

LONG ISLAND BIOLOGICAL ASSOCIATION

ANNUAL REPORT

OF

THE BIOLOGICAL LABORATORY

COLD SPRING HARBOR
LONG ISLAND, NEW YORK
1947

LONG ISLAND BIOLOGICAL ASSOCIATION

INCORPORATED 1924

ANNUAL REPORT

OF

THE BIOLOGICAL LABORATORY

FOUNDED 1890

FIFTY-EIGHTH YEAR

1947

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REPORT OF THE DIRECTOR

The world we live in today is anything but a quiet and peaceful community of nations where the individual might pursue his occupations without distraction from the disturbing impact of everyday events. Indeed, ours is a world full of turmoil and upheaval, where the representatives of divergent economic ideas are locked in an apparently uncompromising struggle; where the social order is undergoing radical change; where industrial developments are changing the modes of living of individuals, families, and nations, technological advances are breaking new trails on the road to improved health and comfort, and scientific research is exploring approaches to a new era of control of natural energy by man.

In such a turbulent world, neither individuals nor organizations can remain static if they wish to accomplish more than is required for survival. In the surge of activities stimulated by present events, new opportunities are opened up for individuals and for institutions. This is particularly true in the sphere of scientific endeavor. The war brought into focus great possibilities in scientific research, and set in motion a chain of events that have awakened great public interest in the accomplishments of scientists. The impetus given by national emergency still persists during this postwar period, and research activity is as intense now as it was during the war. But considerable changes have occurred in the conduct of research. Emphasis is shifting from a "war" type of research, in which effort was concentrated on the application of existing knowledge for a quick solution of practical problems, to fundamental research, in which effort is again turned toward the expansion of basic knowledge. One particularly important change is the relaxation, and in many instances the complete elimination, of secrecy restrictions in research projects supported by government funds. These regulations had their place when the primary purpose of investigations was their application in war activities; but such restrictions are entirely out of place in the study of fundamental principles of science. All-inclusive freedom is the most fertile soil for basic research: freedom to select a research problem, freedom to carry on the work, freedom to discuss the progress of investigations with other scientists, and, finally, freedom to publish results. Restrictions imposed on any of these freedoms—either by a government for security reasons, or by an organization for the purpose of keeping findings secret—cannot but hamper the progress of the research, and must ultimately defeat the primary purpose of the whole undertaking.

During 1947, the work of our Laboratory was entirely unrestricted. Funds for research came from grants received from Schenley Laboratories, Inc., the U. S. Public Health Service, and the Josiah Macy, Jr., Foundation. We had full freedom to pursue the investigations supported by these funds, within the scope of the programs proposed by us. Our other activities, of course, involved no restrictions either. The Laboratory

was host to numerous guests and visitors, who came to work during the summer, to attend the symposium meetings, or simply to meet friends and colleagues and revisit familiar places.

Research

The primary research activity of the Laboratory is the conduct of its own research program. As has been pointed out in previous reports, the research programs of the Laboratory and of the neighboring Department of Genetics of the Carnegie Institution are correlated, in order to strengthen both. At present, the Laboratory's research program deals with variations in microorganisms—namely, fungi, bacteria, and actinomycetes.

Dr. A. Kelner has studied several species of bacteria and actinomycetes for the occurrence of hereditary changes responsible for the production of antibiotics. Through the use of X-rays and ultraviolet radiation, he has been able to increase the frequency of occurrence of hereditary changes, and, by means of a special method he has developed, to detect those changes which increase antibiotic production. Several results of general interest have emerged from this work, some of which should be useful to workers who are trying to develop new antibiotic substances. It seems evident, for example, that if one wishes to use radiations as tools for speeding up the development of new antibiotics, ultraviolet radiation is the most effective for work with bacteria, and X-radiation for work with fungi, whereas either ultraviolet or X-rays are good for work with actinomycetes. Of considerable scientific interest is Kelner's finding, obtained with actinomycetes, that the effect of X-rays on the production of hereditary changes increases proportionally with the dosage up to a certain point only, and that further increase of dosage does not then raise the level of the effect. This is the first observed instance of such behavior among a large number of studies of that problem. The interpretation of the behavior is not yet clear.

Dr. V. Bryson has been studying the capacities of various chemicals to induce hereditary changes. This is a newly opened up field of research, in which the Cold Spring Harbor laboratories are playing a leading role. Using bacteria, Bryson has made a careful study of the genetic potencies of a detergent and of nitrogen mustard, a close relative of mustard gas. Both have been found to induce hereditary changes. Another interesting fact revealed by Bryson's studies is that bacterial strains resistant to mustard are also resistant to penicillin, streptomycin, and ultraviolet radiation. This work has brought us back again into the field of bacterial resistance, to which both of the laboratories at Cold Spring Harbor made significant contributions a few years ago. An effort is now being made to develop studies of the origin of bacterial resistance as a separate project under the leadership of Dr. Bryson.

Early in 1947 a grant was received from the U. S. Public Health Service for the purpose of reviving the biophysical research that was

carried on from 1925 to 1940 under the leadership of Dr. H. Fricke. This research had made a significant contribution regarding effects produced by X-rays on solutions of various chemicals. It was previously conducted by a group of investigators, including a physicist and a chemist. When an effort was made this year to get together a similar group of research personnel, it was found that well-trained scientists in the field of biochemistry were in such demand that the opportunities we could offer were not adequate to attract the competent scientists required. Therefore it was decided to postpone this project until a more opportune time. During the summer months Mr. E. Kerner, graduate student in physics at Cornell University, helped Dr. Fricke with the preliminary task of putting the X-ray equipment into working condition, and started experiments on X-rayed oxalates.

During the summer Dr. Harold A. Abramson, with the assistance of Mr. C. Reiter and Mr. B. Kaufmann, utilized the aerosol technique developed during the war to study aerosol therapy of the lungs and lung function. This research was supported by a grant from the Josiah Macy, Jr. Foundation, made to Dr. Abramson and administered by the Laboratory.

Again this summer we had a group of investigators working with bacteriophages, and another working with *Drosophila* (fruit flies). Dr. Mark Adams, of New York University, studied the inactivation of bacteriophages by various chemicals, and, together with Dr. E. Racker, made a study of the growth of bacteriophages within bacteria by determining the amount of absorption in a certain region of the ultraviolet spectrum during growth of the bacteria. Drs. L. Szilard and A. Novick, both physicists at the University of Chicago, took the course on methods used in research with bacteriophages, and later carried on experiments by crossing different phages.

Dr. Ernst Mayr, of the American Museum of Natural History, experimented with *Drosophila* in an attempt to learn about the mechanisms responsible for isolating groups of individuals. Isolation is considered to be an important step in the origin of new species. Mayr also made observations on the relation between hatching period of the Yucca moth and flowering period of the Yucca plants growing on the Laboratory grounds, and spent some time in writing papers.

G. Streisinger, of Cornell University, continued studies begun the previous summer dealing with sexual preference as a possible cause of isolation between populations of *Drosophila*. A third investigator working with *Drosophila* was I. H. Herskowitz, of Columbia University. He attempted to induce hereditary changes by treating flies with various chemicals.

Dr. L. Michaelis, of the Rockefeller Institute, continued his studies of the theory of biological staining. During July, Dr. J. S. Friedenwald, of the Johns Hopkins Hospital, came to consult with Dr. Michaelis about plans for research on a possible application of magneto-optical methods to the study of semi-quinones.

Dr. F. C. Fraser, of McGill University in Montreal, worked with a hairless strain of mice which showed heavy skin folds. Since a similar condition appears in humans as a result of vitamin-A deficiency, he investigated the relation between vitamin A and the expression of this hereditary characteristic. Results of his experiments indicated that the genetic constitution of mice showing this character interferes with the utilization of vitamin A.

Dr. R. N. Stewart of Columbia University, studied various strains of Liliun collected in several parts of the United States.

Several other scientists utilized time spent at the Laboratory for writing. Dr. E. E. Jones, of Wellesley College, analyzed data, reviewed literature, and made plans for further work. Dr. G. H. R. von Koenigswald, of Bandoeng, Java, studied literature related to his investigations of early man in Java. Dr. H. Waelsch, of the New York State Psychiatric Institute, completed two manuscripts; and Dr. B. H. Willier, of the Johns Hopkins University, wrote one manuscript.

Brief statements written by the investigators about their research while at the Laboratory are presented in the section entitled "Reports of Summer Investigators."

Symposium

The series of conferences known as the Cold Spring Harbor Symposia on Quantitative Biology was started in 1933 and has been held every summer since then except for three years during the war. The aim of these conferences is to bring together scientists working on different aspects of a certain problem, and to give them an opportunity of discussing their work at leisure in the congenial environment of the Laboratory.

This summer the symposium was held from June 11 to June 20. The subject of the conference was "Nucleic Acids and Nucleoproteins." These are substances that play a very significant role in many processes occurring in living organisms, and are especially important in the transmission of hereditary characteristics. Twenty-four papers were presented by twenty-eight invited scientists from this country and abroad, and general discussions on each topic were held by the whole group.

