LONG ISLAND BIOLOGICAL ASSOCIATION

ANNUAL REPORT
OF
THE BIOLOGICAL LABORATORY

COLD SPRING HARBOR
LONG ISLAND, NEW YORK
1934

LONG ISLAND BIOLOGICAL ASSOCIATION

INCORPORATED 1924

ANNUAL REPORT

OF

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FORTY-FIFTH YEAR

1934

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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 1934.

The Biological Laboratory has made valuable contributions to advance in biology through

1. The establishment of a laboratory for research throughout the year in physiology.

2. The maintenance in the laboratory for biophysics of research concerning the physicochemical basis of the biological action of X-rays, and the electrical properties of living cells.

3. The continuance of the practice of arranging and holding conference-symposia during the summer on an important aspect of biology, calculated to advance biology by evaluating and consolidating recent gains on that front. Publishing and distributing the results of the conference-symposia, which this year were concerned with normal and abnormal growth, and constitute Volume II of Cold Spring Harbor Symposia on Quantitative Biology.

4. The giving of financial aid in a compilation of knowledge in bryology.

5. Extending the facilities of the Laboratory for research and study during the summer, to some eighty-five professors and advanced students from about forty-five institutions.

Research in Physiology

For some time we have felt that we should establish here a laboratory for physiology. This was partly because of the results of research which would be likely to come from such a laboratory, and partly because of the value which such a laboratory would have for the work in biophysics and for the work of the Biological Laboratory as a whole. We had delayed action because neither the money nor the right man seemed to be available. Late last year, however, it appeared that a suitable man was interested in the possibilities. The matter was presented to the Scientific Advisory Committee at its December meeting. The last paragraph of the Committee's report for 1933 follows: "The Committee also urges that the Laboratory take steps as soon as possible to carry on work in physiology on an all-year basis. It is believed that by doing this the Laboratory will not only strengthen its all-year work, but will be in a better position to be of service to the increasing number of physiologists who come to the Laboratory during the summer." This report was written with a specific man in mind. That man is Doctor Eric Ponder.

* The Long Island Biological Association is composed of lay members and of biologists. The report of the director is written for lay members. Biologists should refer to the reports of individual workers, following the director's report.

Doctor Ponder* was subsequently appointed to establish, and be in charge of, a small laboratory for research in physiology. By a special arrangement with Doctor Ponder, and with New York University, he began his work at the Laboratory in the spring of this year. He is assisted by Mr. John MacLeod.

The work of the laboratory for physiology has been concerned largely with studies of blood cells, during the first seven months of the laboratory's existence. This is wholly natural, as Doctor Ponder's outstanding contributions to biology have been in the field of the physiology of blood cells.

Blood cells have been particularly useful as material in studies of cellular physiology. For example, let us consider the way in which a cell actually functions within the body.

A cell was so named because it has a wall around it. Like all walls, when functioning properly, the cell wall, or membrane, keeps certain things in, and keeps certain things out. A wall may be an extremely important controlling agent of the nature and function of whatever is within it. Thus, if we have a young women's seminary within a wall, we open the gates, let out all of the young women, let in an equal number of old men, we no longer have a young women's seminary, but we now have an old men's home.

The red blood cells are also surrounded by a wall (cell membrane). They live in a busy thoroughfare, the blood, which is crowded with chemicals of various kinds in gaseous form and in solution. But the red blood cells have definite functions to perform. They have a characteristic structure and composition which allow them to perform these functions. If all chemicals in the blood could pass into, and out of, the blood cells with freedom, the cells would no longer have their characteristic structure and content, and could no longer perform their characteristic functions. Now sometimes that very thing happens. In certain diseases, in cases of poisoning by certain snake venoms, and in other instances, the cell membrane of the red blood cell ceases to function as a selective membrane. Substances pass into and out of the cell freely. The cell loses its function and shows indications of injury or of death. This makes the study of red blood cells very interesting and useful. But the fact which makes the cell membrane of red blood cells of the greatest interest to biologists is that essentially every living cell in the world exhibits this same type of phenomenon: a fish's egg or the cell of an alga in the ocean or in a lake, all the cells of our bodies, all the cells of any animal body, the root tip of a plant in the ground, the cells of a flower in the greenhouse, bacteria in a test tube.

Obviously the membrane of red blood cells will not provide the

* Doctor Ponder was, at the time of his appointment, Professor of Physiology at Washington Square College, New York University. He holds the doctor's degree in medicine and in science from the University of Edinburgh, where he instructed, and conducted research, in physiology previous to coming to the United States. Doctor Ponder is the author of a textbook on physiology (Longmans, Green & Co. 1929), and a book on haemolysis (The Mammalian Red Cell and the Properties of Haemolytic Systems. Protoplasma Monograph 1934), in addition to many articles which appear in scientific magazines. He is an associate editor of the Journal of Experimental Biology. Previous to his appointment to the staff of the Laboratory, Doctor Ponder had for some time been collaborating with Doctor Fricke in part of his work.

answer to the problem of selective permeability in all cells, but enough work has already been accomplished on the red blood cells to show that they provide excellent material for certain studies.

Work in Physiology This Year

Doctor Ponder and his associates have conducted work dealing with the absorption and utilization of various active agents during injury (hemolysis) and destruction (stromatolysis) of the membrane surrounding red blood cells. As a result of these studies he finds that, "Perhaps the most interesting point which emerges from the quantitative study is the fact that complete haemolysis corresponds to the disappearance of a certain fixed quantity of lysin (the active agent causing haemolysis), irrespective of the quantity initially added to the system"; and that "the fundamental process involved in haemolysis and stromatolysis is a combination of the lysin with the cell membranes, this resulting in an ultimate disintegration of the latter."

In other work on the red blood cells it was "found that any condition in which the cell is injured, even slightly (....), results in a loss of salts, and in less swelling than would occur by reason of water intake alone."

Studies were made upon white blood cells (polymorphonuclear leucocytes), which demonstrated the sequence of their early development, and the fact that the number of white blood cells in a person differs with geographical locality. Describing this fact, Doctor Ponder says, "'High' counts are customarily associated with health, and 'low' ones with infection, but counts made on the blood of people from different countries show variations which are statistically significant, even although the persons are selected as being 'normal' in the ordinary physiological or clinical sense. Thus the highest counts are met with in Australia and Florida, which is perhaps not surprising considering the healthy climate, but also in Wigan, which, being an unpleasantly situated industrial town in England, makes the influence of climate and environment less obvious. The lowest counts are met with in Greece, China, Japan, and, curiously enough, New York City. What the significance of these geographical variations may be we do not know, but the fact that they occur is very interesting, for variations in the polynuclear count imply variations in the life history of the white cells."

Collaboration in Physiology and Biophysics

In the work on the physiology of red blood cells we have an excellent example of the type of cooperation in which the Biological Laboratory is particularly interested. The problem of finding out fundamental facts about the red blood cell, its structure, function, other aspects of its life, injury and death, is at times physiological, at times physical, and at times both physiological and physical. The problem is so handled at the Biological Laboratory, with close collaboration in those aspects which are both physiological and physical, between Doctor Fricke and his co-workers and Doctor Ponder and his assistant.

The very existence of a membrane surrounding the red blood cell was established by Doctor Fricke as a result of physical research; a study of the electrical properties of red blood cells. The membrane cannot be seen with the naked eye, or even through the microscope. Its presence and thickness have been established by results of measurements of electrical capacity and resistance which cannot be satisfactorily accounted for in any other way than by assuming the presence of a membrane about one molecule in thickness. Thus, in a sense, the measurement of electrical properties of cells becomes a sort of supermicroscope by which we can "see" structures that are not visible even with the aid of the best developed microscope.

Let us consider another example. As a result of physiological studics we know that when red blood cells are placed in aqueous solution in which the concentration (tonicity) of substances is less than that within the cell, the cell takes into itself water, and gives out other substances. The mass of the water which it takes, is, however, greater than the other substances which it gives. The result is that the cell enlarges and the membrane surrounding the cell stretches. We have found from electrical measurements that the membrane does not become thinner as it stretches (at least not under certain conditions). Hence we assume that it is being constantly repaired; and knowing the original thickness of the membrane and the fact that it has not changed its thickness, we can "see" molecules rushing to the repair of the membrane as fast as it stretches (providing the stretching is not too fast or too great).

This matter of stretching of the membrane is intimately connected with injury and death of a cell, and with fundamental properties of cell membranes. It is one of the problems upon which research is being conducted at the Laboratory at the present time.

An important aspect of work in biophysics and in physiology is the apparatus with which the work is conducted. The extent to which experimental results may be analyzed, depends, in large measure, upon the suitability and accuracy of the apparatus. Unfortunately, for much modern research in physics, it is not possible to choose from a commercial catalogue pieces of apparatus which one has only to place in the laboratory and then begin his researches. Nearly always the apparatus must be designed by the man who wishes to use it, and then constructed under his direction. Even under these conditions the apparatus is usually not wholly suitable after it is completed. Certain needs can be detected only under the conditions of the experiments. Consequently, some apparatus in use is being almost constantly improved. This results in the fact that a laboratory which has been conducting research for some time in a given aspect of physics can probably do the work better than any other laboratory. It accounts, to an appreciable degree, for the speed with which findings come from such laboratories as that of Doctor Millikan at California Institute of Technology.

Now this very thing is true of our laboratory for biophysics. The apparatus for the study of electrical properties of cells has been frequently improved in the last six years until we can now conduct the type of work we are doing probably better than any other laboratory.

Legends for Figures

Figure 1

Corner of room in the George Lane Nichols Building. The apparatus under the right window is a large water bath in which the rate of haemolysis of red blood-cells by destructive agents is measured. To its left is a "Stufenphotometer," which measures the amount of light which passes through suspensions of various kinds of cells. As most cells are opaque to light, the light which is cut off by a suspension depends largely on the number of cells present, and by observing the amount of light which passes through we can tell, from moment to moment, how many cells remain intact under the action of a destructive agent, and how many have been destroyed. The microscope-like apparatus shielded by the box in front of the centre window is a diffractometer of a new design, by means of which the average size of millions of cells can be found within a few seconds. The principle on which this apparatus works is the same as governs the production of halos around the moon on a foggy night, when the size of the colored halos depends on the size of the fog particles. In the apparatus a powerful mercury arc replaces the moon, and a film of cells replaces the fog particles; by looking down the telescope of the apparatus, one sees a number of circular rainbow-colored halos, the size of which depends on the size of the cells in the film, and so the latter can be immediately measured with great accuracy.

Figure 2

Water bath and sets of micro-respirometers. These respirometers consist of two small bottles joined by a very fine tube in which there is a freely moving drop of oil, like a piston. The cells (white or red blood-cells, or muscle cells, etc.) are placed in one bottle, and as they use up oxygen the amount of gas in the bottle becomes smaller, and the drop moves along the tube at a rate corresponding to the rate at which the oxygen is used up. In this way the rate of breathing of the cells can be measured under various conditions, and the effect of injury, X-ray treatment, radiation with ultra-violet light, etc., on their breathing can be found. Certain of these cells ingest small particles, such as bacteria, and when they do so their breathing rate changes; this also can be studied with such apparatus, and so something can be found out regarding the way in which the metabolism of the cells is affected by the entry of bacteria, etc., into them. A very interesting problem is to compare the effects of injury on the rate of breathing of cells, with the effects on their electrical properties. As the slightest change of temperature causes the gases in the bottles to contract or expand, the respirometers require to be kept in a water bath at a very constant temperature, and shaken to and fro continually.

