure line cultures of **Flabellula citata** and **Flabellula mira,** and wild cultures of **Vexillifera aurea, Cochliopodium gulosum, Trichamoeba gumia** and **Mayorella conipes** were used. The wild cultures were grown in a trough of slowly running sea water. The slides made from these wild cultures are intended for preliminary observations. Preparations will be made later from pure line cultures.

About 300 good, iron-haematoxylin preparations, with from 100 to 1000 amebas on a slide, were secured for study during the winter. Preliminary investigation, however, revealed one new feature in the nuclear divisions of **F. citata;** namely, as the nucleus lengthens out in a dumbbell shape in late anaphase or early telophase, the dumbbell is bent in the shape of a crescent .

Doctor Irvin M. Korr's Report

Princeton University

A preliminary investigation was undertaken of oxidation-reduction potentials in heterogeneous systems. False conclusions have often been drawn in studies on cellular and other biological oxidation-reduction potentials involving heterogeneous systems, due to the induction of data and theory obtained from, and applicable to, only systems in homogeneous solution.

The author observed marked shifts in potentials of solutions containing known ratios of some of the Clark redox indicators and their leuco-derivatives, when mixed with suspensions of adsorbents, (e.g. quartz, filter paper), emulsions and even protein solutions. It seems, therefore, that, at least in some of the systems investigated, the potential obtained in colloidal systems is not that corresponding to the ratio of oxidant to reductant, due, apparently to differential adsorption, or differential solubility in the different phases, of the components of that system. This problem is being further investigated, and its biological implications followed out.

In another study, the attempt was made to demonstrate, by means of a model, that oxidation of substrates normally occurring in cells, e.g. succinate, lactate, may play a direct role in bio-electric potentials. Since the latter, in some cases, at least, may be of the nature of phase-boundary potentials (Beutner, Osterhout), it was reasoned that if the two components (i.e. the oxidant and reductant) of a substrate system differed sufficiently in their relative solubility and ionic mobility in the aqueous and non-aqueous phases, then a change in the ratio of their concentrations, as by oxidation or reduction, should produce a change in potential, as measured at non-metallic (calomel) electrodes. With the substances tried, however (succinate-fumarate, and lactate-pyruvate), using Osterhout's guaiacol-cresol model, the potential changes obtained were too small to be considered in support of the hypothesis. The author is now trying a variety of models and membranes for the demonstration of the phenomenon.

A large portion of the summer was devoted to the development and improvement of the technique for the extraction and purification of glucose dehydrogenase from liver. An active extract was finally obtained, in preparation for a study of the oxidation-reduction potentials of the glucose-dehydrogenase-gluconic acid system.

Doctor Alfred Marshak's Report

New England Deaconess Hospital

Previous work indicated that the qualitative effects of X-rays on the chromosomes of the salivary gland of **Drosophila melanogaster** were similar to those observed in the plant **Gasteria.** In order to make a quantitative study it was necessary to devise a technique for rapidly preparing large numbers of permant mounts of the salivary chromosomes. Such a technique was developed, the details of which are being published in the American Naturalist.

A series of larvae (6 to 8 hours old) were irradiated with doses of 40 to 500 r-units. No translocations were observed. This is in keeping with the observation in **Gasteria** that attachments between non-homologous chromosomes do not appear with any appreciable frequency at doses below 500 r.

Rabbit leucocytes (in saline) and yeast cells (in phosphate buffer after growth in William's medium) were given doses of 50,000 roentgens, and the rate of respiration determined immediately after irradiation. Oxygen consumption was followed for the 5 hours following treatment with X-rays. There was no difference between the oxygen consumption of the irradiated and the control cells.

Doctor Samuel Morris' Report

Temple University

During the latter part of the summer, material was collected for a course in Parasitology to be given at Temple University. A preliminary survey was made of the material available locally for future research in this field.

Doctor Laurence S. Moyer's Report

Yale University

Investigations were carried on with Professor Harold A. Abramson. These have resulted in the following papers, to be published from the Laboratory:

Abramson, H. A., and Moyer, L. S., The electrical charge of mammalian red blood cells. Jour. Gen. Physiol. in press.

From data of Ponder on the surface area combined with data of Abramson on the electrical mobilities of mammalian red blood cells in 0.07M phosphate buffer at pH 7.4, it has been possible with the help of the Gouy and Smoluchowski theory, to calculate the net surface charge per cell as well as the charge per unit area. It was found that a single mammalian red cell has a net surface charge ranging from four to fifteen million electrons, depending on the species. No clear relationship between zoological classification and surface charge is apparent. It is suggested that a mechanism exists which is capable of keeping the surface density of net charge constant when comparatively large changes in surface area occur in the anemias.