About 150 persons, coming from nineteen states and from eight foreign countries, were registered at the meetings. The majority of participants lived at the Laboratory during the ten days of the symposium, filling its living quarters to capacity, and an additional number commuted to the meetings from New York, New Jersey, Connecticut and Long Island.

Distinguished foreign scientists attending the symposium included Dr. Andre Boivin, from France; Drs. H. Hyden and B. Thorell, from Sweden; Drs. J. N. Davidson and J. M. Gulland, from England; Dr. and Mrs. Edgar Stedman, from Scotland; Drs. J. Brachet and M. Errera, from Belgium; Dr. G. Gasic, from Chile; and Mr. H. Grimsson, from Iceland.

Invitations had also been issued to two scientists in Russia and one in Portugal; but their respective governments did not allow them to make the trip, even though their traveling expenses were guaranteed by the Laboratory. One paper from Russia and one from Portugal were received, however, and were published in the symposium volume.

All the papers prepared for the symposium, and much of the material presented in discussions, were published in book form, as volume XII of the Cold Spring Harbor Symposia on Quantitative Biology.

One of the most significant papers of the symposium was given by Dr. John M. Gulland, professor of chemistry at University College, Nottingham, England. His warm personality, as well as the excellence of his work, made many friends for him in America. In October, four months after his return to England, Dr. Gulland met a tragic death in a railroad accident. Since our symposium was one of the last meetings he attended, and since his life work and interest had been concerned with the problems discussed there, volume XII of the Symposia was dedicated to him.

Teaching

Although the main emphasis of the Laboratory is on serving science by facilitating contacts between research workers through its symposia and summer accommodations, and by the conduct of its own research projects, some special teaching has been offered during the last few years. This summer the course in Nature Study was given by Dr. and Mrs. J. Southgate Y. Hoyt, of Cornell University. This course is designed to stimulate interest in nature among the younger generation, by showing them how to observe the many interesting plants and animals that occur abundantly around them, by teaching them how to answer the questions raised by their observations, and by making them realize that careful and accurate study of the smaller incidents observed by all of us contributes greatly towards expanding our knowledge of natural phenomena. The course was divided into four sections, according to the ages of the pupils, and was attended by fifty-one local young people.

Another course offered again this summer dealt with methods used in research with bacteriophages. It was taught by professors Mark Adams, of New York University, and Max Delbruck, of Vanderbilt University. The course is designed to familiarize scientists with new methods developed recently in this field of research, and to stimulate interest in investigations dealing with bacterial viruses. There was a capacity registration of fifteen members, of whom the majority were advanced research workers.

Lectures

Seminar lectures were held throughout most of the summer, in cooperation with the Department of Genetics of the Carnegie Institution. The speakers were summer members of the Laboratory, and arrangements were in the charge of Dr. V. Bryson. A list of speakers and titles appears below:

- May 29: Albert Kelner, Biological Laboratory. Lithium chloride-induced secondary colonies of bacteria.
- July 10: Max Delbruck, Vanderbilt University, Nashville, Tennessee. Biochemical mutants of bacterial viruses.
- July 17: Seymour S. Cohen, Children's Hospital, Philadelphia, Pennsylvania. The nutritional requirements of virus multiplication.
- July 24: I. H. Herskowitz, Columbia University. Chemical induction of mutations in *Drosophila*.
- July 31: J. Southgate Y. Hoyt, Cornell University. Through the year with a pileated woodpecker.
- August 7: Milton Levy, New York University. The pipsyl procedure.
- August 14: G. H. R. von Koenigswald, University of Utrecht. The Java man.
- August 21: Gabriel Gasic, (Santiago, Chile), Rockefeller Institute for Medical Research. Movies: Mechanism of cell division. Yale Laboratory movies on primate behavior.
- August 28: F. Clarke Fraser, McGill University. The rhino mouse.

Dinner

Again this summer, on September 16, a dinner was held at the Piping Rock Club for a few neighbors of the Laboratory, at the invitation of Mr. and Mrs. Willis D. Wood and Mr. and Mrs. Arthur W. Page. Mr. Page acted as toastmaster. Dr. Robert Cushman Murphy gave a brief outline of the recent history of the Laboratory and told about its current activities. This was followed by a talk by Dr. G. H. R. von Koenigswald, formerly of the Geological Survey of the Netherlands East Indies, and at present a professor at the University of Utrecht, who had spent the summer at the Laboratory. He told of his experiences in Java, and particularly of his successful search for the remains of the Java man, who lived about half a million years ago. Members of the dinner party had the unique opportunity of examining a skull and several jawbones of the Java man.

Dining Room

The Blackford Hall dining room was in operation during the summer for the members of both the Biological Laboratory and the Department of Genetics. During the symposium period it furnished meals for over one hundred persons, and during the remainder of the summer about fifty persons were served. Mrs. Ralph Thompson managed the dining room for the first three weeks of operation, until the arrival of Mrs. S. G. Stephens, who had charge of it until the end of the summer season.

Laboratories and Equipment

No major changes were made in the laboratories. Year-round research was carried on in the George Lane Nichols Memorial Laboratory,

and during the summer all research space in the other laboratory buildings was well occupied. An incubator, a water bath, and a considerable quantity of glassware were purchased for the Course on Bacteriophages.

Symposium meetings were held in the living room of Blackford Hall, which must serve as a lecture hall. This arrangement is very inadequate; and one of the outstanding needs of the Laboratory is a new lecture hall, with modern equipment and good ventilation.

Buildings and Grounds

Because of shortages of material and high prices, only essential repairs and improvements were carried out. These consisted of reroofing the major portion of Williams House, installing a new kitchen range and canned-gas service in the kitchen of Blackford Hall, replacing the boiler in the Nichols Laboratory and installing an oil-heating system, installing fluorescent lighting in the John D. Jones Laboratory, building a tool shed, and doing a considerable amount of indoor painting.

Acknowledgments

It gives me great pleasure to acknowledge the support given to the Laboratory by the members of the Long Island Biological Association. It is owing primarily to their interest and generosity that the Laboratory has become an outstanding scientific center and is continuing in that status.

The Women's Committee, under the presidency of Mrs. George S. Franklin, made an important contribution toward the support of the scientific work of the Laboratory; and its House Committee, under the chairmanship of Mrs. Percy H. Jennings, collected contributions for the furnishing of residences.

We are grateful to Mr. and Mrs. Willis D. Wood and Mr. and Mrs. Arthur W. Page, who sponsored the dinner at the Piping Rock Club; and to Mr. Arthur W. Page, Dr. Robert Cushman Murphy, and Dr. G. H. R. von Koenigswald, who spoke on that occasion.

Acknowledgment is also made of the contribution of the Wawepex Society toward the upkeep of buildings and grounds, of the John D. Jones Scholarship maintained by that Society, and of a special contribution made this year for the installation of fluorescent lighting in the John D. Jones Laboratory.

The Laboratory is grateful to Schenley Laboratories, Inc., to the U. S. Public Health Service, and to the Josiah Macy, Jr. Foundation, for funds made available for research, and to the Carnegie Corporation for a grant to defray the expenses of foreign guests taking part in the symposium.

We wish to acknowledge the assistance given by the Carnegie Institution, and particularly the opportunity for close cooperation with the Department of Genetics, which has proved very helpful to the work of the Laboratory.

REPORTS OF LABORATORY STAFF

Effects of Chemicals on Bacteria

Vernon Bryson and Maryda Swanstrom

Further information concerning the effects of nitrogen mustard (methyl-bis betachloroethylamine hydrochloride) upon *E. coli*, has been obtained as part of a program to test the mutagenicity of chemicals through induced heritable modifications in phage resistance of bacteria. Those familiar with the experiments of Demerec and Latarjet and the more recent work of Witkin will remember that the capacity of bacterial mutants to resist the lytic action of host-specific phage has been utilized as a foundation for studies of mutagenesis. At present some uncertainty exists concerning the position of bacterial studies within the general framework of genetics as established through investigations of multicellular organisms. Yet one need not be overly concerned about whether phage resistance is a typical mutation in the sense of involving a change in the gene. Even today the gene is so poorly defined from a chemical standpoint that the processes involved in mutation are obscure. In attempts to escape from the resulting impasse, geneticists are breaking with the meristic concepts of classical tradition, and are investigating bacteria and other biological materials whose identification with the "beads on a string" concept of genetic structure is not apparent.

Two processes are involved in testing the ability of a chemical to induce mutations in bacteria. First, it must be determined whether exposure of bacteria to the chemical results in altering the relative proportions of genetic types within the population. Secondly, if a specific type not appearing anew but merely increasing proportionately is suspected of representing induced mutants, the relative sensitivity of mutant and normal individuals must be known. Mutation may then be distinguished from a selective shift in the proportion of genetic types due to variations in sensitivity to toxic effects of the chemical. If the bacteria are reproducing, it is also necessary to know the spontaneous rates of mutation and the relative rate of division of each group under investigation.