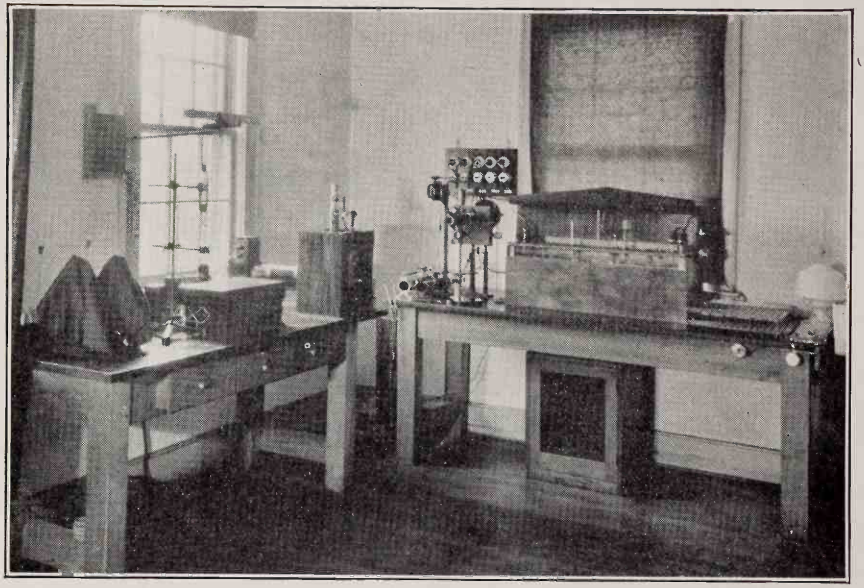
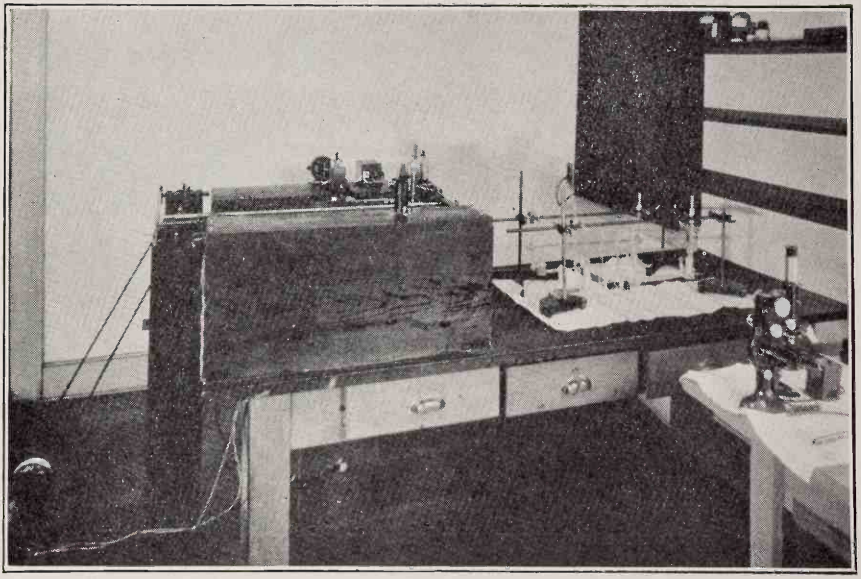


Figure 1



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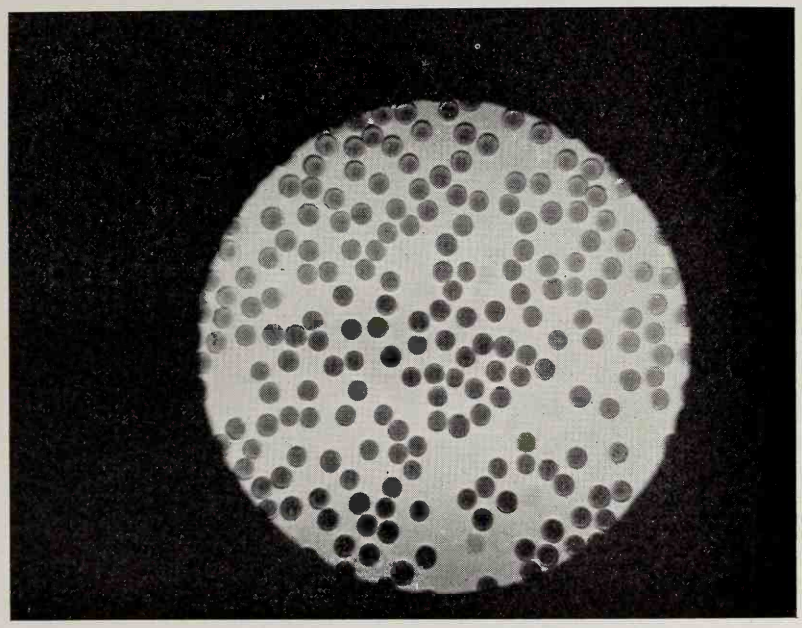

Figure 3

Figure 3

Photograph of red cells, from which their average size can be found directly instead of indirectly by use of the diffraction apparatus. Each cell, measured across its diameter, is only about ten times the wave length of light, and so the edges have to be very sharp in order for accurate measurements to be obtained. It is very difficult to obtain photographs of the necessary degree of sharpness, and even under the best conditions only a few of the cells on each plate are sharp enough to measure. In order to measure 1000 cells, one has to expose about 200 plates, which takes, at least, 3 hours; by diffraction, however, one can find the average diameter of from 100,000 to 1,000,000 cells within thirty seconds. When in the blood stream, these cells are flattened, somewhat like coins with depressions in the middle on both sides, and this peculiar shape makes mathematical work on them very complicated. To simplify things, we frequently change these flattened cells into spheres, and it is these spherical forms which are shown in the photograph. Work both on volume changes and electrical properties is very difficult when the cells are flattened discs, and much more exact information can be obtained when the peculiar shape is eliminated.

(Photograph, at 580, with blue light, N. A. 1.1, sine condition fulfilled. Limit of resolution, 0.2u. Method of Ponder and Millar).

It was primarily because of the importance of tested apparatus in research that we were so happy to make arrangements with New York University to obtain the apparatus with which Doctor Ponder had been conducting his research at that University for the last several years.* The result was that, although our laboratory for physiology is but recently established, it already has the advantages of a laboratory which has been in operation for some years. The laboratory for physiology is located in the George Lane Nichols building.

Biophysics

The research being conducted in the Doctor Walter B. James laboratory for biophysics continues to be concerned with two fundamental questions. One is the electrical properties of cells; the other is a systematic study of the chemical changes produced by X-rays in aqueous solutions of chemicals.

The work dealing with the electrical properties of cells has been mentioned already in this report under the heading: Collaboration in Physiology and Biophysics. Only a few additional remarks are needed. The work on the permeability of red blood cell membranes has been supplemented this year by studies conducted on yeast cells and upon artificial membranes. As a result of the work Doctor Fricke reports, in respect to cell membranes, that: "Measurement at low frequencies (....) provides a method for determining the true ionic permeability of the membrane."

It will be remembered that the basis of the work concerning chemical changes produced by X-rays lies in our belief of the pressing need and importance of systematic studies of the effects of X-rays upon relatively simple substances. In these systematic studies, we have now arrived at X-raying aqueous solutions of a number of organic compounds. These compounds, as well as other details of the results of the work in biophysics this year, are listed in Doctor Fricke's report which is included in the reports of individual workers following the director's report. Doctor Fricke reports that very great differences are found in the sensitivity to X-rays of the different chemicals thus far tested. "The effects studied are all such as are caused by the primary activation of the water by the X-rays, and while effects due to the direct action of the rays on the organic matter of the cell presumably play a role in the biological effects of the rays, it appears reasonable to expect that the former type of activity is at least of equal importance. With respect to the latter, the results so far obtained seem to indicate the possibility of simpler conditions than one might have expected."

Doctor Fricke is assisted in his researches by Doctor Howard J. Curtis, physicist, Doctor Edwin J. Hart, chemist, D. M. Gallagher, radio engineer, and certain part time workers, such as Frank Brink, Jr., who was recipient of one of the John D. Jones Scholarships last summer.

* These arrangements were made possible largely through the excellent scientific attitude of Professor Charipper, head of the Department of Biology of Washington Square College.

Conference-Symposia on Quantitative Biology

If research in biology is worth the full or partial time and effort of some eight or nine thousand biologists, men and women, (not to mention assistants and graduate students) in this country alone, and if it is worth the expense involved in the wages, equipment and supplies required by this army in its work, it is worth the most serious effort to obtain the greatest possible value from the time and apparatus available. To help in the accomplishment of this is the real purpose of the Cold Spring Harbor Conference-Symposia.

It is obviously impracticable to attempt to forward this purpose by direct contact with all of the workers. Furthermore, the divergent interests and knowledge of even 400 or more leaders of biology (starred in American Men of Science), as well as their number, makes a hypothetical conference of all of these men each year of very slight promise indeed. The prerequisite for success in any conference is a relatively small number of participants, and a community of interests.

Now it happens in modern biological research that the problem of a given biologist, or group of biologists, may have much more in common with that of a given chemist or physicist, or small group of either, than with that of a second group of biologists. Every day examples of the truth of this assertion are numerous. Yet the meetings of the various learned societies in this country still fail to take this into account. The conference-symposia at Cold Spring Harbor give very great attention to this fact. Indeed, the primary motive of the conference-symposia is to consider a given biological problem from its chemical, physical and mathematical, as well as from its biological aspects. It is common knowledge than any living organism, or life process, includes physical, chemical and biological phenomena with utter disregard of any artificial boundaries of the disciplines which man may have erected. At Cold Spring Harbor we are restoring to the consideration of life processes those branches of knowledge which have always actually been represented in the phenomena of life and death.

To what extent we are succeeding in doing this may be judged from the fact that among last summer's participants in the conference-symposia there are 2 mathematicians, 5 physicists, 5 biophysicists, 3 physical chemists, 2 chemists,* 1 biochemist, 1 physiological chemist, 8 physiologists, 2 pharmacologists, 8 biologists, 7 zoologists, 3 anatomists, 1 cytologist, 1 embryologist, 7 geneticists, and 2 bacteriologists. It is interesting to note that at large scientific meetings these men would be dispersed into at least nine different section meetings. Some of these nine section meetings would be further subdivided into as many as three simultaneously meeting groups.

In the conference-symposia this year we considered aspects of normal and abnormal growth. Twenty-six men presented thirty-one papers

* One of these chemists received the Nobel Prize in Chemistry this year. While we do not wish to stress this fact unduly, it perhaps may be used as an indication of the type of men taking part in the conference-symposia.

which were discussed by fifty-eight participants. These numbers are slightly larger than those of 1933, when sixteen men presented twenty-one papers on surface phenomena, which thirty-one participants discussed. In Volume I of Cold Spring Harbor Symposia on Quantitative Biology, resulting from the conference of 1933, some 30,000 words of discussion, in addition to the more formal papers, were printed. This year over 60,000 words of discussion are included in Volume II. Of course, much of the discussion which takes place at a given meeting is not included in the printed volume. Indeed, it is probably true that the carefully edited discussion as finally published represents only about half of that recorded by the reporter. The discussion is considered of great value as providing an extensive and critical examination of each paper. Furthermore, the discussions offer an opportunity to place before colleagues work in progress and ideas in formation which one would hesitate to include in a formal presentation.

In short, while we know that Cold Spring Harbor Symposia on Quantitative Biology are concerned with only a part of the whole of biology in any given year, we do find that the experimental method involved is working out to great advantage, and we are well pleased with the results of the second year. That this point of view is shared by others is indicated by the fact that no outside support was granted the conference-symposia the first year. For this, the second, year the Rockefeller Foundation gave $5,000 for their support. For 1935 a grant of $7,000 has been made by the Foundation for the symposia.

Bryology

Volume III, party 4 of the "Moss Flora of North America North of Mexico," together with the index completing Volume III, was published in August. Part 4 contains 99 pages and 36 full page plates. For further details of progress of the work, see Dr. Grout's report.

Dr. Grout continued to receive research students in bryology at his laboratory in 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: electrical charges on the surfaces of the skin; the electrical charge of bacteria during agglutination; electrical resistance and reactance of frog muscle at frequencies of from 1 to 1,000 kc.; change in electrical impedence of nerve during activity; development of polymorphonuclear leucocytes in the blood stream; colony differences in the survival of adrenalectomized rats; effect of salt-treatment on survival of adrenalectomized rats; lactation in adrenalectomized rats; the genital-pituitary pathway in the rabbit; cryptorchidism and the prob-

lem of unity or duality of testicular hormones; the gill of the oyster; the development of a new mutant character, shaker-short, in the house mouse; rate of haemolysis of mammalian red blood cells suspended in hypotonic solutions of non-penetrating electrolytes; the action of ions on the heart of the oyster; the development of the melanophores of **Triturus torosis;** effect of adrenalectomy upon the Δ of the blood of cats; effect of monochromatic light upon the pigment response of **Palaemonetes;** evolution of the Odonata wing; studies on the lamprey eel; gemmipary in plants; and structural twists in spirochaetes and barnacles.

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, six were already professors or instructors in colleges and held doctor's degrees in medicine or science; nineteen were graduate students or graduate assistants and students, and nine were specially recommended undergraduates.