Moyer, L. S., and Abramson, H. A., Electrokinetic phenomena. XII. Electro-osmotic and electrophoretic mobilities of protein surfaces in dilute salt solutions. Jour. Gen. Physiol. in press.

Contrary to the results of White, Monaghan, and Urban and in accord with the results of Bull, it was found that the ratio of electro-osmotic to electrophoretic mobility of certain protein-coated surfaces is very close to 1.0, even in very dilute solutions of electrolytes. White, Managhan, and Urban have explained their results by invoking a "Polarization" of the double layer of the particle and claim that electrophoretic measurements

in dilute solutions do not yield true values. In the light of our data, any polarization of the double layer either operates equally on both the protein coating of the wall and the particle in both dilute and fairly concentrated solutions or else its influence is less than the limits of error of the method. Since the ratio is 1.0 even with very small particles in very dilute solutions, it follows that these results are not inconsistent with the idea that the protein molecule gives the surface on which it is adsorbed its own value of Kappa-r and hence keeps Kappa-r constant.

Doctor Carroll A. Pfeiffer's Report

New York Hospital and Cornell Medical School

A study was made of the effects of ovarian grafts upon the seminal vesicles and prostate of male rats. The ovaries were from littermates and the grafting was done either at birth or at puberty. The effects were tested in both normal and castrated males. The smooth muscle and fibrous tissue of the seminal vesicles are hypertrophied in all cases. The fibrous tissue of the prostate of the castrate is hypertrophied and the epithelium tends to become stratified and even keratinized in the case of the coagulation glands. Vaginal and uterine grafts were placed in the eye in an attempt to measure the amount of hormone produced by the grafted ovaries.

Doctor Eric Ponder's Report

(Includes work of John MacLeod, Doctor Harold F. Blum, Messrs. Fraad and Bookman)

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. **Red cell fragility in different animals.** It is well known that the red cells of different mammals show different "fragilities", i.e., that they begin to haemolyse in solutions of different tonicities. This might be due to differences in the amount of contained water, to differences in the extent to which different types of cell lose salts as they take in water, or to differences in the extent to which the cell membrane can stretch before it becomes permeable to haemoglobin. Measurement of the variables involved, all made simultaneously on red cells **in the spherical form,** show that the last factor is the most important one, and also that the extent to which the cell membrane can be stretched is a very good linear function of the initial cell volume. On the basis of these observations and of the observation that the capacity per unit area of membrane does not change appreciably when the membrane is stretched, I have put forward a hypothesis in which the cell membrane is supposed to be able to be stretched without being thinned, its integrity being maintained, up to a point, by a re-distribution of molecules from surrounding regions of the cell wall. It should be observed, however, that these results apply specifically to the spherical

form of the erythrocyte, which has a considerably smaller surface area than has the discoidal form from which it is derived. It is quite possible that when the sphere is formed from the disc, the surface molecules of the latter re-arrange themselves to cover a smaller area, and that it is these same molecules which are available to enter the surface membrane when the spherical form is caused to swell and its surface to stretch. The question obviously requires more investigation. The paper has been published in the Journal of Physiology, vol. 83, p. 352.

2. **Red cell fragility in the same animal.** Obviously related to the foregoing problem is that of determining why individual red cells of the same animal show different "fragilities", some cells being much more resistant than others. On the hypothesis just mentioned, initial cell size, which varies from cell to cell, ought to be a factor in determining the fragility, and experiments in which the frequency distribution of cell size was obtained in media of different tonicities show that the expected relations are fulfilled, i.e., that the stretching of the cell membrane which the smaller cells can withstand is less than that which can be withstood by the larger cells. The paper appears in the Proceedings of the Society for Experimental Biology and Medicine, vol. 33, p. 156.

3. **Conductivity measurements.** One of the difficulties in applying Dr. Fricke's conductivity method to the determination of volume concentration of red cell suspensions is that the equation for the volume concentration contains a "form factor", which depends on the cell shape. By making conductivity measurements on suspensions of red cells in plasma, and then converting the cells into spheres by adding lecithin, I have studied the variation in the "form factor" in the case of various types of cell, and have checked the conductivity method against other methods for finding volume concentration. The correspondence is excellent.

