LONG ISLAND BIOLOGICAL ASSOCIATION

ANNUAL REPORT

OF

THE BIOLOGICAL LABORATORY

COLD SPRING HARBOR
LONG ISLAND, NEW YORK
1945

LONG ISLAND BIOLOGICAL ASSOCIATION

INCORPORATED 1924

ANNUAL REPORT

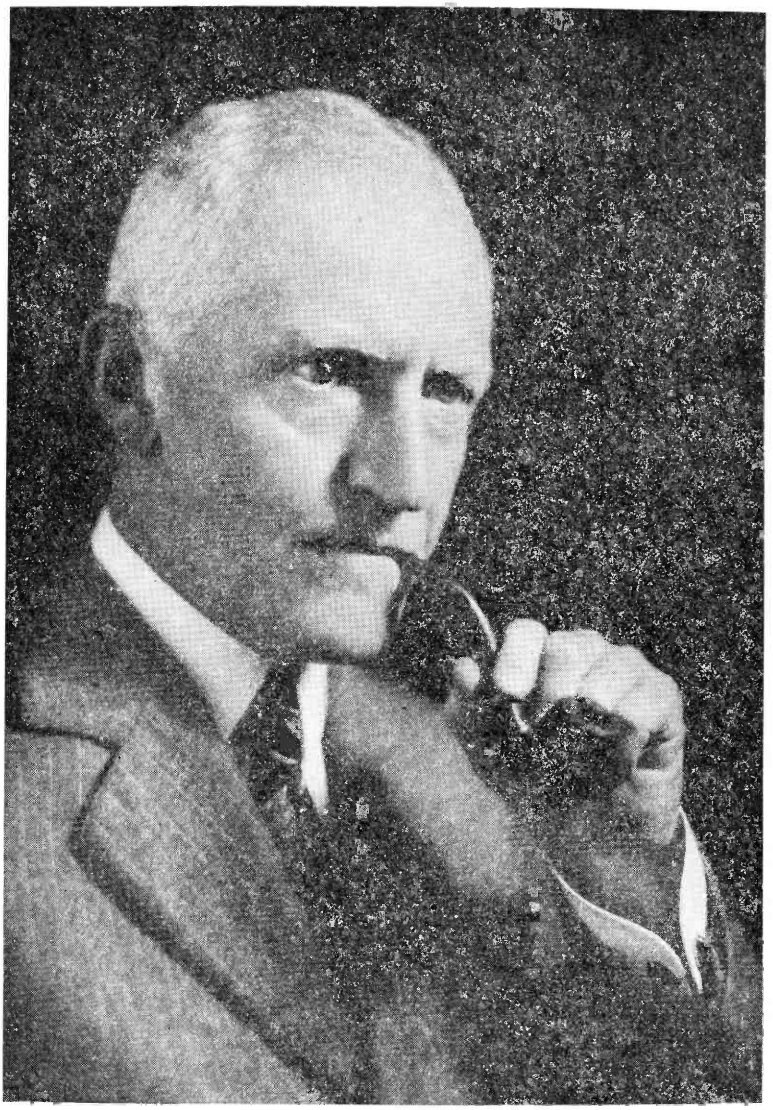
OF

THE BIOLOGICAL LABORATORY

FOUNDED 1890

FIFTY-SIXTH YEAR

1945



Acosta Nichols

In memory of
ACOSTA NICHOLS,
friend and officer
of the Association.

TABLE OF CONTENTS

THE LONG ISLAND BIOLOGICAL ASSOCIATION

President
Robert Cushman Murphy

Vice-President
Arthur W. Page

Secretary
E. C. MacDowell

Vice-President and Treasurer
Marshall Field

Assistant Secretary
B. P. Kaufmann

Asst. Treasurer and Auditor
William F. Dean

Director of The Biological Laboratory, M. Demerec

BOARD OF DIRECTORS

To serve until 1949

H. A. Abramson.....Cold Spring Harbor, N. Y.
M. Demerec.....The Biological Laboratory
Henry Hicks.....Westbury, N. Y.
Stuart Mudd.....University of Pennsylvania Medical School
Robert Cushman Murphy.....American Museum of Natural History
John K. Roosevelt.....Oyster Bay, N. Y.