The course in general physiology has been greatly benefited by important equipment purchased from the Carnegie Corporation's grant of 1933. Under the resulting favorable conditions the course was reorganized under Doctor Taylor's direction so as to take advantage of the exceptional opportunities of instruction offered by all-year and summer research workers at the Laboratory. The staff of the class was enlarged to include Doctors Curtis, Fricke, Ponder, Messrs. Gallagher and MacLeod of the permanent staff, and Doctors Abramson and Cole among the summer workers, in addition to Doctor Taylor and Mr. Walzl, instructors of previous years. The result was that each man instructed that part of the course with which his regular research caused him to be outstandingly well acquainted. The method apparently worked so well that it will be continued next year.

Professor George W. Corner, of the School of Medicine and Dentistry of the University of Rochester was in charge of the course in Surgical Methods. He was assisted by Doctor Ernest Blanchard of Bryn Mawr. Four of the students in this course already held doctor's degrees. The personnel of instruction in the other courses remained unchanged.

List of Evening Lectures

Dr. Harold Abramson, Associate, Department of Bacteriology, Cornell University Medical College—"The Isoelectric Point and Its Relation to the Chemical Constitution of Cell Surfaces."

Dr. Ernest W. Blanchard, Associate, Department of Biology, Bryn Mawr —"The Adrenal Cortical Function as Related to Certain Factors of Resistance."

Dr. Calvin B. Bridges, Carnegie Institution of Washington—"Chromosomes and Linkage Maps in Drosophila."

Dr. George L. Clark, Professor of Chemistry, University of Illinois—"X-rays as Research Tools in Biology."

Dr. George W. Corner, Professor of Anatomy, University of Rochester School of Medicine and Dentistry—"The Present State of the Corpus Luteum Question." "Medicine in the Poems of Chaucer."

Dr. Howard J. Curtis, The Biological Laboratory—"The Electric Properties of Cells."

Dr. E. Carleton MacDowall, Investigator, Department of Genetics, Carnegie Institution of Washington—"Mouse Leukemia."

Dr. Stuart Mudd, Professor of Bacteriology, School of Medicine, University of Pennsylvania—"The Chemical Basis of Specificity."

Dr. Hans Mueller, Professor of Physics, Massachusetts Institute of Technology—"Cooperative Phenomena in Physics."

Dr. Eric Ponder, The Biological Laboratory—"The Factors Controlling the White Cell Count."

Dr. Otto Rahn, Professor of Bacteriology, Cornell University—"Revolution in the Taxonomy of Bacteria."

Dr. Victor C. Twitty, Assistant Professor, Department of Zoology, Stanford University—"Recent Studies on the 'Organizer' of the Amphibian Embryo."

Dr. Harold C. Urey, Professor of Chemistry, Columbia University—"The Preparation and Properties of Deuterium."

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 one thousand 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.

Much attention is being given to the building up and maintenance of our collection of authors' reprints. These now number oven ten thousand, all of which are catalogued according to authors.

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-four 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, Alabama University School of Medicine, Alabama Polytechnic, Barnard, Bellevue Hospital Medical School, Biological Laboratory, Boston University Medical School, Boyce-Thompson Institute, Brooklyn, Brown, Bryn Mawr, Carnegie Institution of Washington, Charleston, Chicago, Clark, College of the City of New York, Columbia, Cornell, Cornell Medical College, Dartmouth, Duke, Gettysburg, Grinnell, Harvard, Illinois, Indiana, International Cancer Research Foundation, Iowa, John Hopkins, Louisville Medical School, Marietta, Maryville, Massachusetts' Institute of Technology, Memorial Hospital, National Institute of Health, New York, Oberlin, Ohio Wesleyan, Pennsylvania Medical School, Pennsylvania State, Physicians and Surgeons, Pittsburgh, Princeton, Quincy, Rochester Medical School, Rockefeller Institute (both the New York and the Princeton Laboratories), Stanford, Temple, Washington, Wesleyan, Wisconsin, Wyoming, Yale and Yale School of Medicine.

In addition to persons in residence, men communicated papers or discussion to the conference-symposia from the following institutions not listed above: Babies and Children's Hospital (Cleveland), Harvard Medical School (and the School of Public Health), Histologische Institut, I. Universitatem (Moscow), Lakinau Hospital, Swarthmore, The University (Leeds, England), and the University of London.

Volume I of Cold Spring Harbor Symposia on Quantitative Biology was sold in more than twenty-five different countries.

Acknowledgements and Recommendations

The work of the Laboratory could not have been so creditable this year had it not been for the generous support of the Rockefeller Foundation, the continued gifts of members of the Association, and of the Wawepex Society, the splendid work of the officers and members of the Women's Auxiliary, and the very helpful advice of laymen and scientists interested in the Laboratory, its maintenance and development.

In this latter matter, which is coimportant with the obtaining of money, the Laboratory is particularly grateful to Arthur Page, President of the Association, Mrs. Merle-Smith, President of the Women's Auxiliary, Acosta Nichols, John Roosevelt and others among the laymen, and to Doctor Davenport, Doctor Harrison, Doctor Osterhout, Doctor Urey and others among the scientists. In arranging the conference-symposia the advice of many others who are not members or officers of the Association has been of very great value.

Acknowledgment is made with thanks of a gift from Carnegie Insti-

tution of Washington of an herbarium, the collection of which was begun by Doctor Shull, containing about one thousand specimens from this region. The gift further includes a check list of the herbarium, metal-lined cases for its storage when not in use, and other useful adjuncts. Doctor Blakeslee, Acting Director of the Department of Genetics, conceived the plan and was active in carrying it through to completion, with the approval of Dr. Merriam, President of Carnegie Institution of Washington.

In giving, and helping to raise money, in addition to many of those mentioned above, we wish to express our appreciation to Marshall Field, Wilton Lloyd-Smith, and John Schiff. Indeed, the time and money of so very many people go into making the Laboratory what it is, that the Laboratory takes, from this fact alone, a unique place among biological laboratories in this country.

The scientific work of the Laboratory is now unquestionably of the highest order it has ever yet attained. Every active member of the Association may have justifiable pride in its accomplishments. Two important needs exist: a fire proof library building with the consequent building up of a more nearly adequate scientific library, and the establishment of a small all-year laboratory for biochemistry. The first of these, the library, should be provided as soon as possible. Our Scientific Advisory Committee recommends it most urgently. The second, the all-year laboratory for biochemistry, should be established as soon as a suitable opportunity arises. With the carrying into effect of such recommendations, the Association will be continuing its excellent work of the past ten years, by not only providing for the maintenance, but also for the proper development, of the Laboratory.

Reginald G. Harris.

Report of Scientific Advisory Committee

The Scientific Advisory Committee wishes to congratulate the Laboratory upon putting into effect in 1934 the Committee's outstanding recommendation of December 1933. We refer, of course, to the establishment of an all-year laboratory for research in physiology, and the appointment of Doctor Ponder to the post thus created.

The Committee is likewise pleased with the accomplishments of the second year of Cold Spring Harbor Symposia on Quantitative Biology.

As we survey the development and prospects of the Laboratory, many needs become apparent. It is rather difficult to say which of these is the most pressing. It seems likely, however, that the need which is most generally felt by all scientific workers at the Laboratory is for a better library and for adequate housing for a library such as the Laboratory should have. If this need were met, it would be of very great benefit to all members of the all-year staff, to summer workers, and to participants in the conference-symposia, indeed to the whole scientific community at Cold Spring Harbor. Partly as a result, and in answer to the needs, of the conference-symposia, the Laboratory has already built up a valuable collection of well over eight thousand separates. This collection, we understand, is now growing at the rate of about two thousand per year. The collection of current and bound periodicals is also constantly enlarging. The value of all of these sources of reference is such that they should be housed in a suitable fireproof building. The providing of such a building would have the further great value of releasing, for use as laboratories, three rooms in the George Lane Nichols Memorial where the library is now.

This need of the Laboratory has existed for many years, but has become increasingly acute of late, with the result that we now feel that the time has come for the Laboratory to make every effort to obtain the money necessary to its fulfillment.

J. H. Bodine,
Chairman.

THOSE TAKING PART IN SYMPOSIA AND IN DISCUSSIONS
(1934)

Abramson, Harold A.—Associate in Bacteriology, Cornell University Medical College.

***Astbury, W. T.**—Lecturer, Textile Physics Laboratory, The University, Leeds.

Banta, A. M.—Professor of Biology, Brown University.

***Barnes, T. Cunliffe**—Instructor in Biology, Yale University.

Bernstein, Felix—Visiting Professor, Mathematical Statistics, Columbia University.

Borodin, D.—Independent Investigator, Washington, D. C.

Chalkley, H. W.—Physiologist, Division of Pharmacology, National Institute of Health, Washington, D. C.

Clark, G. L.—Professor of Chemistry, University of Illinois.

Climenko, D. R.—Lecturer in Pharmacology, Cornell University Medical College.

Cole, K. S.—Assistant Professor of Physiology, College of Physicians and Surgeons, Columbia University.

***Copenhaver, W. M.**—Assistant Professor of Anatomy, College of Physicians and Surgeons, Columbia University.

***Darby, Hugh H.**—Guest Investigator in Physics, Bartol Research Foundation, Swarthmore.

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

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

Farr, Wanda K.—Associate Cotton Technologist, United States Department of Agriculture, Boyce-Thompson Institute.

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

Fulton, MacDonald—Department of Biology, Brown University.

Gowen, J. W.—Associate in Biology, Rockefeller Institute for Medical Research, Princeton.

Gudernatsch, F.—Visiting Professor of Biology, Washington Square College, New York University.

***Gurwitsch, A.**—Director, Histologische Institut, I. Universitatem, Moskva, U. S. S. R.

***Hammett, F. S.**—Science Director, Research Institute, Lankenau Hospital.

Handford, S. W.—Department of Biology, Washington Square College, New York University.

Harris, R. G.—Director, Biological Laboratory, Cold Spring Harbor.

Harrison, R. G.—Professor of Biology, Yale University.

Henshaw, P. S.—Biophysicist, Memorial Hospital, New York.

Hoffman, Olive—Department of Biology, Washington Square College, New York University.

Hollaender, Alexander—Laboratory of Plant Physiology, University of Wisconsin.

* Discussion communicated by mail.

*Huxley, Julian—Fullerian Professor of Physiology, Royal Institution of Great Britain; Zoological Department, Kings College, University of London.

Jahn, Theo. L.—Instructor in Protozoology, Graduate School, Yale University (After September, 1934, Research Associate in Physiology, Department of Zoology, State University of Iowa).

Kornhauser, S. I.—Professor of Anatomy, Histology and Embryology, University of Louisville School of Medicine.

Longsworth, L. G.—Assistant, Physical Chemistry, Rockefeller Institute for Medical Research.

*Lorenz, E.—United States Public Health Service, Jefferson Physical Laboratory, Harvard University Medical School.

MacDowell, E. Carleton—Investigator, Station for Experimental Evolution, Carnegie Institution of Washington.

MacInnes, Duncan—Associate Member, Division of Physical Chemistry, Rockefeller Institute for Medical Research.

Marinelli, L.—Physicist, Memorial Hospital, New York.

McCurdy, Harriet—Department of Biology, Bryn Mawr College.

Mestre, Harold—Department of Bacteriology, Yale University School of Medicine.

Mudd, Stuart—Professor of Bacteriology, School of Medicine, University of Pennsylvania.

Mueller, Hans—Assistant Professor of Physics, Massachusetts Institute of Technology.

*Northrop, John H.—Member, Rockefeller Institute for Medical Research, Princeton.

Packard, Charles—Assistant Professor of Zoology, Columbia University.

*Park, Thomas—National Research Council Fellow in Zoology, Johns Hopkins University.

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

Rahn, Otto—Professor of Bacteriology, Cornell University.

Rashevsky, N.—Department of Physiology, University of Chicago.

Richards, Oscar W.—Instructor in Physiology, Osborn Zoological Laboratory, Yale University.

Riddle, Oscar—Investigator, Station for Experimental Evolution, Carnegie Institution of Washington.

Shedlovsky, T.—Associate, Division of Physical Chemistry, Rockefeller Institute for Medical Research.

Schram, Mildred W. S.—Secretary, The International Cancer Research Foundation, Philadelphia.

Stockard, Charles R.—Professor of Anatomy, Cornell University Medical College.

Twitty, Victor C.—Assistant Professor of Zoology, Stanford University.

Urey, Harold C.—Associate Professor of Chemistry, Columbia University.

* Discussion communicated by mail.

Voegtlin, C.—Pharmacologist Director, National Institute of Health, Washington, D. C.