This investigation was carried out as a preliminary to an investigation, also by conductivity methods, into the way in which red cells swell and shrink in hypotonic and hypertonic solutions respectively. The results obtained were much the same as those obtained by other methods, i.e., the volume changes are usually those of an "imperfect" osmometer which loses salts as it gains water, although sometimes the red cell shrinks in hypertonic solutions as if it were a "perfect" osmometer with all of its water "free". The paper has been published in the Journal of Physiology, vol. 85, p. 439.

4. **"Free" water in red cells.** The abnormally small volumes which are attained at equilibrium by red cells in hypotonic solutions can be explained in one of two ways:—(a) that the cells lose salts as they take up water, i. e., that they are "imperfect" osmometers, or (b), that they are "perfect" osmometers, but that some of their water is "bound". I and my collaborators have always preferred the former idea, but recently it has been claimed that "bound" water exists in appreciable amounts in the mammalian erythrocyte. This conclusion was reached by the use of a method in which the amount of "solvent", or "free" water in the cells is found by determining the partition of ethylene glycol between the cells and the fluid surrounding them. We have found several errors in the

method as originally described, and, in our hands, the ethylene glycol partition method leads to the same conclusion as that arrived at by A. V. Hill with his vapour pressure method, i.e., that virtually all the water in the red cell is "free" or "solvent" water. The paper will appear in the Journal of Physiology shortly.

5. **Red cell shape and the photodynamic dyes.** While working with Dr. Blum this summer on the kinetics of the haemolysis produced by photodynamic dyes (fluorescein, eosin, erythrosin, and rose bengal, see Cold Spring Harbor Symposia,vol. 3, p. 323), we observed that these dyes convert the normally discoidal red cells into spherical forms, and that they do so in sub-lytic concentrations. There is no volume change involved, and the spheres can be re-converted into discs by the addition of serum or plasma. The observations are of great importance in connection with the properties of the red cell membrane, and their implications are discussed in a paper which will shortly appear in the Journal for Experimental Biology. The electrical properties of the spheres produced by the addition of rose bengal have now been studied by Dr. Curtis, and it is a curious fact that the change from disc to sphere, with a reduction of area of some 25 per cent, is unaccompanied by any significant change in capacity per unit area, i.e., the thickness of the cell membrane presumably remains the same irrespective of its reduced extent. The molecules of the surface membrane must be capable of considerable re-orientation, a conclusion in keeping with that mentioned in connection with the fragility of the cells of different animals (1, above).

6. **Cinematograph pictures of haemolysis.** There has always been doubt as to whether, during haemolysis, the pigment of a red cell escapes because the membrane has broken down at one point (a hole), or because the membrane permeability in general is increased. Dr. Fricke has subjected the matter to a mathematical analysis, and last December Dr. Marsland and I made the necessary measurements. What is required is the average time for a single red cell to "fade" in different concentrations of lysin, and these determinations have to be made by cinematographing single red cells. Dr. Robert Chambers kindly allowed us to use his cinematograph, and we were able to obtain excellent films. Measurements from these showed that if lysins such as saponin are used in high concentration the permeability of the cell membrane approaches that theoretically corresponding to complete permeability, while if less concentrated lysins are used the membrane permeability approaches a constant value. The results are in agreement with evidence obtained by electrical methods, and there is no indication that the haemoglobin leaves the cell through a hole. The paper has been published in the Journal of General Physiology, vol. 19, p. 35.

7. **Restoration of semipermeability after hypotonic haemolysis.** As the cinematograph films of cells haemolysed by hypotonic saline show, the permeability of the cell membranes at the moment of haemolysis is considerable, although not so great as to correspond to complete permeability. Addition to a haemolysed suspension of enough NaCl to restore isotonicity, however, results in the appearance known as "reversal of haemolysis", the

suspension becoming once more opaque, and it can be shown that this is due to the haemolysed ghosts returning to their original size on the restoration of isotonicity. This means that the ghosts act as osmometers; and that their permeability to Na ion, for example, must be very small. The permeability to Na ion at the moment of haemolysis, on the other hand, is certainly almost complete, and so the observations lead to the conclusion that the loss of semipermeability which occurs at the moment of lysis is only temporary, and that the membranes soon undergo a process of "repair". The results of electrical measurements point in the same direction.

We are thus able to recognize four stages in the haemolysis of a red cell by hypotonic solutions, and these may be conveniently considered in terms of the stress on the cell membrane. 1. When the cell is in an isotonic solution, there is virtual semipermeability to cations, and no stress on the membrane. 2. When the cell is immersed in a hypotonic solution not hypotonic enough to produce lysis, the membrane is subject either to a stress of stretching or to a stress of deformation, and there is a certain amount of salt loss associated with the change in area or shape of the cell surface. 3. If the solution is sufficiently hypotonic to produce lysis, the deformation of the membrane finally results in a state of greatly increased permeability to salts and also to pigment. 4. Shortly afterwards, some "repair" process restores the original semipermeability, at least to a very considerable extent. It is possible, of course, that these changes in permeability are not the result of any such simple thing as mere deformation of the cell membrane in a physical sense, and, like most of the problems connected with the red cell membrane, the matter requires much further investigation. A preliminary account of these results will be found in the Proceedings for the Society for Experimental Biology and Medicine, vol. 33, p. 630.