One of the first difficulties encountered in exposing bacteria to nitrogen mustard was the extreme toxicity of the chemical. Concentrations of .005 per cent HN₂ (nitrogen mustard) are capable of killing more than 90 per cent of exposed cells in one hour at 37°C. Preliminary work by Mr. Wilton E. Baty had provided us with a strain of bacteria more resistant to HN₂ than the normal. Further exposure of this strain to the chemical in large numbers, with selection and propagation of the few survivors after each experiment, resulted in establishment of a strain (B/M 12) capable of experimental use at HN₂ concentrations of 0.1 per cent. Although phage-resistant mutants of the

strain are relatively viable when treated with HN2, it is possible to demonstrate induced mutation of phage-sensitive to phage-resistant bacteria by use of special techniques, such as the method of tabulating delayed mutants on plates exposed to phage in aerosol form (Demerec and Latarjet).

Through the courtesy of Dr. E. M. Witkin, of the Department of Genetics, several strains of radiation-resistant *E. coli* were obtained. Bacteria described as radiation-resistant are able to survive in relatively large numbers after exposure to ultraviolet light or to X-rays—agents normally destructive to unprotected living cells. Comparison of these radiation-resistant strains with strain B/M 12, selected for resistance to HN2, showed that no differences existed upon exposure to the chemical. It was at once evident that the biochemical changes associated with development of radiation resistance were capable of affording a simultaneous protection against the toxic effects of nitrogen mustard. As a reciprocal experiment, the HN2-resistant cells, which had never been experimentally exposed to concentrated doses of ultraviolet light, were placed in the rays of a mercury vapor lamp. Ultraviolet light emanating from the lamp had no more effect on the bacteria selected for resistance to nitrogen mustard than upon original radiation-resistant strains.

The significance of these observations is obvious. The close similarity in mode of action of nitrogen mustard and short-wave, high-energy radiation, as described by geneticists, cytologists, and pathologists suggests a field of overlapping in the mode of action of these agents. Therefore a single heritable change, presumably in the chemical constitution of the cell, can afford protection against both chemical and physical treatment.

An investigation of the effects of carbamates on normal and phage-resistant bacteria has also been conducted. Four of the simplest compounds were studied—methyl, ethyl, propyl, and butyl. Ethyl carbamate is commonly known as urethane, and has been used pharmaceutically as a sedative. It has been reported to be mutagenic in its activity upon *Drosophila* (Vogt) and carcinogenic for mammals (Larsen). The four carbamates were analyzed for mutagenic effect. Since the toxicity of carbamates varies directly with their molecular weight, it was necessary to use relatively lower concentrations of the heavier and less soluble members of the series to obtain a similar range of killing. Experiments were conducted by two techniques. Concentrated suspensions of *E. coli*, consisting of approximately one billion bacteria per cubic centimeter, were exposed to solutions of carbamates. With high killing, the proportion of phage-resistant cells present among the treated bacteria was observed to increase to more than one hundred times the proportion originally present. Such a situation could arise through the transformation of phage-sensitive to phage-resistant cells by a process of chemically induced mutation. By the second technique, in which phage was applied as an

aerosol to treated cells allowed to incubate on Petri plates, it was clear that no mutations took place during the growth of chemically treated cells, above the spontaneous rate. A continued search for such mutations, called "delayed effect," is in progress.

Carbamates have been found to exert a greater toxic effect upon normal cells. Any phage-resistant cells present as original members in a treated population of necessity increase proportionately, because they are relatively immune to the killing activity of the chemicals employed. Therefore, the selective effect of carbamates could easily obscure any but the most extreme mutagenic capacities, since both selection and mutation must produce similar results—i.e., an increase in the relative numbers of phage-resistant cells. The absence at this time of demonstrated delayed mutations suggests that perhaps the tested carbamates are not mutagenic for bacteria. But we do not yet know how reliably delayed mutations serve as indices of capacity to induce genetic changes that appear in the absence of cell division. It is possible that some chemicals that produce mutations do so only through immediate modification of the genetic constitution, without the convenient side-effect of delayed mutations associated with cell division. The answer to this question will probably come from accumulated studies on chemicals whose immediate "zero-point" effect is not lost as a result of selective pressure in favor of the phage-resistant mutant. We still remain at a stage where valid conclusions must wait upon information yet to be obtained.

Antibiotic Potentialities of Microorganisms

Albert Kelner, Rachel Arbogast, and Louise Pirovane

Induced Mutation in Actinomycetes.—Practically no studies on induced mutations of actinomycetes have been reported. Since we planned to include this group of microorganisms in our investigation of the genetics of antibiotic production, it was necessary that we first make a study of the effect of X-rays and ultraviolet radiation on the mutation frequency of actinomycetes. The preliminary results were published in the Annual Report for 1946; the work was completed this year.

Actinomycete spores were far more resistant to the lethal effects of irradiation than *Escherichia coli* cells. Therefore, higher doses of X-rays and ultraviolet radiation could be used than are commonly employed in such studies. The mutation frequency-dose curve was determined for X-rays from a dose of zero to one of 300,000 roentgens, and for ultraviolet light at 2537 Å from zero to about 20,000 ergs \times mm². The frequency-dose curve with ultraviolet radiation rose linearly with increasing doses and showed no significant leveling off at the highest dose used. The frequency-dose curve with X-rays increased linearly, reaching a maximum at about 200,000 roentgens, then leveled off with increasing radiation. The maximum mutation frequency observed was about the same for both forms of radiation, about 20 per cent. Other

workers who had studied different organisms had found that the mutation frequency-dose curve with ultraviolet radiation rose to a maximum, leveled off, then fell with increasing doses, whereas the X-ray curve rose linearly with increasing doses. Our data may indicate either (1) that actinomycetes behave differently than other microorganisms, (2) that previous workers, because of the radiation-sensitivity of their organisms, were forced to use radiation doses too low to allow them to obtain a complete picture, or (3) that some unknown phenomenon has caused a distortion in our curves.

Since this phase of our work was subservient to the larger problem of the genetics of antibiotic production, we could not pursue the matter further.

The mutations scored were those causing a change in the morphology of the actinomycetes when grown on asparagin-dextrose agar. The particular mutations most abundant (pigment changes, loss of sporulation and vigor of growth) were significant since they helped us understand the changes which the notoriously variable actinomycetes undergo spontaneously in culture.

The immediate practical result of this study was to tell us the optimum radiation dose to use when we irradiated actinomycete cultures in order to induce the formation of antibiotically active mutants.

Antibiotic Potentialities of *E. coli* and of the Actinomycetes.—The major concern of this year's work was an investigation of the genetics of antibiotic formation by microorganisms. The experimental approach was to choose standard strains of microorganisms which had no antibiotic activity or only slight, questionable antibiotic activity against an arbitrarily chosen bacterium. By suitable X-ray or ultraviolet irradiation, a high rate of mutation was induced in these species; and a search was made for induced mutants with definite antibiotic activity. Thus if an induced antibiotically active mutant were found to arise from an inactive parent culture, that culture would be shown to have genetically the potentiality for antibiotic formation.

It was clearly recognized that if antibiotically active mutants were present at all in a population derived from an inactive parent culture, such mutants would probably comprise only a minute fraction of the total population, and it would be necessary to test many thousands of strains derived from the parent culture in order to find the active ones. A method was therefore devised which enabled us with relatively little labor to test large microbial populations for the presence of antibiotically active mutants.

Escherichia coli B/r, a standard strain used by Demerec and others in mutation studies, was the first species tested. Of 78,590 strains derived from irradiated *E. coli* cultures, not one mutant with clear-cut antibiotic activity was found. We could not be sure whether failure with

this organism was really due to the absence of active mutants, or whether our irradiation technique (necessarily modified from that used by previous workers because of the exigencies of our experiments) failed to induce as high a frequency of mutants as feasible, or our method for testing for the presence of active mutants was faulty.

Instead of testing other bacteria, we therefore turned to a group of organisms, the actinomycetes, which was known to have a high proportion of antibiotically active strains. It seemed probable that active mutants could more easily be induced in actinomycete species than in other microorganisms.

Seven representative species were selected from the American Type Culture Collection. In our tests these species were either antibiotically negative or had only trace, questionable activity. They were *Streptomyces albosporus* 3003, *S. albus* 3004, *S. cellulosa* 3313, *S. flaveolus* 3319, *S. griseus* 3326, *S. violaceus* 3355, and *S. viridochromogenus* 3356. These species were irradiated by X-rays, and 1400 to 42,000 substrains of each species tested for antibiotic activity.

All but *S. albus* (or six out of seven species) yielded antibiotically active mutants. The frequency of active mutants ranged from 1×10^{-4} to 1×10^{-2} according to the species.

S. flaveolus was studied most intensively. Among its mutants were at least three distinct physiological types, as shown by different nutrient requirements for maximum antibiotic production. In addition, antibiotic spectra of types requiring the same optimum medium, showed that at least three different antibiotics were formed by three different mutants. Thus this one species, *S. flaveolus*, potentially yields a number of different antibiotics. Among the active mutants were feebly growing asporogenous forms.