***Wetzel, Norman**—Babies' and Children's Hospital, Cleveland.

***Wilson, Edwin B.**—Professor of Vital Statistics, Harvard School of Public Health.

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

Wright, Sewall—Professor of Zoology, University of Chicago.

Wyckoff, Ralph W. G. — Associate Member, Subdivision Biophysics, Rockefeller Institute for Medical Research.

• Discussion communicated by mail.

TABLE OF CONTENTS OF COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY, VOLUME II, (1934).

Introduction
Reginald G. Harris

The Structure of Liquids and Solids
Hans Mueller

The Principles of Crystal Growth
George L. Clark

X-Ray Studies of Protein Structure
W. T. Astbury

The Macromolecule and the Micelle as Structural Units in Biological Materials, With Special Reference To Cellulose
George L. Clark

Ultraviolet Microscopy as a Means of Studying Cell Structure
Ralph W. G. Wyckoff

Deuterium and Its Compounds In Relation To Biology
Harold C. Urey

Chemistry of Cell Growth I
Otto Rahn

Chemistry of Cell Growth II
Otto Rahn

Chemistry of Death
Otto Rahn

Natural Chemical Factors In Growth and Development
F. S. Hammett

Observations Concerning the Chemistry of Cell Growth and Division
C. Voegtlin

Amoeba Proteus as Material For the Study of Cell Growth and Cell Division
H. W. Chalkley

Specific Chemical Factors Influencing Growth and Differentiation
F. Gudernatsch

Factors Antagonizing the Thyroxin Influence on Differentiation
Olive Hoffman

The Gene and Its Role In Ontogeny
M. Demerec

Internal Constitution and Genic Factors in Growth Determination
Charles R. Stockard

The Gene as a Factor in Pathology
J. W. Gowen

The Genetics of Abnormal Growth in the Guinea Pig
Sewall Wright

Growth Correlations in Amphibia Studied by the Method of Transplantation
Victor C. Twitty

The Analysis of Growth as Illustrated by Yeast
Oscar W. Richards

Problems of Population Growth in the Protozoa
Theo. L. Jahn
Mathematical Analysis of Growth of Mixed Populations
C. P. Winsor
Physico-Mathematical Aspects of Cellular Multiplication and Development
Nicolas Rashevsky
Mathematics of Growth
E. B. Wilson
Critique of Curves of Growth and of Relative Growth
Charles B. Davenport
Growth and Decay
Felix Bernstein
Diffusion in Cell Models and Volume Changes Analogous To Growth
L. G. Longsworth
The Physico-Chemical Basis of Biological Radiations
Otto Rahn
Chemical-Physical Foundation of the Biological Activities of X-Rays
Hugo Fricke
The Effects of X-Radiation Upon Cell Growth and Structure
George L. Clark
Biological Dosimeters in Radiology
Charles Packard
Index

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

*†**Ballard, W. W.**—"Mutual Size Regulation Between Eyeball and Lens in **Amblystoma**".

*†**Blanchard, E. W. and H. M. McCurdy.**—"Origin of Melanoblasts in Early Embryonic Stages of **Triturus Torosis**, as Studied by the Dopa Technique."

Climenko, D. R.—See **Ponder.**

Curtis, H. J.—See **Fricke.**

***Fricke, Hugo.**—"Reduction of Oxygen to Hydrogen Peroxide by the Irradiation of Its Aqueous Solution with X-rays." Journal of Chemical Physics, vol. 2, pages 349 and 556, 1934.

"The Rate of Escape of Hemoglobin from the Hemolysed Red Corpuscle." Journal of General Physiology, vol. 18, page 103, 1934.

and H. J. Curtis.—"The Specific Resistance of the Interior of the Red Blood Corpuscle." Nature, vol. 133, page 651, 1934.

"The Electric Impedance of Suspensions of Yeast Cells." Nature, vol. 134, page 102, 1934.

"The Electric Impedance of Hemolysed Red Corpuscles." Journal of General Physiology (in press).

and E. J. Hart.—"The Transformation of Formic Acid by Irradiation of Its Aqueous Solution with X-rays." Journal of Chemical Physics, vol. 2, page 824, 1934.

"The Oxidation of Ferrous to Ferric Sulphate by the Irradiation of Its Aqueous Solution with X-rays." Journal of Chemical Physics (in press).

***Gaunt, Robert and J. H. Gaunt.**—"Survival of Adrenalectomized Rats After Cortical Hormone Treatment." Proceedings of the Society for Experimental Biology and Medicine, vol. 31, number 4, January 1934.

and C. E. Tobin.—"Effect of High Salt Diet on Survival of Adrenalectomized Rats." Proceedings of the Society for Experimental Biology and Medicine, vol. 32, number 1, October 1934.

Also see **Ponder.**

Gordon, A. S.—See **Ponder.**

***Harris, R. G.**—"The Biological Laboratory at Cold Spring Harbor." The Collecting Net, vol. IX, number 1, page 1, 1934.

Hart, E. J.—See **Fricke.**

Haterius, H. O.—"The Genital-Pituitary Pathway, Non-Effect of Stimulation of Superior Cervical Sympathetic Ganglia." Proceedings of the Society for Experimental Biology and Medicine, vol. 31, number 9, June 1934.

†**Kornhauser, S. I.**—"Malpighian Tubules of Anisolabis."

Marsland, D.—See **Ponder.**

* Reference made to the Laboratory in the title.

† Paper presented at the Annual Meeting of the American Association for the Advancement of Science held in Pittsburg.

McCurdy H. M.—See **Blanchard.**

***Ponder. Eric.**—"Relation of Red Cell Diameter and Number to Light Transmission of Suspensions." American Journal of Physiology (in press).

"Absorption of Simple Lysins at Cell Interfaces." Proceedings of the Royal Society, B, vol. 116, page 34, 1934.

"The Measurement of Red Cell Volume, VI. The Different Fragilities of the Red Cells of Different Animals." Journal of Physiology (in press).

"The Kinetics of Haemolysis." Physiological Reviews (in press).

"Length-Breadth Correlation in the Red Cells of the Trout." Quarterly Journal of Experimental Physiology, vol. 24, page 149, 1934.

and R. Gaunt.—"Swelling of the Muscles of Adrenalectomized Rats." Proceedings of the Society for Experimental Biology and Medicine, vol. 32, number 1, page 212, October 1934.

and D. R. Climenko.—"Development of Polymorphonuclear Leucocytes in the Blood Stream." Quarterly Journal of Experimental Physiology, vol. 24, page 289, 1934.

and A. S. Gordon.—"The Kinetics of Haemolysis in Taurocholate-cell-serum Systems." Proceedings of the Royal Society, B (in press).

and D. Marsland.—"The Escape of Haemoglobin from the Red Cell During Haemolysis." Journal of General Physiology (in press).

and E. J. Robinson.—"Measurement of Red Cell Volume. V. Behavior of Cells from Oxalated and from Defibrinated Blood in Hypotonic Plasma and Saline." Journal of Physiology, vol. 83, number 1, page 34, 1934.

"Escape of Potassium from Rabbit Red Cells in Hypotonic Solutions." Proceedings of the Royal Society, B, vol. 116, page 282, 1934.

Robinson, E. J.—See **Ponder.**

Tobin, C. E.—See **Gaunt.**

REPORTS OF RESEARCH WORKERS

Doctor Harold A. Abramson's Report
Cornell University Medical College
(Includes work of Miss Elsie Laity, Temple University)

Teaching: In connection with the course in General Physiology, a course in Surface Chemistry was developed. This course included not only the usual laboratory work in surface phenomena, but also was novel in that quantitative experimentation was offered in all aspects of electrokinetic phenomena. Thus, experiments on surface conductance, streaming potentials, electrophoresis, and electro-osmosis were designed to enable the student to make use of these methods of research.

Research: I. Miss Elsie Laity remained after the course was finished, and conducted a series of experiments on the electrification of the surfaces of the skin of the fingers. She developed a technique which enabled her to study the electrical charges on the surfaces of the skin of the index fingers by means of a differential method. She found, in confirmation of previous work, that the skin reversed the sign of the charge in acid solutions. This fact is of great importance in the study of the introduction of drugs through the surface of the skin either by simple application or by electrophoresis.

II. The writer of this report continued his calculations of the electrical charge of bacteria during the agglutination process by simple salts and immune sera, and presented these data to the Electrochemical Society. It was found, contrary to previous ideas entertained on this subject, that when simple salts act on bacteria to produce agglutination, the electrical charge actually increases, rather than decreasing. This means that there are, on the surfaces of organisms in contact with physiological salt solutions, rather large numbers of excess charges available for chemical reactions. Immune sera may either increase, decrease, or scarcely affect the charge incidental to agglutination.

Some calculations were made of the actual number of free electrons on the surface of the typhoid bacillus in simple salt solutions. This was estimated as about 300,000 electrons.

Doctor E. W. Blanchard's Report
Bryn Mawr College

I. Effect of adrenalectomy upon the Δ of the blood of cats.

In collaboration with Dr. Eric Ponder, of the Laboratory staff, a study of the tonicity changes of the blood of cats following unilateral and bilateral adrenalectomy was undertaken. The results obtained on a preliminary series of animals were so uniform and significant that the work is being continued this fall. The animals are being kept and operated at the laboratory at Bryn Mawr and the blood sent to Dr. Ponder at Cold Spring Harbor for examination. If the later results bear out the original findings a rather significant factor in the syndrome of adrenal insufficiency will be demonstrated: namely, a considerable drop in blood tonicity follow-

ing bilateral adrenalectomy, this change being of such magnitude as to offer a possible explanation for the often-described fluid shift which results in an increased fluid in the tissues with a simultaneous hemoconcentration.

II. Effect of monochromatic light upon the pigment response of **Palaemonetes.**

Initial experiments were undertaken in a study of the effect of monochromatic light of various wavelengths and intensities upon the pigmentation response of **Palaemonetes.** Due to shortage of material during the summer of 1934, no conclusive results can be drawn at the present time. It is planned to continue this work next season in an endeavor to determine the possible interrelation between wavelength and intensity as affecting the pigment pattern.

Doctor Emil Bozler's Report
The Eldridge Reeves Johnson Foundation for Medical Physics
University of Pennsylvania, School of Medicine

1. In collaboration with K. S. Cole, measurements of the resistance and reactance of frog muscles at frequencies from 1-1100 kc. were made. In experiments, which I had made at the Johnson Foundation, Philadelphia, it had been found that the impedance increases during the contraction. The same change occurs during the rigor produced by iodoacetic acid. As this condition lasts for an appreciable time, it could be investigated by the alternating current bridge. The results show that the low frequency resistance is approximately doubled in rigor. The infinite resistance is unchanged. The phase angle of the impedance element is also unchanged. As the volume concentration remains unchanged (no swelling) it is concluded that the impedance of the cell membrane is increased.

2. An attempt was made to demonstrate a change of the impedance of nerve during activity. This change, which would be expected from the membrane theory of nerve conduction, could presumably be more easily detected in non-myelinated nerves than in nerves with a thick myelin sheath. No positive result was obtained. In crab nerves, which were used for the experiment, the change is less than 1:20,000.

Doctor David R. Climenko's Report
Cornell University Medical College

During the summer of 1934, Dr. Ponder and I investigated the development of the polymorphonuclear leucocyte in the blood stream of the intact animal, thus providing direct evidence of the truth of an hypothesis which had heretofore been based entirely on indirect evidence. The essence of the hypothesis is that the leucocytes undergo a form of development in the peripheral circulation in which their nuclei, which are originally simple structures, progressively become bilobed, trilobed, quadrilobed, etc., as the cells grow older. The principle has been found to be of considerable practical importance to clinicians in the prognosis and diag-

nosis of certain pathological conditions, and to experimental haematologists as a guide to the activity of the leucogenic tissues.

The method, however, has suffered from the fact that no direct evidence has been available and the results obtained by its use have at times been questioned. Numerous attempts have been made to obtain such direct evidence, but all of them have failed; this failure has invariably been the result of the failure of the cells to undergo normal development under **in vitro** conditions.

Our experimental method was relatively simple; it consisted of stimulating the leucogenic tissues by means of an injection of nucleic acid, opening the abdomen, and isolating a length of the mesenteric vein from the rest of the peripheral circulation by means of ligatures. Samples of blood were taken from this isolated vessel and compared with samples from the peripheral circulation. This examination demonstrated that progressive development took place in the isolated vessel.

When this work was completed, a study was begun on the effect of a group of drugs containing the benzene ring on the leucogenic tissues, in the hope of elucidating the role that these substances play in the etiology of agranulocytic angina. This study is being continued in my laboratory in the Pharmacology Department of Cornell University.