8. Stromatolysis. The disappearance of lysin during the process of stromatolysis which follows haemolysis has now been extensively investigated. There seems no doubt but that the union of a lysin such as saponin with the material of the red cell membrane is a long drawn-out process, occupying in some cases many hours. The quantity of saponin which finally is used up as a result of the combination, moreover, is not a constant quantity, but depends on the initial concentration of lysin. The reaction, in fact, has all the characteristics of a "pseudo-adsorption", such as is met with in the dyeing of wool, etc.; it certainly is not stoichiometric, and yet it does not have many of the characteristics of a simple "adsorption". The results of this investigation are published in the Biochemical Journal, vol. 29, p. 1263.

9. Lysins and white cell metabolism. Many of the substances which are usually thought of as haemolysins have a powerful cytolytic action on other types of cell, and quantitative investigations of this cytolytic action are altogether missing from the literature. Mr. MacLeod and I have accordingly investigated the lytic effect of a number of haemolysins (saponin, the bile salts, the soaps, hypotonic saline, complement and amboceptor, etc.), on white cells obtained from rabbit peritoneal exudates, using the respiration of the leucocytes as our criterion of their integrity. Most of the lysins

affect white cells much as they do red cells, and produce a visible cytolysis and a more or less complete diminution in the oxygen consumption.

At the same time we investigated the extent to which the lysins combine with the leucocytes, using the same sort of technique as one would use for the study of stromatolysis. The principal result obtained is that the union of a lysin such as saponin with the material of the white cell is remarkably like its union with the material of stromata, both as regards the final quantities combined and as regards the rate of the combination.

The use of respirometry methods as a means of measuring white cell viability has involved a number of purely technical problems, and an account of these, together with an account of the results obtained with the lysins, will appear in the Journal of General Physiology.

10. Quinine salts and red cell resistance. Mr. Abels and I have now completed a long series of observations on the effect of subcutaneously administered quinine on red cell resistance. The work was started some time ago with the aid of a grant from the National Research Council, the idea at the back of it being that there seems to be a relation between the intra-vascular haemolysis which occurs in blackwater fever and the administration of quinine salts. The point in which we were interested was whether the administration of quinine changes the resistance of red cells to lysins **in vitro,** and we have found that it does. The red cell resistance to lysins such as saponin and the bile salts is greatly reduced after dosage with suitable quantities of quinine hydrochloride, and this is not surprising in view of the fact that the quinine salt is itself a haemolysin. If an intravascular haemolysin is formed in blackwater fever, as is believed, it is very probable that its effects are enhanced **in vivo** by quinine.

11. The Hattingberg Effect. Two years ago Hattingberg described an increase in the oxygen consumption of a red cell suspension when an electric current is passed through it. Any such effect on the metabolism of a red cell suspension would be very interesting, for the red cell has a structure which could scarcely be expected to respond to stimulation as does, for instance, a muscle or a nerve. The observation can be readily reproduced by passing a 60 cycle A. C. current or the current from an induction coil through a red cell suspension in one of the cups of a Fenn respirometer; there is an apparent increase in oxygen consumption, as indicated by the volume of the cup containing the stimulated suspension diminishing at a greater rate than that at which it diminishes when the contents of the cup are unstimulated. The result, however, is only an artifact, for a similar effect is obtained when 1 per cent NaCl, without red cells, is placed in the cup and stimulated. We appear to be dealing with an obscure electrode phenomenon, for the effects entirely disappear when the electrodes are platinised. The results appear in the Journal of General Physiology, vol. 19, p. 265.

12. Review on the kinetics of haemolysis. Our knowledge of the kinetics of haemolysis have been considerably added to, and in some ways modified, since the publication of my Monograph in 1933. The field has been reviewed, with the incorporation of new material, in a review which appears in Physiological Reviews, vol. 16, p. 19.

Mr. Fraad and Mr. Bookman have completed their investigation on the effect of severe and continuous exercise on the polynuclear count, and have shown by a study of the count in members of the Brown University football team that the count is virtually unaffected by prolonged training and severe exertion. Their paper has appeared in the Proceedings of the Society for Experimental Biology and Medicine, vol. 33, p. 183.