The A. T. C. C. strain of *S. griseus* 3326 has not hitherto been considered a streptomycin producer. One of its mutants (found once among the 28,440 substrains tested) produced an antibiotic whose spectrum closely resembled streptomycin. It was almost as active in submerged culture as some of the strains used for streptomycin production.

A full understanding of the significance of our findings awaits the completion of work in progress, in which the character of the antibiotics formed by the mutants is being more closely studied.

REPORTS OF SUMMER INVESTIGATORS

Abramson, Harold A., Cold Spring Harbor, N. Y.—With the assistance of Mr. C. Reiter and Mr. B. Kaufmann, experiments were carried out along three lines.—(1) Aerosol Therapy: Quantitative data on the therapy of the lungs in connection with penicillin therapy were obtained by developing a technique of calibrating nebulizers. It was found that weighing the liquid lost introduced a serious error. In addition, it was found desirable to fractionate the particles delivered by the nebulizer into two groups, so that nebulization delivery could be assayed in terms of probable delivery in the lungs themselves.—(2) Lung Function: As previously observed, the low concentration of phenol red used originally was inadequate to test lung function. By having normal and pathological subjects inhale a much higher concentration of dye, it was possible to develop a standard test for the study of lung function by studying urinary excretion of the dye. It was desirable to use nasal tips for this procedure. It is believed that this is the first aerosol test for lung function that has been developed.—(3) Purification of Ragweed Solution: Continuing the experiments begun in this laboratory, further experiments were performed to simplify the technique of obtaining highly purified ragweed by electrophoretic fractionation. These experiments will be continued, since the present apparatus costs over \$1000 and the yield is very small.

Adams, Mark H., College of Medicine, New York University, New York, N. Y.—In working with phage T5 in chemically defined media, it was noted that citrate and oxalate ions brought about a very rapid inactivation of the virus. It was eventually discovered that this effect was not a direct action on the virus. The virus was rapidly inactivated by 0.1 N sodium ions, and this inactivation could be prevented by 0.001 N calcium or magnesium ions. The apparent inactivating effect of citrate ions was really due to removal of the protective calcium and magnesium ions by complex salt formation. Phage T1 is also rapidly inactivated by sodium ions, but the other five phages are quite stable. The toxic action of sodium ions is counteracted by Ca, Mg, Ba, Sr, Co, Ni, Zn, Cd, and Cu ions at 0.001 M concentration. Potassium ions also inactivate phages T1 and T5, but apparently at a slower rate than do sodium ions.

Fraser, F. C., McGill University, Montreal, Canada.—It has been shown that mice homozygous for the recessive gene "rhino" are characterized by the development of a follicular hyperkeratosis beginning at the end of the first hair-growth cycle (14 days of age). Since the histological appearance of the condition resembles that occurring in the skins of rats and humans deficient in vitamin A, it was decided to test the effect on the skin of feeding massive doses of vitamin A to rhino mice. It was found that oral doses of the order of 500 International units of vitamin A a day would halt the progress of the hyperkeratotic process at the stage in which it was at the beginning of the treatment (the earliest suc-

cessful treatment was started at three weeks of age). Larger doses than this produce toxic manifestations including splenomegaly, hepatomegaly, emaciation, widespread hemorrhage, and eventual death; and even doses of this size eventually produce splenomegaly and, to a lesser degree, hepatomegaly. The data are in accord with the hypothesis that the rhino gene in the homozygous condition interferes with the utilization of vitamin A or one of its derivatives by the skin cells.

Friedenwald, Jonas S., Johns Hopkins Hospital, Baltimore, Md.—During the month of July, through the kindness of the Director, I was permitted to work at the Biological Laboratory. The object of the work was the exploration of possible application of magneto-optical methods to the study of semi-quinones. The work consisted mainly in consultations with Dr. Michaelis, and studies in the library of the Department of Genetics, Carnegie Institution. A few preliminary experiments were performed. No results are to be reported yet.

Herskowitz, Irwin H., Columbia University, New York, N. Y.—Gametes of *Drosophila melanogaster* were exposed to chemicals by means of the vaginal-douche technique. Subsequently, sex-linked recessive lethals induced by this treatment were detected. An increase in the number of lethals indicated that either the genes themselves or the processes leading to gene changes were affected. It is hoped that studies of this type will aid in elucidating the nature of the agents causing spontaneous mutations, the characteristics of the mutation process, and the relationship of metabolism to mutation.—Injections of dinitrophenol, hydrazine hydrate, and trypsin produced no detectable increase in the number of lethals. Data for other chemicals tested are not yet complete, and experiments are being continued.

Jones, E. Elizabeth, Wellesley College, Wellesley, Mass.—The time spent in Cold Spring Harbor was used in analyzing data, reviewing literature, and checking references in preparation for further work on the effects of 2,4-dinitrophenol on the development of tumors in mice. It was a profitable summer.

Kerner, Edward, Cornell University, Ithaca, N. Y.—With the object of measuring the gases liberated in the irradiation of organic solids with ionizing radiation, the technical development of a low-pressure gas-analytical apparatus was begun, using a McLeod manometer and solid chemical absorbents. Preliminary observations on X-rayed oxalates were made with it.

Koenigswald, G. H. R. von, Geological Survey of the Netherlands East Indies, Bandoeng, Java.—A study was made of literature on genetics in general, and especially in connection with a possible hybridization of the early human forms in Java, making use of the library at the Department of Genetics, Carnegie Institute of Washington.

Mayr, Ernst, American Museum of Natural History, New York, N. Y.—During the summer of 1947 I was occupied with four projects. I completed a paper on ecological factors in speciation, published in *Evolution*, volume I, pages 263-288.—I continued work on *A Natural History of Birds*.—Work on isolating mechanisms in *Drosophila* was continued; a number of experiments were conducted to test the possible role of sense organs in the tarsi and, in particular, in the front tarsi. All the tarsi of the male *pseudoobscura* were coated with paraffin of a low melting point. The isolation index of these males did not differ materially from that of control males. The significance of this experiment remains inconclusive until it is combined with an elimination of other sense organs. An amputation of the frontal tarsi appeared to lead to a slight reduction of the isolation index in double-choice experiments involving males of *D. pseudoobscura*.—A study was made of the relationship of the *Yucca* plant and *Yucca* moth on Long Island, a locality considerably north of the normal range of these species. It turned out that the hatching period of the moths is no longer synchronous with the flowering period of the *Yucca*. It also appeared that a high percentage (75 per cent) of the seed pods do not contain moth larvae. This suggests that the flowers can occasionally be pollinated by other agents than the moths. These results are at variance with the previously published literature on these species, and deserve to be investigated more closely.

Michaelis, L., Rockefeller Institute for Medical Research, New York, N. Y.—The study of the theory of biological staining was continued. As regards staining with basic dyes, model experiments were carried out in which a colloidal solution of a stainable substrate was used in place of the fixed tissue in order to facilitate spectrophotometric studies. The present stage of the results may be summarized as follows. The cation of the basic dye is adsorbed by a negatively charged group of the substrate. According to the nature of the substrate, the adsorbed dye may have different shades of color, which can be characterized spectrophotometrically and appear on visual inspection in two extreme modifications. For instance, using toluidine blue, nucleic acid is stained always blue ("normal" or "orthochromatic" color), whereas colloidal sulfuric esters of carbohydrates—such as mucus, cartilage, heparin, agar—are stained purple ("metachromatic" color). There are colloidal substrates that do not occur in histological objects, which, according to the ratio of substrate to dye, may show all transitions from orthochromatic to metachromatic color. No other substrate has yet been found with the same properties as nucleic acid. Therefore, basophilic or orthochromatic color is an almost specific reaction of nucleic acid. As regards staining with acid dyes, it can be shown that the stainability of any substrate depends on the presence of positively charged amino groups. Any procedure that eliminates the charge of the amino group (by adequate buffering) or destroys the amino group chemically, prevents stainability with acid dyes. This is an approxi-

mate outline of the work, which is still going on, concerning the nature of histological staining and its significance not only for morphological differentiation but even for specific histochemical reactions.

Racker, E., and Adams, M. H., College of Medicine, New York University, New York, N. Y.—Nucleic acids have such a high absorption of ultraviolet radiation at 2600 A that it is possible to follow nucleic-acid synthesis in growing bacterial cultures and in phage-infected cultures by means of the Beckman spectrophotometer. In cultures of strain B of *Escherichia coli* growing in a chemically defined medium, the absorption due to nucleic acid increases exponentially with time, doubling in about ninety minutes.—In cultures of strain B infected with a fivefold multiplicity of T2 phage, nucleic-acid synthesis ceases for a period of five to ten minutes after infection, then proceeds at a rate that is a linear function of time. This observation confirms the work of Dr. Seymour Cohen, who found by chemical analysis of phage-infected bacterial cultures that desoxyribose nucleic acid was synthesized at a linear rate.—In cultures of strain B irradiated with ultraviolet so that only one cell in five hundred survives, nucleic-acid synthesis proceeds at about 70% of the rate of an unirradiated control. This experiment indicates that nucleic-acid synthesis proceeds for a short period of time almost normally in bacteria that have been killed by ultraviolet irradiation.—In cultures of strain B multiply infected with T2 bacteriophage which has been irradiated for five minutes, there is no synthesis of nucleic acid. This experiment confirms the observations of Dr. S. Cohen, who found by chemical analysis that heavily irradiated T2 bacteriophage completely inhibited the synthesis of nucleic acid by *E. coli*.—However, if T2 bacteriophage is irradiated with ultraviolet light for only one minute (1000 ergs/cm²), and then used to multiply infect a culture of strain B of *E. coli*, nucleic-acid synthesis proceeds. Plaque counts done on the infected cultures indicated that an extensive renaissance of ultraviolet-inactivated phage particles takes place in the multiply infected bacteria, thus confirming the observations of Dr. S. E. Luria.—These studies were undertaken to demonstrate the utility of the Beckman spectrophotometer as a tool in following the synthesis of nucleic acids in bacteria before and after infection with bacteriophage.