Doctor Kenneth S. Cole's Report
College of Physicians and Surgeons
(Includes work of Robert H. Cole)

Electric Impedance of Frog Muscle.

The electric resistance and capacity of the frog sartorius muscle, relaxed and in isometric iodo-acetic acid rigor, have been measured at frequencies from one thousand to one million cycles per second on an alternating current Wheatstone bridge.

The measurements indicate that the membrane of the muscle fiber has a direct current resistance and an electrolytic polarization impedance. The increase of theses two quantities is the only electrical change found in rigor, and there is a reason to believe that the changes which take place in a normal contraction are similar.

From similar measurements on muscle in Ringer solution with varying amounts of iso-osmotic sucrose solution added, it was found that the membrane resistance and phase angle were apparently changed while the internal conductivity remained unaltered.

These results should assist in the formulation of the cell membrane mechanism, and when such a formulation is available, they should have an increased value in the analysis of muscle physiology.

Professor Henry S. Conard's Report
Grinnell College

The Botany Class, under the direction of Professors Conard and Sargent, continued its study of the plant associations of the region. Besides re-working the immediate vicinity, one trip was made to Montauk Point,

with important results. The four students in the class were the most advanced workers yet registered. One of them, Dr. Stanley A. Cain, has published several papers on Plant Sociology, and has sponsored similar publications by his students. His counsel on many phases of the work was invaluable. It was decided to prepare for immediate publication the growing manuscript on the Vegetation of Cold Spring Harbor. Miss Sargent assisted with laboratory work, and, as formerly, made the identifications in the more difficult groups, rushes, grasses, sedges, etc. Two students who had formerly been members of the class returned for special work for periods of two and three weeks respectively.

At the close of the term Professor Conard tendered his resignation from the Staff, with expressions of appreciation for the privileges and courtesies enjoyed during his several years of association with the Laboratory. He feels that other duties demand his attention. He will be continued for another year as a nominal member of the Staff in order to represent the Laboratory at the Sixth International Botanical Congress at Amsterdam, Holland, in September, 1935. Dr. Conard will present an invitation paper on "Climax Associations of Northeastern North America", based on his work at Cold Spring Harbor. He is presenting another paper, by invitation, at a conference on soil erosion at Iowa State College in November. The title will be "Mosses in Relation to Soil Erosion". A part of the work to be reported was done at The Biological Laboratory.

Doctor Hugo Fricke's Report

A study has been made of the chemical changes produced by X-raying the aqueous solutions of a number of organic compounds, including methyl, ethyl and propyl alcohols, acetaldehyde, propylaldehyde, acetone, the saturated straight-chain monobasic acids from formic to octaic, isobutyric and isovaleric acids, alpha-hydroxy-isobutyric acid, oxalic, malonic and succinic acids, tartaric acid, allyl alcohol, fumaric and maleic acids, benzene, benzoic acid, dextrose, glycin, urea, creatin and serum proteins. The influence of oxygen, of the hydrogen ion, and of certain other ions has been determined. While in certain cases (for example, formic and oxalic acids) the X-rays cause a complete or partial decomposition of the organic compounds, leading to the production of carbon dioxide, generally the first effect of the rays in a gas-free solution consists in an attachment of the oxygen of the water to the organic molecule. Very great differences are, however, found in the sensitivity of different chemicals to the X-rays. The effects studied are all such as are caused by the primary activation of the water by the X-rays, and while effects due to a direct action of the rays on the organic matter of the cell presumably play a role in the biological effects of the rays, it appears reasonable to expect that the former type of activity is at least of equal importance. The results so far obtained seem to indicate the possibility of simpler conditions than one might have expected.

Work has also been carried out on the oxidation of certain inorganic ions, including the ferrous, the nitrite, and the sulphite ions, the stannous and the mercurous ions being added now. A rather complete study has

been made of the oxidation of the ferrous ion, extending work carried out several years ago.

A continuous improvement in the accuracy with which the electric impedance of cell membranes can be measured, is being made. For the red corpuscle and for the yeast cell, the membrane impedance is found to be due, at high frequencies, to the static capacitance of a surface membrane, at low frequencies, to the polarisability of the conductance current through the membrane. Measurement at low frequencies thereby provides a method for determining the true ionic permeability of the membrane. By this method, a study of hemolysed erythrocytes showed that lysins (water, saponin, complement amboceptor in low concentration) cause an increase in the permeability of the membrane, while its static capacitance remains unchanged. As the concentration of saponin is increased, the permeability of the membrane increases, until a certain point is reached where the complete disintegration of the membrane takes place. At present, we are engaged in a study of the changes resulting from such injuries of the corpuscle membrane, which are not intense enough to result in lysis.

Work has also been carried out on the polarisation of artificial membranes, and theoretical work on membrane potentials.

During the summer, a course in biophysics was given to the students in the General Physiology course by Dr. H. J. Curtis, Mr. D. M. Gallagher, and Mr. E. Victoreen.

In cooperation with the laboratory, Dr. F. Hollander of the Dental School, Columbia University, is working out a method for determining the calcium content of sections of teeth, by X-ray absorption measurements.

(Doctor Fricke's publications are included in the list on page —.)

The Report of Professor Robert Gaunt, Jo Howland Gaunt and Charles E. Tobin College of Charleston

Our work was concerned with a study of three phases of the general problem of **Adrenalectomy in the Rat.**

I. Colony Differences in the Survival of Adrenalectomized Rats. Previously one of us had presented evidence to indicate that one reason for the great diversity of results found by different investigators concerning the survival of adrenalectomized rats, was the fact that colonies of rats differ, in some intrinsic way, in their susceptibility to adrenalectomy. This hypothesis was further substantiated by the study of the survival of rats sent to us by Dr. J. T. Lewis of the Instituto de Fisiologia, Buenos Aires. 65% of these animals survived adrenalectomy if operated after maturity. 12.5% survival is the highest we have ever obtained in an untreated series of animals from our colony. The Lewis-strain animals succumb, however, in about 95% of the cases (as do those of our colony) if adrenalectomized at 30 days of age.

II. Effect of Salt-Treatment on Survival of Adrenalectomized Rats. It has been demonstrated that salt or salt solutions will palliate temporarily the symptoms of adrenal insufficiency in the dog and in the cat, and

in cases of Addison's disease. Rubin and Krick stated that a solution resembling Ringer's solution, given adrenalectomized rats to drink, kept them alive indefinitely, i. e., substituted for the cortical hormone.

We tried the oral administration of the Rubin-Krick solution, and normal saline solution, together with, in some of the cases, an increased amount of NaCl in the dry diet. We also used in some cases intraperitoneal injections of normal saline (10 c.c. a day). The general conclusions follow:

(1) All the methods of treatment were helpful, in some of the cases, in delaying fatal adrenal insufficiency, at least for the 30-day period of treatment. No one method of treatment was strikingly more effective than another. No type of treatment, however, substituted for the cortical hormone by keeping all the animals alive during treatment.

(2) Adult animals are benefitted more than those operated at 30 days of age, both in the numbers which survive during treatment, and in the numbers which survive indefinitely after treatment is discontinued, due to the hypertrophy of adrenal accessories.

(3) Certain percentages of adrenalectomized rats are not helped at all by salt treatment.

(4) The survival of a large percentage while treated (50% or more), followed by death when treatment is discontinued, is explained hypothetically on the basis that these rats have minute cortical accessories, incapable of sustaining life unassisted, but sufficient, with the help of extra salt in the diet, to maintain life. Salt-treatment in animals without accessories (cat and dog) is not so effective.

III. Lactation in Adrenalectomized Rats. Lactation is rarely possible in rats suffering from even a mild adrenal insufficiency. The Swingle-Pfiffner cortical extracts do not support a normal lactation in adrenalectomized rats; approximately half of the litters live, but all are undernourished. A high salt diet is of only slight help. A high salt diet together with cortical extract, however, will support a lactation rate that is near to, but does not quite reach, normal. This shows that if there is, as has been suggested, a separate lactation hormone in the adrenal cortex, it is not very specific. Sub-totally adrenalectomized rats (where only a small fragment of one gland is left intact) lactate normally, showing that the surgical manipulation just before parturition is not the cause of the lactation failures noted above, and showing also that quantitative reductions in the amount of hormone available are probably not the cause of lactation failure in the extract-treated cases.

(See also Dr. Ponder's report, subheading 7.)

Doctor A. J. Grout's Report

Volume III, part 4 of the Moss Flora of North America with index, completing the volume, was issued in August. It contained 99 pages and 36 full page plates with a page of description for each.

Dr. Winona H. Welch of DePauw University, contributed 30 pages on the Fontinalaceae. The difficulty of this part of the work delayed

publication several months but the result has called forth appreciation from several eminent bryologists.

This part was much larger than the others and the printing and engraving cost alone was over $1,600 for the 1,500 copies. Some of the preceding parts, however, were below the contemplated size.

Fully one-half the manuscript for Volume 2, part 2, is now ready, as are the illustrations to accompany it. Dr. Seville Flowers has made all the original drawings for Vol. 3, part 4, and is making all those for Vol. 2.

Miss Geneva Sayre, an assistant to Dr. Conard at Grinnell College in 1933-34, and this year assistant at the University of Wyoming, is working on three small families for Vol. 2, part 2. Both Dr. Flowers and Miss Sayre spent six weeks at the Newfane Laboratory, doing excellent work. Dr. Flowers, in addition to his drawing, is writing the Bartramiaceae for Vol. 2, part 3.

Mr. Russell Lee Walp of Marietta College spent nearly three weeks at Newfane Laboratory before going to Cold Spring Harbor.

All three students expressed themselves as highly pleased with their work and the unusually attractive surroundings.

The desire of the trustees of the Laboratory that its work be the training of research workers is carried out nearly 100% at Newfane.

Professor Sharp of Tennessee, Dr. Welch of DePauw, Miss Sayre and Dr. Flowers all have done excellent work in preparing manuscript for the "Moss Flora" and will be capable of continuing the work for the next generation.

Every institution that has been asked to assist by loans of specimens or information, both in this country and Europe, has cordially responded. Among these institutions are Harvard, Yale, the New York Botanical Garden, the Canadian National Museum, Museum d' Histoire Naturelle at Paris, the Norwegian Museum at Oslo, Bergens' Museum in Norway, and the Swedish National Museum at Stockholm. The U. S. National Museum at Washington has loaned over 1,500 specimens during the year. From one to five thousand plants are examined in the preparation of each part of the "Moss Flora". This not only gives the authors a wide range of variation and distribution, enabling them to detect new forms, but the annotations on the specimens will enable future students to check their conclusions.

As usual, in addition to the preparation of the "Moss Flora", hundreds of specimens have been identified for students of North American bryophytes. Also, considerable exploration has been done in the Everglades and other parts of Florida.

Numbers 251-275 of my **Musci Perfecti** were issued in September. These are subscribed for by about thirty of the leading colleges and botanical gardens of the United States and Canada and a few in Europe.

The International Congress of Botanists meets at Amsterdam next summer. At Cambridge, England, in 1930, I was chosen a member of the international committee on the nomenclature of the bryophytes and have since taken an active part in its work. It seems at present that financial reasons and the desirability of pushing the work on the "Moss Flora" will prevent attendance at Amsterdam.

At the end of this five-year term one-half of the "Moss Flora" has been written and 5-12ths published. If good health and financial aid be given, ten years will see the work completed. It is hoped that it will be a credit to American botany and an invaluable aid to future students.

Doctor H. O. Haterius' Report
(Includes Report of Mark E. Parks)

1. **The genital-pituitary pathway in the rabbit.**

Problem: The rabbit ovulates only following coitus, and almost exactly ten hours later. Moreover, the anterior hypophysis is necessary in this reaction, but necessary only during the first hour postcoitus; removal of the pituitary, i. e., one hour and fifteen minutes after copulation does not inhibit ovulation—earlier removal does.

We know that the pituitary-ovary stimulus is hormonal. What is the nature of the initial stimulus—nervous or hormonal? Experiments in other laboratories have shown (1) artificial insemination does not induce ovulation and (2) vulval and vaginal anesthesia inhibits neither copulation nor ovulation. We have shown that stimulation of the superior cervical sympathetic ganglia (thought to innervate the anterior lobe) results negatively.