Report of Dr. A. A. Schaefer, Miss Elsie Laity and Mr. Alan Bernheimer

Temple University

A very interesting case of protoplasmic fusion was discovered in an undescribed marine ameba belonging to the genus **Trichamoeba.**

If the ameba is cut into two pieces, the one with the nucleus moves the more rapidly and fuses with the enucleated piece. Fusion occurs within a second or two, if the two pieces of the ameba are brought together as soon as possible after cutting the ameba in two. Fusion is delayed progressively as the time after cutting increases. Fusion does not occur if from 15 to 30 minutes elapses after cutting. Pieces from amebas with clear protoplasm fuse more quickly and for a longer time after cutting than pieces from amebas of granular appearance.

A piece of one ameba readily fuses with a piece from another ameba. If two amebas are cut into two pieces each, all four pieces can, with proper manipulation, be made to fuse into a single ameba. This (double) ameba moves off at once in an apparently perfectly coordinated manner.

This extraordinary power of fusion of protoplasmic fragments appears not to be known to occur in any other species of ameba.

Pure line cultures of **Vexillifera aures** and of **Pontifex maximus** were established and maintained throughout the summer. Numerous attempts to establish a pure line culture of the common marine **Trichamoeba gumia** failed.

Miss Laity worked on spiral movements in **Flabellula citata,** a small fan-shaped marine ameba.

Frequency curves based on the length of sections of path continuously right (or left) until the direction changes, were shown earlier to be based on factors which were the square roots of whole numbers, for four species of amebas. **F. citata** was studied, as a fifth species, to determine the factor characteristic for it. Since the accumulation of data is a tedius process, and the treatment of the data is statistical, not sufficient data have yet been accumulated to draw a definite conclusion. The work has gone far enough, however, to indicate that a clear-cut result is obtainable with this ameba.

Mr. Bernheimer studied the crystals in paramecia and other protozoa, and also the crystallizable products of paramecia. Large numbers of paramecia, when placed in distilled water and kept at a low temperature for a few days, give off, presumably mostly through the contractile vacuoles, various substances which crystallize out on evaporation. Large crystals of what are probably potassium chloride are among the most conspicuous of these crystalline products.

The physical properties: solubility, effect on polarized light, general shape, etc., were studied in a number of species of amebas and ciliates. In general, the preliminary survey shows that the similarities in physical properties parallels the taxonomic relationships.

Doctor Edward Singer's Report
(Includes work of Elizabeth Cuzzort.)

St. Clare's Hospital, New York

The glomeruli in the kidney of the living **Rana catesbiana** were examined with my fluorescence microscope for living tissues using a total magnification of 600X. The form of the glomerulus was observed and its function interpreted under different physiological and experimental, pathological conditions.

The effects of certain bands of the electro-magnetic radiations on living tissues were observed and clues were obtained as to how the staining of the nucleus and the cytoplasm of the living cells are influenced by exposure to the electro-magnetic radiations.

This work was made possible through the generosity of Dr. Hugo Fricke, who kindly permitted me to use the facilities of his laboratory.

Professor T. L. Smith's Report

College of the Ozarks

The following is a summary of the work done on **Galleria mellonella** during the summer. Irradiation treatments were given to 89 male individuals with X-ray dosages ranging from 4000 to 5400 r-units. These males were mated to virgin females which will be bred through the second and third generations and will be observed for gene mutations or other possible effects of the irradiation treatments. Aceto-carmine smears were made of the salivary glands and also of malpighian tubules of the larval stage in an attempt to determine whether or not giant chromosomes might be found similar to those found in **Drosophila** larvae. The smears revealed that both the salivary glands and the malpighian tubules contained cells with nuclei which were from 150 to 200 times as large as the gonial cells. For the most part, the nuclei appeared to be in a normal resting stage and in some cases rather suggestive chromatin groupings were found, indicating that possibly giant chromosomes might be present.

Doctor Herman T. Spieth's Report

Marine and Fresh Water Zoology

The course in Marine and Fresh Water Zoology was designed to fulfill the following three major 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. Emil Witschi, Dr. William A. Castle, and Dr. Herman T. Spieth.

The actual work of the class was divided into field and laboratory work. Twenty field trips were made to various habitats, of which eleven were to marine and seven to fresh water situations. One trip was taken to the Vanderbilt Museum and one to the American Museum of Natural History.