Stewart, Robert N., Barnard College, Columbia University, New York, N. Y.—Determinations of karyotype were made for collections of *Lilium superbum* from Massachusetts, Maryland, North Carolina, and three stations west of the eastern divide. These "races" were morphologically indistinguishable and were completely interfertile. Variation on a geographical basis was found in the number of chromosomes with nucleolus forming secondary constrictions. The occurrence of nucleolar chromosomes, in addition to the C and K pairs common to all individuals, is indicated in the following chart.

Chromosomes	Mass.	Md.	N.C.	West
2D 2J	0	2	0	0
2D 1J	0	1	0	0
2D 0J	10	7	0	0
1D 2J	0	0	0	0
1D 1J	0	19	0	0
1D 0J	0	0	0	0
0D 2J	0	8	15	0
0D 1J	0	2	0	0
0D 0J	0	1	0	4

Streisinger, George, Cornell University, Ithaca, N. Y.—The study of sexual isolation in *Drosophila pseudoobscura* and *D. persimilis* was continued. Normally, males of one species mate more frequently with females of their own species than with females of the other species. An attempt was made to select strains in which the males mate equally often with females of both species.—Two males of one species and two females of the other species were placed in shell vials; the first of 120 such pairs to copulate was selected, and the male mated to a virgin female of his own species. Twenty such experiments were conducted. The sons of four of the ten selected *D. persimilis* males showed a significant decrease of mating preference; no such change was observed among the sons of the ten selected *D. pseudoobscura* males.—We do not yet understand the reason for the incompleteness of a large percentage of attempted interspecific copulations. An attempt was made to clarify this problem.—Mr. Irwin Herskowitz, of Columbia University, observed that males of *D. melanogaster* copulate with etherized females of their own species. We placed males of *D. pseudoobscura* together with equal numbers of etherized females of *D. pseudoobscura* and *D. persimilis*. Of 31 males that copulated successfully, 17 inseminated females of their own species and 14 females of *D. persimilis*. When *D. pseudoobscura* males were placed together with equal numbers of conscious *D. pseudoobscura* and *D. persimilis* females, 27 *pseudoobscura* and 3 *persimilis* females were inseminated. Of 44 *D. melanogaster* males that were placed together with equal numbers of etherized *D. melanogaster* and *D. persimilis* females, 20 inseminated females of their own species and 24 females of *D. persimilis*. When conscious females of these two species are placed with *D. melanogaster* males, only intraspecific copulations take place. These experiments are more fully described and discussed elsewhere.

Szilard, L., and Novick, A., University of Chicago, and Argonne National Laboratory, Chicago, Illinois.—Preliminary experiments were made on the crossing of the bacterial viruses T2+ and T4r. Bacteria were mixedly infected with these two viruses, and the virus liberated from single bacteria were studied. Analysis of the plaques produced by virus thus liberated from mixedly infected bacteria showed, in addition to the two original viruses introduced, also T2r and T4+. A low

multiplicity of infection was used, in an effort to determine whether under such conditions there is any marked correlation between the number of T2 plaques that show the acquisition of the r character and the number of T4 plaques that show the loss of the r character. It was not possible, however, to establish the presence or absence of a marked correlation from these preliminary experiments.

Waelsch, Heinrich, New York State Psychiatric Institute, New York, N. Y.—During the summer of 1947, experimental data accumulated during the last two years on the metabolism of glutamic acid were evaluated. The findings form the basis for two manuscripts, which were written at Cold Spring Harbor and are now in press. The library of the Department of Genetics, Carnegie Institution, was extensively used in order to collect material for a contemplated monograph on brain metabolism.

Willier, B. H., Johns Hopkins University, Baltimore, Md.—During the five weeks spent at the Laboratory I was engaged in writing a manuscript on "The Physiology of Development of the Skin and its Derivatives."

COURSE ON BACTERIOPHAGES

June 30—July 19, 1947

Instructors: Mark H. Adams, College of Medicine, New York University, New York, N. Y.; Max Delbruck, Vanderbilt University, Nashville, Tenn.

Assistants: Nancy J. Collins, New York University.
Gerard Seltzer, College of the City of New York.

As in the previous two years, an intensive three-week course was offered in techniques and problems of research on bacterial viruses. Fifteen students were enrolled, as compared with twelve and six in the previous two years. Several new experiments were added to the schedule, to keep the material presented abreast of current progress in virus research. During the course, seminars on specialized topics were presented by course members and by other scientists from the Carnegie Institution and the Biological Laboratory. After the conclusion of the course, several students undertook research problems on bacterial viruses. The course and subsequent virus-research work were housed in the Davenport Laboratory.

The following students were enrolled in the course:

- Annabell Avery, Research Assistant, School of Medicine, University of Pennsylvania
Dr. G. H. Beale, John Innes Horticultural Institution, London, England
Dr. Margaret Grieg, School of Medicine, Vanderbilt University
Halldor Grimsson, Rockefeller Foundation Fellow, Reykjavik, Iceland
Dr. Albert Kelner, Bacteriologist, Biological Laboratory
Dr. P. Morrison, Department of Physics, Cornell University
Dr. Aaron Novick, Argonne National Laboratory
Dr. Gerald Oster, Rockefeller Institute for Medical Research, Princeton, N. J.
Dr. Richard B. Roberts, Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D. C.
Harvey Rothberg, Princeton University
Dr. Albert Schatz, New York State Department of Health, Albany
Andrew G. Smith, Department of Bacteriology, School of Medicine, University of Pennsylvania
Dr. Leo Szilard, Professor of Biophysics, University of Chicago
Wolf Vishniac, Graduate Student, Hopkins Marine Station, Pacific Grove, Calif.
Marian Willis, Research Assistant, Indiana University.

NATURE STUDY COURSE

Dr. and Mrs. J. Southgate Y. Hoyt

Laboratory of Ornithology, Cornell University, Ithaca, N. Y.

The Nature Study Course was conducted with three aims in view: (1) that the students learn to observe the many interesting plants and animals that occur abundantly about them all the time; (2) that each student learn how to make observations of these phenomena and how to answer his own questions about his findings; (3) that they learn that each person can make a contribution, by careful and accurate study of the smaller incidents observed by all of us but not interpreted and heeded, in the tremendous field for study always at hand.

The Biological Laboratory nestles in an unusually rich location for these studies. Within short walking distance one may visit large fresh-water ponds; swift, heavily shaded streams; hot, slow streams; the mergence of fresh-water streams into salty lagoons, providing brackish water habitats; heavy forest areas of deep shade and moist floor; open fields with typical field of flora and fauna; long, sandy sea beach, and tide pools among rocks; and rich, deep, salt swamp and mud flats. Each of these places was visited by some class, and the life found was studied with emphasis on how much could be seen and its relation to other forms of life in nearby areas. Wawepex Laboratory served as headquarters for the course; it was here that the students gathered for more detailed study of the forms found in the field. The laboratory was open at all times, and each student was encouraged to return at any time for any type of work he wanted.

There were four age groups, divided as follows: The fifteen Juniors, aged six to eight, met every Monday and Wednesday from 9:00 to 11:00 a.m.; the twenty-four students of the Intermediate group, aged nine to eleven, met every Tuesday and Thursday from 9:00 to 11:00 a.m.; the five students of the Senior group, aged twelve years and up, met every Monday and Wednesday from 2:00 to 4:00 p.m.; and the Advanced group met every Tuesday and Thursday from 2:00 to 4:00 p.m. This last group was for students especially interested in some particular problem or phase of natural history requiring more intensive study than was permitted in the other classes; it consisted of four students ranging in age from thirteen to seventeen.

The two younger groups spent most of their time roaming these various localities in search of everything they could find, learning that in every corner there is some form of life especially adapted and suited for its special existence in that particular habitat. Two questions were always asked first of all: (1) "What is it?" and (2) "What will it do or what good is it?" Whenever possible the students found the answers to these questions themselves and learned to relate one form of life

with some other seen before, either in the class or elsewhere. On one field trip, within a stone's throw of the laboratory, a shrew was found and caught alive. The habitat of the shrew was carefully studied, and each student had ample opportunity to see for himself the type of place such animals inhabit and their requirements for life. The relationship of the shrew, an animal none of the class had ever seen before, to the mouse and the mole, animals most of the class knew, was demonstrated. This little animal was brought into the laboratory and attempts were made to keep it alive for observation by all the classes. Unfortunately, it died, as do all such animals in captivity, but not without first being of real value to the entire class in the lessons they learned from it. After its death we were able to show the teeth of this smallest of mammals, and the class could readily understand the reasons for the stories told them about the ferocity of the shrew.