To serve until 1948

W. H. Cole.....Rutgers University
Mrs. George S. Franklin.....Cold Spring Harbor, N. Y.
E. C. MacDowell.....Cold Spring Harbor, N. Y.
William B. Nichols.....Syosset, N. Y.
Roland L. Redmond.....Oyster Bay, N. Y.
B. H. Willier.....Johns Hopkins University

To serve until 1947

†Charles M. Bleecker.....Cold Spring Harbor, N. Y.
Marshall Field.....Huntington, N. Y.
Ross G. Harrison.....Yale University
B. P. Kaufmann.....Carnegie Institution
Arthur W. Page.....Huntington, N. Y.
Harlow Shapley.....Harvard University

To serve until 1946

Robert Chambers.....New York University
George W. Corner.....Carnegie Institution of Washington
Th. Dobzhansky.....Columbia University
Mrs. Van S. Merle-Smith.....Oyster Bay, N. Y.
John M. Schiff.....Oyster Bay, N. Y.
Harold C. Urey.....Columbia University
Willis D. Wood.....Huntington, N. Y.

Members Emeriti

R. C. Leffingwell ..... Oyster Bay, N. Y.
Henry L. Stimson ..... Huntington, N. Y.
†H. E. Walter ..... Providence, R. I.

EXECUTIVE COMMITTEE

Mrs. G. S. Franklin
E. C. MacDowell
Robert Cushman Murphy
William B. Nichols
Arthur W. Page
John K. Roosevelt

FINANCE COMMITTEE

Marshall Field
William B. Nichols
Willis D. Wood

BUILDINGS AND GROUNDS COMMITTEE

Mrs. George S. Franklin, Chairman

Mrs. Percy H. Jennings
Henry Hicks
B. P. Kaufmann
William B. Nichols

SCIENTIFIC ADVISORY COMMITTEE

George W. Corner, Chairman

L. C. Dunn
Alexander Hollaender
E. C. MacDowell
Alfred E. Mirsky

†Deceased

Members of the Long Island Biological Association

Founders

By contribution of at least $5,000 in money or property

Carnegie Corporation
Mrs. Ethel Clyde
Mrs. Henry W. de Forest
Mrs. Leonard Elmhirst
Marshall Field
Mrs. Walter B. James
Mrs. Otto H. Kahn
Russell C. Leffingwell
John & Mary Markle Foundation
Mrs. Van Santvoord Merle-Smith
Mrs. Acosta Nichols
Arthur W. Page
Rockefeller Foundation
John M. Schiff
Wawepex Society

Deceased

Mrs. Eugene Blackford
Henry W. de Forest
Dr. Walter B. James
Walter Jennings
John D. Jones
Wilton Lloyd-Smith
William J. Matheson
J. P. Morgan
Acosta Nichols
Mortimer L. Schiff
William K. Vanderbilt
Col. T. S. Williams
Robert B. Woodward

Patrons

By contribution of at least $500

Miss Rosina Boardman
John Chase
W. R. Coe
John W. Davis
Mrs. Henry W. de Forest
W. E. Erhart
S. A. Everitt
Childs Frick
Hugo Fricke
Princess Andrew Gagarin
Mrs. Walter Jennings
Alfred Ephraim Kornfeld
Russell C. Leffingwell
Gerald M. Livingston
Mrs. Wilton Lloyd-Smith
Van Santvoord Merle-Smith
A. G. Milbank
Mrs. George Nichols
Herbert L. Pratt
Victor Rakowsky
John K. Roosevelt
Walter J. Salmon
Carl J. Schmidlapp
Donald Scott
Howard C. Smith
Henry L. Stimson
Henry C. Taylor
William C. Whitney Foundation
George Whitney
Willis D. Wood
Mrs. Willis D. Wood

Deceased

James C. Ayer
Frank L. Babbott
Eugene Blackford
Charles M. Bleecker
Nicholas F. Brady
Thomas Cochran
Paul D. Cravath
Charles B. Davenport
Mrs. Charles B. Davenport
Robert W. de Forest
Mrs. Robert W. de Forest
Cleveland H. Dodge
F. N. Doubleday
Edward Floyd-Jones
Edward S. Harkness
Mrs. E. H. Harriman