The work in the laboratory, to which approximately one and one-half hours to every one hour of field work were given, was spent as follows:

1. Identification and maintenance of living material collected;
2. Experiments;
3. Lectures.

Experiments were conducted on regeneration, metamorphosis of amphibia, death gradients, tolerance to changed salinity, and chromatophoral activity. In addition, quantitative sampling experiments were conducted in connection with the field work. Demonstrations of thigmotaxis and phototaxis were given by the staff.

Seventeen lectures were given by the staff for the course, and Dr. Cain kindly gave a special lecture on plant sociology. The lectures dealt with the various aspects of the course such as field methods, ecology of the region, and the various experiments.

Mr. Harry Stoudt's Report

Temple University

Several weeks were spent in the preparation of drawings for a paper on gemmipary in **Kalanchoe diagremontiana,** a plant belonging to the family Crassulaceae.

This paper is the third of a series on the general subject of gemmipary in the large family Crassulaceae, in which this process of regeneration with associated reproduction is very conspicuous. The plants from which the material for study was obtained, were derived originally from many sources including the gardens of the Biological Laboratory. The preparations on which this paper is based were made in part during the summer of 1934 at the Laboratory, for study during the winter at Temple University.

Doctor Ivon R. Taylor's Report
(Includes work of Edward Anderson)

Brown University

During the first part of the summer my time was mainly devoted to the course in general physiology. The organization and content of the course work were essentially similar to what they were last year except

that experiments on photobiology were offered by Dr. A. C. Giese who joined the staff for the summer.

On the regular staff of the course were Dr. Eric Ponder, Dr. Hugo Fricke, Dr. H. A. Abramson, Dr. K. S. Cole, Dr. A. C. Giese, Dr. E. Walzl and Dr. I. R. Taylor. Dr. Fricke was assisted in the course work which he offered by Dr. Hart, Dr. Janes, Dr. Katzoff and Mr. Gallagher. Dr. Moyer aided in the work which was under the direction of Dr. Abramson. Likewise Mr. MacLeod cooperated with Dr. Ponder. The assistance rendered to Dr. Ponder, Dr. Abramson and Dr. Fricke by these men, some of whom were visiting-investigators, was very helpful and much appreciated.

In accordance with previous practice, a number of men who took part in the Symposia on Quantitative Biology or who were visiting-investigators were invited to lecture to the class. Those who gave special lectures were Dr. H. F. Blum, Dr. F. S. Brackett, Dr. H. K. Hartline, Dr. H. Mestre, Dr. L. Moyer, Dr. C. B. van Niel and Dr. E. Wolf. These lectures represented a valuable contribution to the course and we are grateful to the men who presented them. The lectures throughout the course were open to everyone at the Laboratory and they were well attended.

It is our aim to offer training in certain branches of general physiology not ordinarily obtainable by students. Efforts are made to put the work on a quantitative basis. While means of introducing improvements are still being looked for, in large measure these objectives were achieved this season.

Towards the latter part of the summer, Mr. Anderson and I undertook an investigation of the effects of certain salts in different concentrations upon the dissociation constant of brom thymol blue. This work involved measurements with the glass electrode and the pH colorimeter of the Hastings type at constant temperature. The results will be described when the work is more nearly completed.

Doctor Edward Walzl's Report

Johns Hopkins University

Many investigators have attempted to measure the changes in A. C. impedence which accompany contraction in muscle. Recently Bozler and Cole found that the low frequency resistance of frog sartorius muscle increases in contraction and in iodoacetate rigor (which is contrary to the results of some other workers); that the high frequency resistance remains unchanged; and that the phase angle remains unchanged (which seems to cast doubt on the change in selective permeability accompanying contraction assumed by current theories.)

During experiments on the effects of salts on the heart of the oyster, made at The Biological Laboratory the past few summers, it has been found possible to stop the heart in different degrees of contraction by perfusion with solutions of different salts. The heart can be held in the desired condition for several minutes, and then restored to normal beat.

It is hoped that measurement of the A. C. impedence of the heart

of this animal while it is stopped in different degrees of contraction will (1) give further information concerning the mechanism of the action of salts, and (2) show what changes in permeability accompany these effects. Therefore, after the course in Physiology was over, several weeks were spent in attempting to develop a technique for making these measurements. However, insufficient data have been obtained to present any conclusions at this time.

Elizabeth A. Whitaker's Report

Brown University

It has been shown by Ingle that starved Cladocerans have a greater longevity than those which are well fed. Three experiments were performed by the writer during the summer in an attempt to discover whether there is an optimum dilution of medium, as far as longevity is concerned, for the Cladoceran, **Moina macrocopa.** Dr. Banta's medium for Daphnids was used.