Method of Attack: It was planned to hypophysectomize mature females, and to follow this by substitutional implantation of a pituitary into the kidney capsule. In the first place, semi-permanent implants of pituitary substance have never been reported. In the second place, should such grafts prove successful, and oestrous changes manifest themselves, it seemed probable that copulation might result in giving a clue as to the nature of the initial stimulation. If ovulation resulted, conclusive evidence would be on hand that the mechanism is humoral; no ovulation, on the other hand, in an animal otherwise all prepared for such a reaction, would argue in favor of an essential nervous mechanism. In either event, it is believed that the question could be settled.

Work Accomplished: At The Biological Laboratory we accomplished the first phase of what has proved to be rather an arduous undertaking. A technique for successful hypophysectomy was worked out, and hypophyses were implanted in operated animals. Such grafts proved viable, and persisted for as long as two months; in one instance, a small bit of tissue was recovered four months later.

Through pressure of other duties, the work has been temporarily held up; it is proposed to complete the problem this winter, namely, through the production of a series of hypophysectomized-transplanted animals, and by allowing these to copulate. Exploratory operation following coitus should tell the story.

2. **Cryptorchidism and the problem of unity or duality of testicular hormones. (Mark E. Parks).**

Problem: Experimental cryptorchidism results in change in the anterior hypophysis comparable, in general, to those induced by complete castration. Concurrently, the germinal elements of the testes undergo disintegration, leaving the non-germinal interstitial tissue intact. The sex accessories remain normal. Two explanations have been advanced.

(1) A single hormone is present, controlling both pituitary and accessories; cryptorchidism, with its attendant destruction of germinal substance, results in a quantitative reduction in hormone output and the pituitary, possessing a higher threshold for this principle than do the accessories, is first to be affected. (2) Two hormones are present, one inherent in the interstitial tissue and controlling the accessories, and one located in the germinal elements, regulating the anterior hypophysis.

Method of Attack: These hypotheses, it seemed, could be tested in the cryptorchid animal by the administration of a gonad-stimulating substance. The interstitial tissue resident in this type of gonad should be stimulated to greater activity, increasing the hormone output. Should the quantitative concept be correct, a repair of the pituitary should be brought about. If, on the other hand, two hormones are normally present, such administration should result merely in increase in size of the accessories.

This procedure was carried out; daily injections of pregnancy urine (for a period of three months) were given cryptorchid rats, with castrate and normal controls. Histological studies made at the end of the experimental period revealed:

(1) No change in the castration pituitary of treated castrate animals (control).

(2) No change in the sex accessories of treated castrate animals (control).

(3) An increased acidophilia in pituitaries of treated normal animals (controls).

(4) An increased acidophilia, with partial correction of castration changes, in treated cryptorchid animals.

(5) A striking increase in size of sex accessories of both treated normal and treated cryptorchid animals.

On the basis of these results, it would seem that the rat testis contains one hormone, which exercises the dual function of regulating the pituitary and controlling the sex accessories. Experimental elevation of the testes, resulting in gradual destruction of the germinal elements, induces a quantitative reduction of this principle, the pituitary being the first structure to give evidence of a reaction to such reduction.

Before we are completely satisfied, however, we would like to obtain a **complete** repair of the cryptorchid pituitary; it is planned, further, to repeat the experiments on a series of long-time cryptorchid animals (i. e., which have been cryptorchid for 8-12 months and longer). The results obtained so far are, accordingly, not being published until these additional data are on hand.

Studies on the Lamprey (Petromyzon marinus)

M. F. Keen, Temple University

The first part of the summer was spent in an attempt to develop a technique for the removal of the endostyle of the larval lamprey. Since certain cells of the endostyle have been found to give rise to the thyroid of the adult lamprey, I was interested in its removal as a preparatory step for later experiments on the role of the thyroid in metamorphosis. Various

operative procedures were tried without success, due largely to the fact that the operated area was one richly supplied with blood vessels and there was consequently such a great loss of blood that the animals did not live long enough to allow for experimental work. Suggestions of different methods have since been received and the work is being continued.

A study was also started to see whether a secretion of the anterior lobe of the pituitary acted as a growth stimulant on the gonad, as it has been found to act by other investigators on various animals. A commercially prepared extract, Antuitrin-S, was injected into the body cavity. Again the work was mostly the development of a proper technique. Various anesthetics were used but a weak solution of chlorotone gave the best results. Experiments with different dosage strengths were carried out and it was found that the lampreys could stand injections of .1 cc. every other day. Physiological salt was used for injection into the control animals.

The source of material was unfortunately quite limited and the lampreys that were collected did not cover so large a range in size as was desired. The animals that were successfully experimented showed almost no change in the gonads, but the results cannot be considered conclusive because of the small amount of data. So few animals were in the critical period of sex differentiation, which extends from the time the larvae are about 35 mm. in length until they are about 70 mm. long, that nothing could be concluded as to the effect of Anuitrin-S on this differentiation. This work is being continued on new material with a view to perfecting the technique and getting enough data to make definite conclusions.

Professor S. I. Kornhauser's Report
School of Medicine, University of Louisville

Beside teaching the course in Field Zoology, I began work on the gill of the oyster. First, a study of the living tissues with and without vital staining was pursued. The types of ciliated cells and their action, the muscle bands and supporting bars, and the blood system were all studied. Injections of the blood vessels were made and tissues were prepared by a wide variety of methods to study the cytology of the ciliary apparatus, the Golgi bodies and mitochondria. Three types of ciliated cells produce currents for respiration feeding and cleaning of the gills. Their movement is beautifully adapted to the needs of the animal and the ciliary beat continues for at least twenty-four hours in fragments of gills separated from the animals and placed in sea water under the microscope. This is even true of gills in which the musculature has been anaesthetized by magnesium sulphate added to the sea water.

A second problem was begun in a study of pigment formation in the cells of the oyster gills. Right valves of oysters were removed and the animals were placed in running sea water outside the laboratory unshielded from the daylight. In a week the gills turned dark brown to black. These tissues were fixed and embedded together with normal controls and opened specimens kept in the laboratory where they were shielded from direct sunlight where they did not develop pigment. A careful cytological study of pigment formation with the possible correlation of changes in the plasma structures is now being pursued.

Doctor Harriet M. McCurdy's Report
Bryn Mawr College

The development of the melanophores of **Triturus torosus.**

The development of the melanophores of **Triturus torosus** was studied by means of the "Dopa" (3, 4-dioxyphenylalanine) reaction of Bloch. This reaction is specific, not for melanin, but for the melanoblasts, and gives a positive reaction in the presence of the melanin-forming oxidase. This enables one to recognize the cells which will produce melanin before any pigment is present.

Various stages of the larval form of **Triturus** were studied and the results indicate that all the melanophores are of ectodermal origin. In the very early embryos, prior to the formation of the neural groove, melanoblasts are present throughout the entire ectoderm. During the time of formation of the neural groove, and its closure, the melanoblasts disappear from the general ectoderm and can be demonstrated only in the region of the neural crests. Those melanophores (which appear in the later stages in the subdermal, and other mesodermal, areas), can be shown to have been derived by migration and cell division from the neural crest melanoblasts and not to be of mesodermal origin.

Dr. E. W. Blanchard, Bryn Mawr College, is collaborating in the study of this material.

The Development of a New Mutant Character, Shaker Short, in the House Mouse.
Clara Oltmann, Brooklyn College.

This problem, the effects of the shaker short character on the development and embryology of the house mouse, is being investigated under the direction of Dr. L. C. Dunn of Columbia University. The character, shaker short, is a relatively new mutant character. Dr. Dunn in his paper "A New Gene Affecting Behavior and Skeleton in the House Mouse" (Proceedings of the National Academy of Sciences, Vol. 20, No. 4, p. 230-232, April 1934), reported on the effect of the gene. The shaker short character acts as a recessive one. Mice possessing this character are usually sterile. However, later investigations have shown that one male was fertile.

During the summer of 1934 at the Biological Laboratory at Cold Spring Harbor, a stock of heterozygous shaker short mice, not possessing the other genes affecting equilibration, was established. This stock is to be used for future investigations. A series of embryos, for preliminary studies, from matings of heterozygous shaker short mice, which had not been tested against other genes affecting equilibration, was obtained. These ranged from 10 to 14½ days, the full term being 19 days. It was found that Bouin's fluid was the best for fixation. Heidenhain's haemotoxylin, counterstained with eosin and a modification of Mallory's connective tissue stain gave the best results in sectioned material. This preliminary work indicated that the homozygous shaker short mice can be detected in their twelfth day of embryonic development by the abnormal development of the tail. Before any definite conclusions can be ascertained from this work, the studies, which are being continued on the stock which was established during the summer, will have to be completed.

Doctor Eric Ponder's Report

The work which I and my collaborators have completed since May of this year is best reported upon under the heads of the papers in which it is being published.

1. **The absorption of haemolysins by red cells.** It has long been suspected that such surface active substances as the haemolysins might be concentrated upon, or absorbed by, the cells upon which they act. Direct experimental evidence of such a concentration has hitherto been lacking except in a few special cases, and in no case has the amount of absorption been measured quantitatively, although it is most important that it should be in view of the fact that a number of attempts have been made to account for lytic phenomena in terms of the "absorption" of lysin.

Direct measurement of the quantity of lysin which disappears from a haemolytic system reveals a condition of considerable complexity. Some lysins, such as the bile salts and digitonin, are exceedingly rapidly concentrated at the red cell surfaces; others, such as saponin (which in other respects is very like digitonin), are not subject to this rapid concentration at all. Whether the absorption occurs or not, however, the concentration of free lysin in the system steadily falls as time goes on. Such a steady fall in lysin concentration has always been suspected; this investigation shows that it takes place, and that its course, moreover, is in accordance with those equations which have been supposed to apply. Perhaps the most interesting point which emerges from the quantitative study is the fact that complete haemolysis corresponds to the disappearance of a certain fixed quantity of lysin, irrespective of the quantity initially added to the system. The paper will shortly be published in the Proceedings of the Royal Society.

2. **Utilisation of lysin during stromatolysis.** Since lysin continuously disappears during the process of haemolysis, it is important to establish whether or not it disappears during the subsequent process of breaking up of the ghosts, or stromatolysis, for it is with this latter process that the marked changes in conductivity and capacity occur (see Dr. Fricke's report). The disappearance has been followed in detail, and, taken together with the results of conductivity and capacity measurement, leaves little doubt that the fundamental process involved in haemolysis and stromatolysis is a combination of the lysin with the cell membranes, this resulting in an ultimate disintegration of the latter. The paper will appear in the Biochemical Journal.

3. **The "Sen Problem".** The problem of providing a quantitative analysis for the complex haemolytic system which results when an animal's own serum is added to its own cells after they have been in contact with small amounts of one of the bile salts or soaps (familiarly known as the "Sen Problem", after Sen, who obtained the first continuous curves) is of great theoretical, if somewhat academic, interest. The remarkable point about it is the addition of the usually powerful inhibitor, serum, results in an **acceleration** of haemolysis if it is made **after** the cells have been in contact with the bile salt, but not if it is made before. This spring Dr. A. S. Gordon of Washington Square College undertook the task of obtain-

ing complete experimental data, and these have now been analysed in terms of a few simple concepts. The analysis has proved to be a formidable one, and cannot be described in non-technical language; the system, however, provides a link between the simpler haemolytic systems and those in which the lysin is effective only after the cells have been sensitised.

4. **Osmotic behaviour of red cells.** It is recognized that under certain circumstances the red cell behaves as an "imperfect" osmometer, not only taking in water from a hypotonic solution and swelling in consequence, but losing salts into the hypotonic solution and swelling less than it otherwise would. The "laws" applicable ot this imperfect osmotic behaviour have already been studied by Dr. Saslow and myself, and this summer Dr. Robinson and I continued investigations into the conditions under which the "imperfect" osmotic behaviour is observed. Briefly, we found that any condition in which the cell is injured, even slightly (such as oxalating the blood, suspending the cells in very hypotonic plasma, or suspending them in NaCl, KCl, or sugar solutions), results in a loss of salts and in less swelling than would occur by reason of water intake alone. In making the volume measurements we were able to use the new diffractometer now assembled in the Nichols Laboratory, and we were able to estimate the quantity of salts lost by the cells by direct analytical methods. Papers will appear in the next numbers of the Biochemical Journal and the Journal of Physiology.

After the conclusion of the physiology course, Mr. Irving Ochs spent a month at the Laboratory investigating the osmotic behaviour of red cells in very hypotonic sugar solutions. The work was continued and completed by Dr. Robinson, and the paper is now ready for publication (see Dr. Robinson's report).