All the students were encouraged to bring from home anything they could find of interest for the rest of the class to see. Many students caught quite a few insects, including many of the more spectacular larger moths. They were shown how to prepare these for mounts, and some even prepared mounts of a permanent nature for displaying in their homes. A few students were interested in starting a collection of pressed flowers. Help was given here, and suggestions were offered as to methods of collecting, pressing, and keeping the flowers, but the students were encouraged to do most of the work themselves. One boy was particularly interested in starting a rock collection and learning more about the rocks of the neighborhood. Considerable time was spent in showing him how and where to find the rocks he wished and how best to keep and display them without cluttering up one's possessions with extra material. A girl was especially interested in finding as many different shells as she could during the period of the course. She had collected some twenty different kinds by the end of the course. These were displayed and she was helped in learning their names and the reasons for the various shapes as well as the lives of the animals that once inhabited them. Similar instances can be mentioned for almost any field of natural history one may choose.

The Senior group was small and was united in its interest in the unknown life of the waters around the community. The interest seemed to concentrate on microorganisms for quite a long time, and consequently we spent a great deal of time collecting material from all possible sources and studying it in the laboratory with the aid of microscopes. Without exception, every member of the class was excited and anxious to learn the names and habits of as many of the microorganisms as possible. A large number was studied, including a few rather uncommon forms. During the latter portion of the course this group became interested in studying and collecting moths, butterflies, and others of the larger, more spectacular insects. A trip was taken by car to some fields and woods not visited by other classes, and here new material was

collected with the aid of home-made as well as laboratory-provided nets. This material was mounted, and each student took home with him some attractive mounts and beautiful collections of insects. One girl in the class was especially interested in collecting and learning more about the ferns of the area. She collected and pressed all that we could find and had a very nice collection by the end of the course, having learned the names and characteristics of most of them. Another girl from near by already had a good collection of moths and butterflies, but she added a few new ones to her collection and contributed greatly to the class by showing the other members how to mount and care for a collection. Sharing of experiences and exchange of methods is especially encouraged among the members of a class, with the result that all learn from others how to do something not known before.

The Advanced class consisted of three boys, with a fourth joining later. The interests of the group concentrated on the study of birds, and for a short time on the study of fishes of the nearby streams. Many bird walks were taken to various localities within walking distance of the laboratory and observations made on the habits of the birds as well as identification of the various species seen. Indoor classes on the anatomy and behavior of birds were held in an informal manner, with emphasis on the practical and readily observable features. This class, being small, was taken on several long excursions from the laboratory. Two such trips were made to the area of Jones Beach to observe the nesting colonies of Least Terns and Piping Plovers. Upon one of these trips considerable time was spent in searching for birds in the thick woods bordering the coastal waters. Here several southern birds were found that do not often frequent Long Island. Another trip was made into the city of New York to visit the American Museum of Natural History and the New York Zoological Gardens. The class was taken behind the scenes in both places and shown how a museum and zoo operate as well as shown exhibits usually denied the general public.

All the classes were taken to the New York State Fish Hatchery across from the Biological Laboratory. Here they were conducted on a tour to learn the methods used in raising the fish from eggs to adults. Members of the staff made remarks on the purpose of the fish hatchery in the role of conservation in the state.

The Roosevelt Bird Sanctuary in Oyster Bay was also visited by all the classes. Here Mr. Callaghan, the director, very generously explained all the exhibits and purposes of the Sanctuary. The classes were able to see some of the forms of life we had been unable to study at the laboratory in the short time allotted to each class. The excellent demonstrations displayed in the museum of this sanctuary were especially appreciated and studied very carefully by many of the students.

July 31 was the formal closing of the course, with a public exhibition of the activities of the various classes. The students were encouraged to prepare demonstrations of their particular interests and to arrange

the material in an attractive manner for visiting by their parents and friends. Without exception, every member of the course had some type of exhibit prepared by himself, and many had several exhibits. At two o'clock the parents and friends assembled in Wawepex Laboratory for the exhibition. Everyone was greatly impressed with the tremendous amount of material found within the few weeks of the course and gathered from this one locality. At three o'clock everyone was invited to attend a movie showing the life history of the rare Pileated Woodpecker, which has been the study of Mr. Hoyt for the past ten years. This movie was in kodachrome and was accompanied by an informal lecture on the habits of this bird. After the movie, ice cream and cake were served by the Laboratory to all present.

The following is a list of students who attended the classes:

Abramson, Harold A., Jr.	McCullough, Norman
Ammidon, Hoyt	McCutcheon, David
Ayer, William	Metz, Richard
Baty, Charlotte	Muhlhausen, Peter
Briere, Yvonne	Murphy, Jane
Brown, Mary Alice	O'Brien, Jean
Brush, John	Olds, Pepper
Bryson, David	Poor, Henry
Cady, John	Prime, Ford
Carpenter, Joy	Rutherford, John, Jr.
Childs, Tommy	Schneider, Elizabeth
Everitt, Sambo	Schneider, Timothea
Farnham, Hunter	Schwartz, Arthur
Farnham, Lee	Storey, Elinor Lee
Grace, Cathe	Stout, Lee
Gudebrod, Ginger	Truslow, Fred
Hurry, Eleanor	Truslow, Tim
Jacoby, Stephen	Vaquier, Victor
Jacoby, Sylvia	Ward, George
Kaufmann, Anders	Warner, Bradford A., Jr.
Kimbrig, Linda	Warner, Miner Hill
Kleet, Howard	Watkins, Eric
Kleet, Warren	Wilson, Ellen
Koenigswald, Felicitas von	Woodcock, Johnnie
Langley, Jimmie	Wright, George
Lefferts, Peter	

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY

Previous Published Volumes

- *Vol. I (1933) Surface Phenomena 239 pp.
 - *Vol. II (1934) Growth 284 pp.
 - Vol. III (1935) Photochemical Reactions 359 pp.
 - Vol. IV (1936) Excitation 376 pp.
 - *Vol. V (1937) Internal Secretions 433 pp.
 - *Vol. VI (1938) Protein Chemistry 395 pp.
 - *Vol. VII (1939) Biological Oxidations 463 pp.
 - Vol. VIII (1940) Permeability and the Nature of Cell Membranes 285 pp.
 - *Vol. IX (1941) Genes and Chromosomes 315 pp.
 - Vol. X (1942) The Relation of Hormones to Development 160 pp.
 - Vol. XI (1946) Heredity and Variation in Microorganisms 314 pp.
- *Out of print

NUCLEIC ACIDS AND NUCLEOPROTEINS

Volume XII (1947) of the Cold Spring Harbor Symposia on Quantitative Biology, about 300 quarto pages, 19 plates, and 119 figures.

The twelfth volume of this series contains papers presented at the Symposium held at the Biological Laboratory during the summer of 1947, edited discussions, a large number of line drawings and half-tone plates, and an index. Besides the authors indicated below, other workers in the field contributed discussions.

CONTENTS

- BELOZERSKY, A. N.—On the nucleoproteins and polynucleotides of certain bacteria.
- BOIVIN, ANDRE—Directed mutation in colon bacilli, by an inducing principle of desoxyribonucleic nature: its meaning for the general biochemistry of heredity.
- BRACHET, JEAN—The metabolism of nucleic acids during embryonic development.
- CHARGAFF, ERWIN—On the nucleoproteins and nucleic acids of microorganisms.
- COHEN, SEYMOUR S.—The synthesis of bacterial viruses in infected cells.

- DAVIDSON, J. N.—Some factors influencing the nucleic acid content of cells and tissues.
- ERRERA, MAURICE—In vitro and in situ action of ionizing radiations on nucleoproteins of the cell nucleus.
- GREENSTEIN, JESSIE P., CARTER, CHARLES E., and CHALKLEY, HAROLD W.—Enzymatic degradation of ribonucleic and desoxyribonucleic acids with an addendum on the effect of nucleates on the heat stability of protein.
- GULLAND, JOHN MASSON—The structures of nucleic acids.
- HYDEN, HOLGER—The nucleoproteins in virus reproduction.
- KNIGHT, C. A.—Nucleoproteins and virus activity.
- MAZIA, DANIEL; HAYASHI, TERU, and YUDOWITCH, KENNETH—Fiber structure in chromosomes.
- MICHAELIS, L.—The nature of the interaction of nucleic acids and nuclei with basic dyestuffs.
- MIRSKY, A. E.—Chemical properties of isolated chromosomes.
- POLLISTER, ARTHUR W., and RIS, HANS—Nucleoprotein determination in cytological preparations.
- RIS, HANS—The composition of chromosomes during mitosis and meiosis.
- SCHMIDT, GERHARD; CUBILES, RICARDO, and THANNHAUSER, S. J.—The action of prostate phosphatase on yeast nucleic acid.
- SCHNEIDER, WALTER C.—Nucleic acids in normal and neoplastic tissues.
- SCHULTZ, JACK—The nature of heterochromatin.
- SERRA, J. A.—Composition of chromonemata and matrix and the role of nucleoproteins in mitosis and meiosis.
- SPIEGELMAN, S., and KAMEN, M. D.—Some basic problems in the relation of nucleic acid turnover to protein synthesis.
- STEDMAN, EDGAR, and STEDMAN, ELLEN—The chemical nature and functions of the components of cell nuclei.
- TAYLOR, BETTIE, GREENSTEIN, JESSE P., and HOLLAENDER, ALEXANDER—The action of X-rays on thymus nucleic acid.
- THORELL, B.—The relation of nucleic acids to the formation and differentiation of cellular proteins.
- WITKIN, EVELYN M.—Mutations in *Escherichia coli* induced by chemical agents.