Groups of females were kept in different dilutions and longevity and number of young were recorded. No definite conclusions can yet be drawn from these experiments. Further work is being done this winter at Brown University on the same problem under the direction of Dr. Banta.

Doctor Charles A. Winter's Report

The University of Buffalo

The work which I did at Cold Spring Harbor this summer included the following:

(a) Observed swelling curves of muscles from normal and from adrenalectomized rats in hypotonic solutions;

(b) Continued some experiments already begun on pituitary-adrenal relationships;

(c) Studied phosphate diffusion in rat muscle, with the object of determining the relative volumes of cells and interspaces; this work was done in collaboration with Dr. Ponder.

Doctor Emil Witschi's Report

State University of Iowa

Dr. Emil Witschi and Dr. Carroll A. Pfeiffer have carried on investigations in the physiology of reproduction of the rat. Some of the experiments had been started in the Zoological Laboratories of the State University of Iowa.

A first series deals with "The Hormonal Control of Oestrus, Ovulation and Mating in the Female Rat."

Female rats which are continuously kept under the influence of follicle stimulating hormones exhibit the condition of "constant oestrus". Since they do not mate, ovulate nor form corpora lutea it is concluded that the

follicle stimulating hormone is not in control of these events which characterize full oestrus. Injection of luteinizing hormones from sheep hypophyses as well as from urine of pregnant women causes ovulation at any time within ten to twelve hours. Ovulation is followed by corpus luteum formation. The females develop their mating instincts and in case of successful mating, the eggs prove to be fertilizable. On the basis of experimental facts an interpretation of the oestrus cycle has been attempted.

Persons in Residence at the Laboratory in 1935
Including Members of the Staff
Investigators, Assistants, and Technicians

Abels, Jules—Ass't., fellow, chem., N. Y. Univ. Medical School.
†**Abramson, Harold A.**—Research and inst., ass't. prof. physiol., College of P. and S., Columbia.
Atchely, Dana W.—Ass't.
Bacon, Annette L.—Technical sec'y., biol. Temple.
Bernheimer, Alan—Research, grad. stud., Temple.
†**Blanchard, E. W.**—Research and inst., assoc. prof. biol., Bryn Mawr.
Blum, Harold F.—Research, ass't. prof. physiol., Univ. of California Medical School.
Brackett, F. S.—Research, Washington (D. C.) Biophysical Institute.
†**Cain, Stanley A.**—Research and inst., assoc. prof. bot., Univ. of Tennessee.
†**Castle, William A.**—Inst., ass't. prof. biol., Brown.
Climenko, David R.—Research, pharmacologist, Calco Chem. Co.
†**Cole, Kenneth S.**—Research and inst., ass't. prof. physiol., Columbia.
Cole, Robert—Research, grad. stud., Oberlin.
Conklin, Faith—Asst., undergr., Duke.
†**Corner, George W.**—Inst., prof. anatomy, Univ. of Rochester School of Medicine and Dentistry.
Cunningham, Bert—Research, prof. biol., Duke.
†**Curtis, Dorothy A.**—Secretary, Biol. Lab.
***Curtis, Howard J.**—Research, physicist, Biol. Lab.
Cuzzort, Elizabeth—Research, medical artist, L. I. College of Medicine.
†**Deery, Edward**—Glassblower, Bell Telephone Labs., N. Y.
***Fricke, Hugo**—Research, in charge biophysics, Biol. Lab.
***Gallagher, D. M.**—Research, radio engineer, Biol. Lab.
Gaunt, Jo Howland—Research.
Gaunt, Robert—Research, biol., Washington Square College.
Giese, A. C.—Research and inst., inst. biol., Stanford.
***Grout, A. J.**—Research and inst., bryologist, Biol. Lab.
***Harris, Reginald G.**—Director, Biol. Lab.
***Hart, Edwin J.**—Research, chemist, Biol. Lab.
Hinchey, M. Catherine—Research, grad. stud., Temple.
†**Howland, Elsa**—Ass't., undergr., College of Charleston.
Huene, Elizabeth—Ass't., undergr., Duke.
Janes, Robert P.—Research, grad. stud., Wisconsin.
†**Kalling, Edna**—Secretary, Biol. Lab.
Katzoff, Samuel—Research, grad. stud., Johns Hopkins.
Kaunitz, Paul—Ass't., N. Y. Univ. Medical School.
Keen, Maurice—Research, inst. biol., Temple.
***Klem, Dorothy**—Secretary, Biol. Lab.
Korr, Irvin M.—Research, fellow biol., Princeton.
Laity, Elsie—Research, grad. stud., Temple.