5. **Opacimetric methods of red cell counting.** Since 1895 it has repeatedly been suggested that the number of red cells in blood could be found by measuring the extent to which light is transmitted through a suitably prepared suspension, for the more cells the less light will be transmitted. Further, the larger the cells, the less light will be transmitted, and so the method has been proposed for finding red cell sizes. At first sight it looks very promising, but a detailed investigation shows that the light transmission is affected by so many factors, some of them uncontrollable, that the method is not suitable either for making red cell counts or for finding red cell size. The paper will appear in the American Journal of Physiology.

6. **Development of the polymorph in the blood stream.** Dr. Climenko and I have at last succeeded in following the early development of the polymorphonuclear leucocyte in the blood stream of rabbits, thereby settling an important, but hitherto doubtful, point regarding the life-history of these cells. See Dr. Climenko's report. The paper will appear in the next number of the Quarterly Journal of Experimental Physiology.

7. **Investigations related to problems of adrenal insufficiency.** Since both a colony of adrenalectomised rats and apparatus for studying the osmotic behaviour of muscle were available at the Laboratory this summer, Dr. Gaunt and I attempted to confirm a recent claim that the muscles of adrenalectomised rats take in water more rapidly than do normal muscles.

Experiments with 40 normal muscles and 40 muscles from rats in a state of adrenal insufficiency failed to show any statistically significant difference in the rate of water intake. The paper appears in the October number of the Proceedings of the Society for Experimental Biology and Medicine.

Dr. Blanchard and I also carried out a number of determinations of the depression of freezing point of the serum of cats before and after double adrenalectomy, with the idea that if the water content of the tissues is increased in insufficiency (as it is recognized to be), the water content of the plasma should be increased too, and its tonicity decreased. Any such fall in the tonicity of the plasma after adrenalectomy would, of course, supply the force necessary for a shift of water to the tissues, and ultimately for the concentration of the blood which is known to occur. In 5 out of 7 animals a very significant decrease in tonicity was found (from 4 to 11%), but the point is of such importance that we require more experiments, principally directed towards showing whether or not the tonicity change is peculiarly characteristic of adrenal insufficiency, before being certain of its significance.

8. **The polynuclear count.** This count, a modification of the Arneth count, consists in classifying 100 polymorphs according to the number of lobes in their nuclei, and is of considerable clinical and physiological importance. It has frequently been pointed out, however, that the count varies quite a little even in normal people, and, in the already extensive literature, it has been suggested that there may possibly be climatic, racial, or at least local variations. Through the cooperation of physiologists in all parts of the world, Mr. MacLeod, my assistant, has been able to make a unique collection of normal blood smears, and from them to show differences in the polynuclear count with locality. "High" counts are customarily associated with health, and "low" ones with infection, but counts made on the blood of people from different countries show variations which are statistically significant, even although the persons are selected as being "normal" in the ordinary physiological or clinical sense. Thus the highest counts are met with in Australia and Florida, which is perhaps not surprising considering the healthy climate, but also in Wigan, which, being an unpleasantly situated industrial town in England, makes the influence of climate and environment less obvious. The lowest counts are met with in Greece, China, Japan, and, curiously enough, New York City. What the significance of these geographical variations may be we do not know, but the fact that they occur is very interesting, for variations in the polynuclear count imply variations in the life history of the white cells.

Mr. Bookman and Mr. Fraad spent some time here after the conclusion of the physiology class, learning the technique of making polynuclear counts with the object of studying the effect of severe exercise and training upon it, this to be done at Brown University.

Laboratories. Of my three laboratories in the Nichols building, two are now in working order. One contains apparatus for respirometry, particularly of white cells during phagocytic activity. The second is fully equipped for work on red cell permeability, haemolysis, and similar problems, and the fitting up of this room has been greatly facilitated by the administration of New York University consenting to transfer my special

apparatus from that institution to the Laboratory. The third room is being equipped for the study of narcosis in muscle and nerve, and will contain a conductivity and capacity bridge, an oscillograph, a cinematograph, and other optical recording devices. Much of this apparatus has been obtained by means of a grant from the Bache Fund of the National Academy of Sciences.

Throughout the summer I have been in collaboration with Dr. Fricke in connection with our work on haemolytic systems, this, and related work, appearing very promising for the forthcoming year. Much of the apparatus in the Nichols building will be used in connection with next summer's class in general physiology, and will be very valuable in enabling us to offer students an opportunity to learn special technique.

Doctor E. J. Robinson's Report
Washington Square College, New York University

A summary of investigations carried on in collaboration with Dr. Ponder will be found elsewhere in these reports. I wish to outline here the results of work done in collaboration with Mr. Irving Ochs on the rate of haemolysis of mammalian red cells suspended in hypotonic solutions of non-penetrating non-electrolytes.

Jacobs has measured the time for a given percentage (75%) of haemolysis to be reached when the red cells of the ox are suspended in distilled water and in dilute solutions of saccharose. He finds that in concentrations of saccharose from zero (distilled water) to about 0.12M, there is very little change in the resistance of the cells to haemolysis, but that above this concentration it increases rapidly. He then formulates equations for the swelling of the cells, based upon the rate of entry of water into them from hypotonic solutions, and shows that, up to a concentration of about 0.12M., they satisfactorily explain the behaviour of the cells. In other words, up to this concentration, the cells behave according to the simple osmotic laws.

In the present investigation the method used was essentially that of Jacobs, but 90-95% haemolysis was used as the end point instead of 75%. Experiments were made upon the red cells of the ox and of the rabbit suspended in hypotonic solutions of saccharose, dextrose, levulose, lactose, maltose and galactose. The cells of both animals always behaved in the same way. When suspended in solutions of saccharose, dextrose and levulose the results are essentially the same as in Jacob's experiments, the resistance of the cells to haemolysis being low and showing little change until a concentration of 0.10-0.12 M. is reached. Above this concentration the resistance increases very rapidly. In lactose the cells show a gradual, though small, increase in resistance up to a concentration of 0.10-0.12M., and here again the rapid increase occurs. In solutions of maltose and galactose, however, the resistance is relatively high even at the lowest concentrations, and it regularly increases up to the point where 90-95% haemolysis is not reached in a minute. In no case does the resistance show the sharp increase which characterizes systems of cells suspended in the other non-electrolytes.

These results show that, while, suspended in some sugar solutions, the red cell may behave according to the simple osmotic laws, this conclusion cannot be extended to solutions of non-electrolytes in general.

Report of Doctor A. A. Schaeffer and R. Peterman
Temple University

The greater part of the time set aside for research at the Laboratory was spent in determining the left-right ratio of the spiral twists in the organism of syphilis, **Treponema pallida.** Some six years ago, when the senior author was making exploratory observations on the correlation between asexual reproduction and preponderance of left over right structural twists in organisms, several scores of spirochaetes were examined with the expected result of left preponderance over right (in the ratio of about 1.5 left twists to 1 right).

Spirochaetes are well adapted for this sort of study, for the spiral twists in the body are not fixed, but labile, and subject to change of direction from right to left and vice versa, as the organism moves about. The change of direction is presumably due to chance, and under uniform external conditions, a left-right ratio, if constant, should reflect a structural characteristic in the organism as definitely correlated with the ratio. The chief drawbacks in the study of this organism are its very small size and the rareness with which really good silver-impregation slides can be made.

Altogether 4,746 spiral turns were counted whose direction of turn could be observed in whole or in part. Of this number, 13 whole turns could be followed completely around; 813 turns could be followed almost completely; in 2,390 cases, only the top (upper part of slide) half could be determined, and in 830 more only the bottom half of the turn could be determined.

The inability to see more than half or three-quarters of a spiral turn was probably due to diffraction caused by granules, other than those in the spirachaete, lying in the path of the light.

All the spiral turns in five prepared slides were counted. In all, the left turns predominated, from 1.2 lefts to 1 right to 2.6 lefts to 1 right. When the complete and nearly complete turns are all taken together, the lefts are to the rights as 1.75 to 1.

The left preponderance occurred in all five slides and in the first three classes of data: whole turns, nearly whole turns, and top-half turns; but in four of the five slides, the bottom half turns, curiously enough, gave only .67 left turns to 1 right—that is, a strong right preponderance. Whether this anomalous result is due to differential discharge of silver between the left and right twisted spirochaetes lying near the glass slide surface, or to some asymmetry in the lighting system or unnoticed systematic error in technique, we do not yet know.

There are good indications that the left-right ratio is influenced by external conditions, that is, the part of the host-body or tissue they live in, or else by their cultural age. More exact knowledge of case histories is required, however, before this interesting point can be settled.

The junior author made all the readings on the spirochaets.

A few days were spent in investigating the underlying structural twist of barnacles. According to my earlier hypothesis, based on correlated general structures in organisms (Science, July, 1931), the barnacles are expected to be a left twisted group, because of sessile habit and hermaphroditic breeding. This apparently is the case, for the large, unpaired, extromittent penis in **Balanus eburneus** has a very regular left coiled sperm duct with an average of about 34 turns (29 specimens).

Among the orchids, **Spiranthes gracilis,** in the Davenport field, of which the whole population was again examined, two specimens were found that were twice as tall, with correspondingly thicker stems, as the plants of normal size. No intermediate sizes occurred. In both of these giants, the spiral arrangement of the flowers was irregular. Thinking that these might be cases of tetraploidy, we measured 150 pollen grains from the giant, and some 150 from normal plants. The volume of the giant pollen grains was almost exactly 50% larger than that of the normal plants. According to Blakeslee, Cartledge, and others, actual tetraploidy seems to be associated with a 100% increase in pollen size. These giant sizes apparently occur much less frequently among **Spiranthes cernua,** for in a meadow under observation for four seasons, in which over 1000 **Spiranthes cernua** were examined none was found above the normal range of size.

The original intention was to spend the larger part of the summer in studying the movements of human white blood corpuscles. Unexpectedly heavy correspondence in connection with raising a fellowship fund in honor of Dr. R. C. Schiedt, Emeritus Professor of Biology, Franklin and Marshall College, and a frequent visitor at the Laboratory before the war, prevented me from carrying out these plans. I did, however, get a few records, sufficient to confirm my earlier preliminary report that the large, active, polymorphs move predominantly to the right in their spiralling movements in glass capillaries.

Doctor Herman T. Spieth's Report
College of the City of New York

While working with Ephemerida wings (Spieth, 1931 and 1933, **Phylogeny of Some Mayfly Genera),** it was found possible to separate the two surfaces of the wing from each other, and by this means to further the investigation of wing veins with regard to phylogeny and nomenclature.

The Odonata possess wings which are in some features similar to those of the Ephemerida. The wings of both orders are fan-like with alternate "up" and "down" or "plus" and "minus" longitudinal veins. Thus it was believed that the splitting of the wings might give some clue as to the evolution of the Odonata wing which is obviously more complicated than that of the Ephemerida.

Specimens of adult Odonata were therefore collected at and near Cold Spring Harbor, and the wings were treated by boiling them in potassium hydroxide. The two surfaces of the wings did not separate, however, as had the two surfaces in the Ephemerida wing, but it was discovered that the wings of teneral specimens could be handled successfully. This

increased the difficulty of the problem, since the specimens remain in the teneral condition only a very short time after emerging from the nymphal stage.

It was possible to collect but a small number of teneral specimens and the remainder of the available time was spent treating the wings of these specimens. These wings are being studied at the present time, and preliminary investigations show that they will help us to interpret the evolution of the Odonata wing as well as to determine homologies in nomenclature with other orders.

II.

After the close of the Field Zoology class, I spent several weeks during the latter part of August and the first part of September on a field expedition collecting Ephemerida. The route selected was through New York State, Pennsylvania, Indiana, Michigan, across the Straits at Sault Ste. Marie and eastward to Montreal via Sudbury, North Bay and Ottawa. From Montreal I went south into New York State and, via the Adirondacks, to New York City. Collections were made at various points along the way. The specimens that were collected have been mounted and are being studied at present. By themselves they are of little value. In conjunction with material already collected and yet to be collected, they will help in the determination of the distribution of species, time of emergence, amount of variation, etc. In other words, this trip represented only a small part of a problem which has been under consideration since 1927 and which will need a great many more seasons of work before a comprehensive and complete picture can be presented.

Harry M. Stoudt's Report
Temple University

Few plants have received more attention from investigators in so-called "regeneration" than **Bryophyllum calycinum Salisb.** The term "regeneration" has been used for the process by which new individuals arise from purely vegetative plants, such as the leaf notches in **Bryophyllum.** Much criticism has been directed against the use of this term as applied to plants, since with them the process is one of normal vegetative reproduction, and not one of replacement of parts.