LABORATORY STAFF

- Arbogast, Rachel—Research Assistant
Bryson, Vernon—Research Biologist
Demerec, M.—Director
Dorsey, Henry—Laborer
Farrington, Margaret—Technical Assistant
Franzese, Eleanor—Clerical Assistant
Kelner, Albert—Bacteriologist
Klem, Dorothy V.—Secretary
Pirovane, Louise—Research Assistant
Rae, William S.—Superintendent of Grounds
Reddy, William—Laborer
*Stephens, Dorothy—Dining Hall Manager
Swanstrom, Maryda—Research Assistant
*Templeton, McCormick—Technical Assistant
*Thompson, Stella—Dining Hall Manager
*Summer

SUMMER RESEARCH INVESTIGATORS

- Abramson, Harold A.—Cold Spring Harbor, N. Y.
- Adams, Mark H.—New York University College of Medicine, New York, N. Y.
- Cohen, Seymour S.—University of Pennsylvania School of Medicine, Philadelphia, Pa.
- Collins, Nancy—New York University College of Medicine, New York, N. Y.
- Fraser, F. Clark—McGill University, Montreal, Canada.
- Friedenwald, Jonas—Johns Hopkins University, Baltimore, Md.
- Herskowitz, Irwin H.—Columbia University, New York, N. Y.
- Jones, E. Elizabeth—Wellesley College, Wellesley, Mass.
- Kaufmann, B. W.—Johns Hopkins University, Baltimore, Md.
- Kerner, Edward—Cornell University, Ithaca, N. Y.
- Koenigswald, G. H. R. von—Geological Survey of the Netherlands East Indies, Bandoeng, Java, and University of Utrecht, Holland.
- Levy, Milton—New York University College of Medicine, New York, N. Y.
- Mayr, Ernst—American Museum of Natural History, New York, N. Y.
- Michaelis, L.—Rockefeller Institute for Medical Research, New York, N. Y.
- Novick, Aaron—University of Chicago, Chicago, Ill.
- Racker, E.—New York University College of Medicine, New York, N. Y.
- Reiter, Carl—Long Island College of Medicine, Brooklyn, N. Y.
- Roberts, R. B.—Carnegie Institution of Washington, Washington, D. C.
- Seltzer, Gerald—College of the City of New York, New York, N. Y.
- Stewart, R. N.—Barnard College, New York, N. Y.
- Streisinger, George—Cornell University, Ithaca, N. Y.
- Szilard, Leo—University of Chicago, Chicago, Ill.
- Waelsch, H. B.—New York Psychiatric Institute, New York, N. Y.
- Waelsch, Salome—Columbia University, New York, N. Y.
- Willier, B. H.—Johns Hopkins University, Baltimore, Md.

REPORT OF THE SECRETARY

The 53rd meeting of the Board of Directors of the Association was held on January 31, 1947, at the Down Town Association in New York City, with seventeen members present. President Murphy reported that Mr. Marshall Field would appreciate release from the office of Treasurer; and consideration was given to the election of a new treasurer. A resolution was passed authorizing the sale of the Stewart Cottage, located on Route 25A in Cold Spring Harbor, and further authorizing the proper officers to enter into all legal proceedings required for such sale. The Director of the Laboratory reported the termination in December of the Laboratory's contract with the Medical Division of the Chemical Warfare Service. He also reported briefly on the progress of the new research with microorganisms begun the previous October under a grant from Schenley Laboratories, Inc. Dr. Demerec then discussed the question of financing a future research program. An analysis of income and expenditure for a six-year period shows that the Laboratory should be able in the future to cover anticipated expenses of the summer program, including the Symposia, without difficulty, but that its present resources are entirely inadequate for developing a full-time research program. Dr. Demerec advocated the possibility of raising funds for support of research from outside sources, such as the American Cancer Society, industries, or agencies of the Federal Government. He reported that plans for the 1947 Symposium, on the topic "Nucleic Acids and Nucleoproteins," had been completed. After conclusion and discussion of the Director's report, the financial statement of income and outgo for the year 1946 was approved as distributed; and the proposed budget for 1947 was distributed and approved.

On July 29, 1947, the 24th Annual Meeting of the Association was held at Blackford Hall. The report of the Director of the Laboratory covered the continuing program of investigation of microorganisms for production of antibiotics, headed by Drs. V. Bryson and A. Kelner, and the very successful meetings of the Cold Spring Harbor Symposium, held the previous month. He also mentioned other summer activities, such as the Course on Bacteriophages, the Nature Study Course for Young People, and the research work of summer guests at the Laboratory. He reported the sum of \$71,000 received in special funds, for the support of a two-year research program, and for the traveling expenses of foreign participants in the Symposia over a five-year period. After the Director's report, President Murphy addressed the meeting. The report of the Treasurer for the year 1946 was presented by Dr. Demerec, and approved by vote. The following members, proposed by the Nominating Committee (Dr. Ernst Mayr, Mrs. R. C. Murphy, and Dr. Charles O. Warren), were re-elected to the Board of Directors, to serve until 1951: T. Bache Bleecker, Marshall Field, Ross G. Harrison, Caryl B. Haskins, B. P. Kaufmann, Arthur W. Page, and Harlow Shapley.

The 54th meeting of the Board of Directors was held on July 29, following the Annual Meeting, with sixteen members present. A motion by Mrs. Franklin to amend Article VIII of the By-Laws, changing the name of the "Women's Auxiliary Board" to "Women's Committee," was passed by unanimous vote. The midyear financial report was presented by Dr. Demerec. In discussion two points were emphasized: The desirability of investing certain funds of the Association, and the critical importance of finding a new treasurer. By unanimous vote, the Executive Committee, consisting of Mrs. G. S. Franklin, E. C. MacDowell, R. C. Murphy, W. B. Nichols, A. W. Page, and J. K. Roosevelt, was re-elected for the coming year. The Secretary reported that the legal procedures connected with the sale of the Stewart property were at the point of completion. Dr. Demerec reported that a legacy of \$1000 from the estate of the late Dr. Charles B. Davenport, for the establishment of a "Charles B. Davenport, Jr. Science Fund," had been accepted for the Association by the Executive Committee in a mail vote. It was voted that this Fund be made operative more quickly by addition from the Charles B. Davenport (Senior) Fund, and that the method of procedure be guided by advice of counsel.

A meeting of the Executive Committee of the Board of Directors was held on November 5, 1947, at the office of Vice-President Page, 46 Cedar Street, New York City. Three members were present, and two more were represented by voting instructions. Resolutions were unanimously adopted, accepting the resignation of Mr. Marshall Field from the Board of Directors and from the offices of Vice-President and Treasurer of the Association, and electing Mr. Grinnell Morris a member of the Board of Directors, in the Class of 1951, to fill the place vacated by Mr. Field. Mr. Grinnell Morris was then unanimously elected to the vacant office of Treasurer of the Association.

A second meeting of the Executive Committee was held on December 2, 1947, at 46 Cedar Street, New York City. A resolution was unanimously voted electing Mr. Grinnell Morris, Treasurer, a member of the Executive Committee and also a member and chairman of the Finance Committee. It was voted to accept the resignation of Mr. W. F. Dean as Assistant Treasurer, and to convey to him the thanks and appreciation of the Board of Directors for his long and faithful service in this capacity. The primary purpose of the meeting was to prepare and adopt the corporate resolutions necessary to remove the funds, securities, and documents of the Association, then held by the Bankers Trust Company, to the Central Hanover Bank and Trust Company, in order to facilitate the transactions of the Treasurer. These resolutions were unanimously voted, and the Secretary was authorized to execute the formal resolutions of corporation.

E. Carleton MacDowell, Secretary.

REPORT OF THE TREASURER

This year, the books of the Association were audited by Main & Co. Because all auditing firms are particularly busy immediately following the end of the calendar year, it seemed desirable to change our fiscal year to a period ending at a time when less audits are being made and auditors better able to devote time to our books. The fiscal year of the Association was, therefore, changed to end April 30, and the audit covers both the calendar year 1947 and the four months ended April 30, 1948.