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* All-year Staff.
† Summer Staff or part time.
B: Bryology (Newfane, Vt.)
S. M.: Surgical Methods
G. P.: General Physiology
M. Z.: Marine and Fresh Water Zoology
P. S.: Plant Sociology

†**Lytle, Theodore**—Administration, grad. stud., Princeton.
*†**MacLeod, John**—Research, research ass't. general physiol., Biol. Lab.
Marshak, Alfred—Research, grad. stud., Harvard.
Mestre, Harold—Research, Yale School of Medicine.
Morris, Samuel—Research, inst. biol., Temple.
Moyer, Laurence—Research, fellow, Yale School of Medicine.
Mudd, Stuart—Research, prof. bacteriol., Univ. of Pennsylvania Medical School.
Osterhout, W. J. V.—Rockefeller Institute.
Penfound, William T.—Research and inst., assoc. prof. bot., Tulane.
Pfeiffer, Carroll—Research, New York Hospital and Cornell Univ. Medical College.
*†**Ponder, Eric**—Research, investigator in general physiol., Biol. Lab.
Rouse, Sylvia—Research, grad. stud., Bryn Mawr.
Schaeffer, Asa A.—Research, prof. biol., Temple.
Singer, Edward—Research, St. Clare's Hospital, N. Y.
†**Smith, Lily K.**—Stenographer, Biol. Lab.
Smith, T. L.—Research, prof. biol., Ozarks.
†**Spieth, Herman T.**—Research and inst., inst. zool., College of City of New York.
Stoudt, Harry—Research, inst. biol., Temple.
†**Taylor, I. R.**—Research, and inst., ass't. prof. physiol., Brown.
Tobin, Charles E.—Research, biol., College of Charleston.
*†**VanOlinda, Ruth E.**—Ass't., Biol. Lab.
Walzl, Edward—Research and inst., fellow biol., Johns Hopkins Univ.
Whitaker, Elizabeth—Research, grad. stud., Brown.
Winter, Charles—Research, inst. physiol., Univ. of Buffalo School of Medicine.
†**Witschi, Emil**—Research and inst., prof. zool. and experimental embryology, State Univ. of Iowa.
Yeakel, Eleanor—Research, grad. stud., Bryn Mawr.

Students

Anderson, Edward—G. P., grad. student, Brown.
Avis, Frederick—G. P., grad. student, Brown.
Barrett, Harold—G. P., undergr., Brown.
Bojar, Samuel—G. P., undergr., Brown.
Bookman, John—S. M., grad. stud., Brown.
Burdick, Donald—S. M., inst., Albany Medical College.
Chertoff, Muriel—G. P., undergr., Pembroke.
Creighton, Margaret—M. Z., grad. stud., Connecticut College.
Fink, Kenneth—M. Z., undergr., Princeton.
Fraad, Daniel, Jr.—S. M., grad. stud., Brown.
Gilder, Helena—S. M., grad. stud., Vassar.
Greenwald, Beatrice—G. P., undergr., Bryn Mawr.
Haring, Inez M.—B., grad. stud., Vassar.
Heyen, Adelaide—M. Z., grad. stud., Adelphi.
Huene, Elizabeth—M. Z., undergr., Duke.

Huntington, Margaret—G. P., undergr., Swarthmore.
Klapper, Clarence—S. M., inst. and grad. student, Cornell.
Kosovsky, Arthur—S. M., undergr., Washington Square.
Lloyd, Charles—S. M., undergr., Princeton.
MacQuigg, Rodger—S. M., undergr., Princeton.
Marino, Marie—M. Z., undergr., Alfred.
Mathewson, John—M. Z., undergr., Brown.
McCullough, Herbert—P. S., grad. stud., Pittsburgh.
McGee, Hall T.—S. M., grad. stud., College of Charleston.
Noyes, Barbara—M. Z., grad. stud., Randolph Macon.
Orloff, Arthur—G. P., undergr., Rutgers.
Pfeiffer, Carroll—S. M., New York Hospital and Cornell Univ. Medical College.
Preston, William—G. P., grad. student, Harvard.
Schoepfle, Gordon—M. Z., undergr., DePauw.
Shola, Nicholas—G. P., grad. stud., Brown.
Steck, J. Reynold, Jr.—P. S., grad. stud., Pittsburgh.
Sussman, Louis—S. M., grad. stud., South Dakota.
Winokur, Morris S.—S. M., inst. and grad. stud., College of City of New York.
Wright, George W.—M. Z., inst., Richmond Hill H. S.