Reginald G. Harris
A. Augustus Healy
August Heckscher
Anton G. Hodenpyl
Frank S. Jones
Oliver L. Jones
Miss Mabelle F. Lane
Ogden L. Mills
William H. Nichols, Jr.
Henry F. Noyes
Isaac R. Oeland

Frederick B. Pratt
George D. Pratt
Harold I. Pratt
Cornelia Prime
Oran W. Rice
W. Emlen Roosevelt
Mrs. W. Emlen Roosevelt
Clarence W. Seamans
Louis C. Tiffany
Walter J. Whipple
Mrs. Timothy S. Williams

Sustaining Members

David Aboff
Harold A. Abramson
Winthrop W. Aldrich
Justin M. Andrews
Henry F. Atherton
H. A. Baylis
Dennistoun M. Bell
Frederick Bernheim
T. Bache Bleecker
Edward C. Blum
Harold F. Blum
D. Bodenstein
George Bowdoin
Vernon Bryson
Dean Burk
McKeen Cattell
Robert Chambers
John Chase
F. S. Child
H. B. Child
Edward D. Churchill
Elizabeth R. Cole
Kenneth S. Cole
William H. Cole
George W. Corner
Paul Cushman
W. N. Davey
F. Trubee Davison
Max Delbruck
M. Demerec
Abigail C. Dimon
Th. Dobzhansky
Ugo Fano
Marshall Field
Ernst Fischer

Alexander Forbes
Childs Frick
Ralph W. Gerard
H. Bentley Glass
Myron Gordon
Charles V. Graham
Susan A. Green
Ross G. Harrison
Miner C. Hill
Alexander Hollaender
Gail H. Holliday
Davenport Hooker
G. Beekman Hoppin
Mrs. S. C. W. Hoppin
Clarence A. Horn
Mrs. Walter B. James
Everett C. Jessup
E. Elizabeth Jones
B. P. Kaufmann
Frances Kuchler
Mrs. Ruth Ledyard
Mrs. Wilton Lloyd-Smith
S. E. Luria
E. C. MacDowell
Duncan A. MacInnes
John F. Mackay
Ernst Mayr
Ward Melville
Mrs. Van Santvoord Merle-Smith
Leo M. Meyer
Dudley H. Mills
Alfred E. Mirsky
Louis de B. Moore
Mrs. Louis de B. Moore
Henry S. Morgan

Stuart Mudd
James Murphy
Robert Cushman Murphy
James Neel
William B. Nichols
Charles Packard
Arthur W. Page
G. H. Parker
John C. Parker
Francis T. P. Plimpton
Henry S. Pratt
Richardson Pratt
Isaac Prussin
Otto Rahn
Nicolas Rashevsky
Roland Redmond
Oscar W. Richards
Harry C. Robb
John K. Roosevelt
S. A. Salvage
Charles E. Sammis, Inc.
John M. Schiff
Francis O. Schmitt
Schwartz Brothers
Harlow Shapley
Ida Sitler
B. Sonnenblick
Carl C. Speidel
Henry L. Stimson
George F. Sykes
Henry C. Taylor
Isabel H. Tuthill
Harold C. Urey
Roy A. Waggener
Harry E. Warmke
Charles O. Warren
Katherine Brehme Warren
Wawepex Society
B. H. Willier
Willis D. Wood
W. Wilton Wood
Sewall Wright
S. Zamenhof

The following, though not members of the Long Island Biological Association, have contributed to the Land and Endowment Fund:

E. LeGrand Beers
Albert D. Silver
J. G. Dettmer
William G. Loew
John Hill Morgan
Acosta Nichols, Jr.
George Lane Nichols
C. J. Peabody
James H. Post
W. A. Putnam
Herman Stutzer

WOMEN'S AUXILIARY BOARD

President—Mrs. George S. Franklin
Vice-President—Mrs. Van Santvoord Merle-Smith
Secretary—Mrs. Alvin Devereux
Treasurer—Mrs. George Nichols
Chairman, House Committee—Mrs. Percy H. Jennings
Chairman, Membership Committee—Mrs. John C. Hughes

Benefactors

(By contribution of $100 or more)