The writer (American Journal of Botany, Vol. 21, pp. 562-572, 1934) described this phenomenon in **Burnesia Weinbergii Rose** and proposed the term "gemmipary." The word has the advantage of having had current usage, and its application here does not materially broaden its original meaning.

Members of the Family **Crassulaceae** exhibit gemmipary in varying degrees. **Bryophyllum,** with its numerous meristematic areas distributed along the leaf margin, is capable of producing many individuals from a single leaf, whereas other species, such as **Byrnesia,** with but a single meristematic area, develop but one individual.

The summer of 1934 was spent in extending the previous work. A number of species of plants belonging to this family were grown in a gar-

den on the grounds of the Laboratory and were kept under observation. A large number of slides of this type of reproduction in five species (of **Echeuria** and **Kalanchoe**) were made for later critical morphological study. Various stages of gemmipary were obtained for two other species and placed in preservative for sectioning and study during the winter.

The study is being continued with as many species as possible in order to gain a more complete knowledge of gemmipary in the **Crassulaceae.**

Doctor Ivan R. Taylor's Report
Biological Laboratory, Brown University.

This season the course in General Physiology was organized so that the five members of the staff of instruction had charge of different phases of the work, each phase being under the direction of a staff member who, because of considerable experience in the particular field, was especially well qualified to take charge. This arrangement, and the fact that the students had fine equipment at their disposal, made it possible to offer advanced types of work. It is felt that it was a decided advantage to the students to have supervision by a group of men whose research interests in physiology are somewhat different within the group. The response by the students throughout the course was most encouraging. The members of the staff of the course were Dr. H. A. Abramson, Dr. Eric Ponder, Dr. Hugo Fricke, Dr. K. S. Cole and Dr. I. R. Taylor.

In addition to the regular facilities of the course at The Jones Laboratory, the class had the use of equipment at The Biophysics Laboratory and at Dr. Ponder's Laboratory. Grateful acknowledgment is made of the assistance which Dr. H. Curtis, Mr. D. M. Gallagher and Mr. E. Victoreen gave to the course in aiding Dr. Fricke, who directed the work on X-rays and ultra-violet light. Mr. Victoreen presented a lecture to the group. Dr. E. J. Robinson and Mr. J. MacLeod assisted Dr. Ponder in the work which he directed; their kindness in giving this help is much appreciated. These additional contacts were greatly to the advantage of the class.

The Symposia on Quantitative Biology were held at The Laboratory while the course was in session and a valuable contribution to the course was made by certain members of the symposia who lectured to the class. Special lectures were given by Dr. Hans Mueller, Dr. V. C. Twitty, Dr. George L. Clark and Dr. Otto Rahn. These lectures created considerable interest and the kindness of these men in giving them is much appreciated.

Mr. Edward Walzl assisted in the regular work of the course.

After the completion of the course several members of the group remained at The Laboratory for various periods of time to conduct investigations under the direction of Dr. Abramson and Dr. Ponder.

During the year several publications by members of the staff of the course have appeared. Two outstanding publications are Dr. Abramson's book 'Electrokinetic Phenomena' and Dr. Ponder's book 'The Mammalian Red Cell and the Properties of Haemolytic Systems'.

Edward Walzl's Report
John Hopkins University

Following the course in General Physiology, I continued some experiments that had occupied me during the two preceding summers at the Biological Laboratory, on the action of ions on the heart of the oyster, **Ostrea virginica.**

The results of previous experiments showed that solutions containing only a single salt caused cessation of beating; e. g., isotonic solutions of NaCl or KCl cause systolic arrest with increased tonus, and those of $CaCl_2$ and $MgCl_2$ cause arrest in diastole with loss of tone. They also showed that decrease in the concentration in Van't Hoff Solution produces decrease in the extent of relaxation, and that increase of KCl over that in Van't Hoff Solution has the same effect. This indicates that there is an optimum concentration of KCl, departure on either side of which causes the same effect. Similar experiments with $CaCl_2$ also showed that lack of $CaCl_2$ causes a prolonged period of systole with a gradual decrease in the extent of contraction until the heart stops in diastole, and that excess of $CaCl_2$ causes decrease in frequency and increase in amplitude.

These experiments were repeated and confirmed during the past summer. The results indicate the difficulty of assigning a specific role to a given ion.

The experiments on the action of solutions containing only a single salt were extended. The results follow:

1. If the heart is transferred from Van't Hoff Solution to solutions of successively lower concentrations of NaCl in which the isotonicity is maintained with dextrose, there is decrease in the level of tonus at which systolic arrest occurs until a concentration is reached in which continued beating obtains. However this beating is characterized by increased diastolic tonus, but becomes more nearly normal as the concentration is further decreased.

2. The action of KCl is like that of NaCl except that the concentration which permits continuous beating is much lower.

3. Similar diminution of effect with decreased concentration was also obtained with $CaCl_2$. In low concentrations the hearts continue to beat for long periods of time, though with decreased amplitude and rate. With successively higher concentrations of $CaCl_2$, the rate and amplitude are diminished until arrest in diastole obtains. Increase of $CaCl_2$ beyond this results in decrease in tonus.

At the request of Dr. Ivon Taylor a few experiments were made on the actions of solutions of methyl and ethyl germanium hydroxides on the heart of the oyster. Some rather promising results were obtained, but the experiments have not been carried far enough to warrant a report at this time.

Persons in Residence at the Laboratory in 1934
Including Members of the Staff.
Investigators, Assistants and Technicians

†**Abramson, H. A.**—Research and inst., assoc. bacteriol., Cornell Univ. Medical College.

Bacon, Annette L.—Research, ass't. biol., Temple.

†**Blanchard, Ernest W.**—Research and inst., assoc. biol., Bryn Mawr.

Bosler, E.—Research, fellow med. physics, Johnson Foundation, School of Medicine, Univ. of Pennsylvania.

Brink, Frank, Jr.—Research, Pennsylvania State College.

Cain, Stanley—Research, ass't. prof. bot., Indiana.

†**Chouteau, Ellen M.**—Librarian, Biol. Lab.

Clark, George L.—Research, prof. chem., Univ. of Illinois.

Climenko, David R.—Research, lect. pharmacology, Cornell Univ. Medical College.

†**Cole, Kenneth S.**—Research and inst., ass't. prof. physiol., College of P. and S., Columbia.

Cole, Robert H.—Research, undergr., Oberlin.

†**Conard, H. S.**—Research and inst., prof. bot., Grinnell.

†**Corner, George W.**—Inst., prof. anatomy, Univ. of Rochester School of Medicine and Dentistry.

Cunningham, Bert.—Prof. biol., Duke.

*Curtis, Howard J.—Research, physicist, Biol. Lab.

†**Deery, Edward.**—Glassblower, Bell Telephone Labs., N. Y.

Flowers, Seville.—Research, B., inst., Carbon County High School, Utah.

*Fricke, Hugo.—Research, in charge biophysics, Biol. Lab.

Fulton, MacDonald.—Research, dept. biol., Brown.

*Gallagher, D. M.—Research, radio engineer, Biol. Lab.

Galliger, Gladys.—Research, dept. bot., Univ. of Illinois.

Gaunt, Jo.—Research.

Gaunt, Robert—Research, prof. biol., College of Charleston.

†**Gold, Dorothy.**—Secretary, Biol. Lab.

*Grout, A. J.—Bryologist, Biol. Lab.

*Harris, Reginald G.—Director, Biol. Lab.

*Hart, Edwin J.—Research, chemist, Biol. Lab.

Haterius, H. O.—Research, ass't. prof. biol., Washington Square College, New York Univ.

Hinchey, M. Catherine.—Dept. biol., New Jersey State Normal School.

Keen, Maurice F.—Research, inst. biol., Temple.

†**Kornhauser, S. I.**—Research and inst., prof. embry., Univ. of Louisville Medical School.

Laity, Elsie M.—Research, grad. student, Grinnell.

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

Leitch, Maurice L.—Research, inst. biol., Temple.
†**Marsh, Phronsie.**—Secretary, Biol. Lab.
***MacLeod, Catherine.**—Secretary, Biol. Lab.
***MacLeod, John.**—Research, research ass't. general physiol., Biol. Lab.
McCurdy, Harriet.—Research, dept. biol., Bryn Mawr.
Mueller, Hans.—Research, prof. physics, Mass. Inst. Tech.
Ochs, I. J.—Research, undergr., Wesleyan.
Oltmann, Clara.—Research, inst. biol., Brooklyn College.
Osterhout, W. J. V.—Rockefeller Institute.
†**Parkins, W. M.**—Administration, research assoc., biol., Princeton.
Parks, Mark E.—Research, inst. biol., Washington Square College, New York Univ.
Peterman, Robert.—Research, Gettysburg College.
***Ponder, Eric.**—Invesigator general physiol., Biol. Lab.
Rahn, Otto.—Research, prof. bacteriol., Cornell.
Rashevsky, Nicolas.—Research, dept. physiol., Univ. of Chicago.
Robinson, Ellis J.—Research, ass't. biol., Washington Square College, New York Univ.
Sargent, Louisa M.—Inst., ass't. prof. bot., Grinnell.
Sayre, Geneva.—Research, B., ass't., Univ. of Wyoming.
Schaeffer, A. A.—Research, prof. biol., Temple.
†**Spieth, Herman T.**—Inst., inst. zool., College of City of New York.
Stoudt, Harry N.—Research, inst. biol., Temple.
†**Taylor, I. R.**—Research and inst., ass't. prof. physiol., Brown.
Twitty, Victor C.—Research, ass't. prof. zool., Stanford.
***VanOlinda, Ruth E.**—Assistant, Biol. Lab.
***Victoreen, Ernest.**—Research, technical ass't., Biol. Lab.
Walp, Russell Lee.—Research, B., prof. bot., Marietta College.
†**Walzl, Edward.**—Research, fellow biol., Johns Hopkins Univ.
Winsor, C. P.—Research, dept. physiol., Harvard.

Students

Ballard, W. W.—S. M., inst. zool., Dartmouth.
Bifoss, Rev. Callistus G.—P. S., prof. biol., Quincy College.
Boettiger, Edward.—G. P., grad. student, Brown.
Bookman, John J.—G. P., undergr., Brown.
Booth, Lois.—F. Z.; grad. stud., Pittsburgh.
Brambora, Erna C.—G. P., grad. stud., Brooklyn College.
Cone, Avis Wood.—F. Z., P. S., Montreal.
Corner, George.—F. Z., Rochester.
Curtis, Brian.—S. M., grad. stud., Stanford.
Downes, Nancy.—G. P., undergr., Barnard.
Finkelstein, Allen.—S. M., grad. stud., Bellevue Hospital Medical School.
Fraad, Daniel J., Jr.—G. P., undergr., Brown.
Fuller, Caleb A., Jr.—F. Z., grad. stud., Brown.
Harrison, James S.—G. P., undergr., Brown.
Harwood, Paul H., Jr.—S. M., undergr., Princeton.

Himmelright, Mary Eleanor.—G. P., grad. stud., Maryville College.
Hunt, Thelma.—S. M., ass't. prof. psychology, Washington Univ.
Hunt, Thomas E.—S.M., prof. histol. and embryol., Alabama Univ. School of Medicine.
Jones, Herman D.—S. M., assoc. prof. organic and biochem., Alabama Polytech. Inst.
Kleinberg, William.—S. M., grad. stud., New York Univ.
Laity, Elsie M.—G. P., grad. stud., Grinnell.
Lytle, Theodore L.—S. M., undergr., Princeton.
Maynard, Francis L.—G. P., grad. stud., Brown.
Ochs, I. L.—G. P., undergr., Wesleyan.
Ross, Donald.—F. Z., grad. stud., Grinnell.
Rouse, Sylvia B.—S. M., grad. stud., Brown.
Rubin, Morton A.—G. P., grad. stud. and ass't., general physiol., Clark.
Tobin, Charles E.—S. M., grad. stud., College of Charleston.
tumSuden, Caroline.—S. M., research fellow, Evans Memorial Hospital and Boston Univ. School of Medicine.
Vandam, Leroy K.—G. P., grad. stud., Brown.
Wahlers, Alice M.—S. M., grad. stud., Adelphi.
Wawro, N. W.—S. M., grad. stud., Brown.
Whitaker, Elizabeth A.—F. Z., grad. stud., Brown.
Young, Lawrence E.—S. M., undergr., Ohio Wesleyan.

SUSAN COOPER