During the depression years of the 1930's, income and contributions were sharply curtailed and, in order to carry on our work, it became necessary to use a portion of the funds making up the Matheson bequest which is unrestricted. During recent years our financial position has improved to the extent that the sums so used have now been entirely made up. Since the Matheson bequest is unrestricted as to purpose, no securities have been specifically allotted to it, it being considered as a part of the general investment fund of the Association.

There are various funds which were bequeathed to the Association for specific purposes. In the past, no specific securities were allotted to these bequests but it has been decided, as a matter of policy, that such an allotment should, in fact, be made and it is currently being done.

As a matter of policy, it was decided during the year that contributions received through the efforts of the Women's Auxiliary should be listed with all other contributions, rather than separately, as has been done in the past. Accordingly, although a larger sum was actually raised by the Auxiliary, only \$145 is listed as being received through this source and, in future years, this item will not appear on our balance sheet.

Grinnell Morris
Treasurer

MAIN AND COMPANY
Certified Public Accountants
New York, U. S. A.

AUDIT CERTIFICATE

Long Island Biological Association,
Cold Spring Harbor, L. I., N. Y.

We have made an examination of the accounts of the Long Island Biological Association for the period from January 1, 1947 to April 30, 1948. Without making a detailed audit of the transactions we have examined or tested the accounting records of the Association and other supporting evidence by methods and to the extent we deemed appropriate. We did not review the transactions prior to January 1, 1947 to determine if there were any funds not recorded in the books of account as of that date.

In our opinion, the accompanying balance sheet and related statements of income and expense and net worth, together with the note thereon, present fairly the position of the Long Island Biological Association at April 30, 1948 and the results of its operations for the period from January 1, 1947 to April 30, 1948.

Main and Company
Certified Public Accountants

New York, N. Y.,
June 15, 1948.

LONG ISLAND BIOLOGICAL ASSOCIATION
BALANCE SHEET

April 30, 1948

ASSETS

Cash		\$ 23,436.71
Investments (market value \$47,494.78)		47,210.21
Accounts receivable		395.49
Land, buildings and equipment, at cost or appraised values:		
Land	\$ 86,580.52	
Improvements to land	2,898.01	
Buildings	101,265.00	
Land and buildings leased from Wawepex Society	49,700.00	
Equipment	57,940.32	298,383.85
	Total	\$369,426.26

LIABILITIES, FUNDS AND NET WORTH

Liabilities:		
Accounts payable		\$ 7,251.69
Special grants:		
Schenley Laboratories, Inc.	\$ 7,304.04	
Josiah Macy, Jr. Foundation	1,624.89	
The Jane Coffin Childs Memorial Fund for Medical Research	303.17	9,232.10
	Total liabilities	\$ 16,483.79
Endowment Fund:		
Dr. William J. Matheson Bequest		20,000.00
Special Funds:		
Blackford Memorial Fund	\$ 5,000.00	
Charles Benedict Davenport Memorial Fund	4,981.25	
Charles Benedict Dayenport, Junior, Fund...	1,000.00	
Temple Prime Scholarship Fund	2,500.00	
Dorothy Frances Rice Fund	2,000.00	15,481.25
Net Worth		317,461.22
	Total	\$369,426.26

NOTE: In accordance with the Association's established practice the above balance sheet does not include the inventory at April 30, 1948 of the published volumes of the Association's yearly Symposia of Quantitative Biology, nor has any depreciation or amortization been recorded on buildings and equipment.

LONG ISLAND BIOLOGICAL ASSOCIATION
LAND, BUILDINGS AND EQUIPMENT

April 30, 1948

Land:			
Purchased with funds raised through public subscription....	\$69,580.52		
Henry W. de Forest land	12,000.00		
Airsleie land	5,000.00	\$ 86,580.52	
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Improvements to land:			
Pipe line	\$ 1,860.39		
Road	746.64		
Light and telephone poles	290.98	2,898.01	
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Buildings:			
Airsleie Building	\$ 5,000.00		
Blackford Hall*	19,000.00		
Cole Cottage	2,105.00		
Davenport Laboratory	8,500.00		
Henry W. de Forest Building	15,000.00		
Reginald G. Harris House	8,500.00		
Dr. Walter B. James Laboratory	13,500.00		
George L. Nichols Memorial Laboratory	13,700.00		
Williams House	11,300.00		
Urey Cottage	2,660.00		
Machine Shop and Garage	2,000.00	101,265.00	
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Land and buildings leased from Wawepex Society under lease expiring in 1979:			
Land	\$13,500.00		
Buildings:			
Hooper House	\$13,200.00		
Jones Laboratory	10,000.00		
Osterhout Cottage	5,500.00		
Wawepex Laboratory	7,500.00	36,200.00	49,700.00
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Equipment:			
General	\$38,577.27		
Biophysics	16,849.90		
Physiology	2,513.15	57,940.32	
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Total		\$298,383.85	
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* Built on land leased from Wawepex Society.

LONG ISLAND BIOLOGICAL ASSOCIATION

STATEMENT OF NET WORTH

For the Period from January 1, 1947 to April 30, 1948

Balance, January 1, 1947		\$313,624.59
Add:		
Excess of sale price over book value of Stewart Cottage	\$ 1,850.00	
Transfer of prior years' contribu- tions to net worth:		
Contribution received from Mrs. Acosta Nichols	\$ 5,000.00	
Rockefeller Foundation grant for Symposia	12,000.00	17,000.00
Transfer of balance in Wawepex Society Library Fund account	318.45	19,168.45
		\$332,793.04
Deduct:		
Adjustment of book value of in- vestments at January 1, 1947	\$ 2,402.13	
Excess of expense over income for the year ended December 31, 1947	7,700.24	10,102.37
		17,102.51
Balance, December 31, 1947		\$322,690.67
Deduct:		
Excess of expense over income for the period January 1, 1948 to April 30, 1948		5,229.45
Balance, April 30, 1948		\$317,461.22

LONG ISLAND BIOLOGICAL ASSOCIATION

STATEMENT OF INCOME AND EXPENSE

For the Year Ended December 31, 1947

Income:

Contributions:

Dues and contributions	\$5,088.63	
Carnegie Corporation (grant for annual Symposia) ..	6,000.00	
Wawepex Society	1,250.00	
Women's Auxiliary	145.00	\$12,483.63

Symposia:

Book sales	\$6,621.12	
Registration fees	63.00	6,684.12

Dining hall		9,236.29
Rooms and apartments		7,064.99
Interest and dividends on invest- ments		1,901.13

Other income:

Research fees	\$ 600.00	
Summer course tuition	450.00	
Refund of prior years' property taxes	655.76	
John D. Jones Scholarship	250.00	
Nature study course	172.90	
Annual distribution from Walter B. James Fund	125.00	2,253.66

Total income		\$39,623.82
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Expense:		
Symposia:		
Publication of Annual Symposia on Quantitative Biology	\$7,004.40	
Expense of Participants and Lec- turers	5,597.82	\$12,602.22
	<hr/>	
Dining Hall		10,448.62
Rooms and Apartments		2,029.14
Research Expenses		125.78
Scholarships:		
John D. Jones Scholarship	\$ 125.00	
Temple Prime Scholarship Fund...	75.00	200.00
	<hr/>	
Buildings and Grounds Maintenance:		
Salaries	\$5,877.75	
Material and Supplies	8,155.94	
Heat, Light and Water	1,485.88	15,519.57
	<hr/>	
General and Administrative Expense:		
Salaries	\$3,711.00	
Insurance	1,278.47	
Printing and Stationery	421.04	
Telephone and Telegraph	244.96	
Miscellaneous	743.26	6,398.73
	<hr/>	
		<hr/>
		47,324.06
Total Expense		
Excess of Expense Over Income		\$ 7,700.24
		<hr/> <hr/>

LONG ISLAND BIOLOGICAL ASSOCIATION

STATEMENT OF INCOME AND EXPENSE

For the Period January 1, 1948 to April 30, 1948

Income:

Contributions:

Dues and Contributions	\$ 182.50	
Carnegie Corporation (grant for annual Symposia) ..	6,000.00	\$ 6,182.50

Symposia—Book Sales		6,516.76
Rooms and Apartments		1,010.80
Interest and Dividends on Investments		256.25

Total Income		\$13,966.31
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Expense:

Symposia:

Publication of Annual Symposia on Quantitative Biology	\$7,479.67	
Expense of Participants and Lec- turers	3,359.80	\$10,839.47

Laboratory Research—Salaries		2,000.00
Summer Course Expense		114.00
Loss on Sale of Securities		30.31

Buildings and Grounds Maintenance:

Salaries	\$2,073.30	
Material and Supplies	1,242.64	
Heat, Light and Water	689.88	4,005.82

General and Administrative Expense:

Salaries	\$1,415.00	
Insurance	305.53	
Printing and Stationery	271.03	
Telephone and Telegraph	94.41	
Miscellaneous	64.30	2,150.27

Other Expense		55.89
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Total Expense		19,195.76
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Excess of Expense Over Income		\$ 5,229.45
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SUSAN COOPER