Mrs. F. Huntington Babcock
Mrs. G. Beekman Hoppin
Mrs. Walter Jennings
Mrs. Van Santvoord Merle-Smith
Mrs. Acosta Nichols
Mrs. Roland Redmond

Sustaining Members

(By contribution of $10 or more)

Mrs. H. A. Abramson
Mrs. Henry Anderson
Mr. Charles B. Belt
Mrs. Charles B. Belt
Mrs. Charles Bleecker
Mrs. Kenneth S. Boardman
Mrs. Trowbridge Callaway
Mrs. C. T. Church
Mr. C. T. Church
Mrs. Henry P. Davison
Mrs. Henry L. de Forest
Mrs. Henry W. de Forest
Mrs. Alvin Devereux
Mrs. John Foster Dulles
Mrs. Walter K. Earle
Mrs. George S. Franklin
Mrs. Childs Frick
Mrs. William B. Given
Mrs. Winston Hagen
Mrs. Paul Hammond
Mrs. John C. Hughes
Mrs. Henry James
Mrs. Walter B. James
Mrs. Percy H. Jennings
Mrs. Otto Kahn
Mrs. Hugh Knowlton
Mrs. Russell C. Leffingwell
Mrs. Wilton Lloyd-Smith
Mrs. Ray Morris
Mrs. George Nichols
Mrs. William B. Nichols
Mrs. John W. Nields
Mrs. D. Grinnell Noyes
Miss Isabel Peters
Mrs. Harold I. Pratt
Mrs. Lansing P. Reed
Mrs. Gordon S. Rentschler
Mrs. Philip J. Roosevelt
Mrs. Theodore Roosevelt, Sr.
Mrs. Stanley M. Rumbough
Mrs. J. Barstow Smull
Mrs. Henry L. Stimson
Mrs. Francis M. Weld
Mrs. Willis D. Wood

Members

(By contribution of $5)

Mrs. Charles E. Ames
Mrs. J. Howland Auchincloss
Mrs. Daniel Bacon
Mrs. T. Bache Bleecker
Miss Rosina Boardman
Mrs. Herbert Bodman
Mrs. George E. Brower
Mrs. W. Averall Brown
Mrs. Henry E. Coe, Jr.
Mrs. Paul Cushman
Mrs. F. Trubee Davison
Mrs. M. Demerec
Mrs. Richard Derby
Mrs. James A. de Tomasi
Mr. Fairman R. Dick
Mrs. Fairman R. Dick
Mrs. Russell Doubleday
Mrs. Albert H. Ely, Jr.
Mrs. Luis J. Francke
Mrs. Hamilton Hadden
Mrs. Ashton Hawkins
Mrs. Miner C. Hill
Mrs. S. C. W. Hoppin
Mrs. George Hornblower
Mrs. Myron Jackson
Mrs. Frederic R. King
Mrs. Francis S. Kinney
Mrs. José A. Machado, Jr.
Mrs. Robert B. Meyer
Mrs. Robert Cushman Murphy
Mrs. D. Chester Noyes
Mrs. Arthur Page
Mrs. John E. Rousmaniere
Mrs. Donald Scott
Mrs. Charles J. Symington
Mrs. Henry C. Taylor
Miss Dorothy Truesdell
Mrs. Donaldson Tucker
Miss Marguerite Valentine
Mrs. H. E. Walter

Honorary Members

Mrs. Robert Bacon
Mrs. Andrew Carnegie
Mrs. Leonard K. Elmhirst
†Mrs. E. H. Harriman
†Mrs. Anton G. Hodenpyl

†Deceased

THE PEACE-TIME COURSE

Since I first had the honor of including a presidential greeting in the Annual Report of the Laboratory our organization has been metamorphosed in its adaptation to quasi-peace and war. Today the cycle has been completed and we look forward with confidence to the challenge of a world at peace.

The title of my remarks in the report for 1941 was "Retrospect and Faith." They dealt with the antecedents and history of the Laboratory, and with the continuity of purpose that has made and kept it a national asset. The account for 1942, entitled "Holding the Lines," pointed out the special value of the Laboratory, as created by decades of normal development, in a time of emergency. That for 1943—"Another War Year"—referred to the prosecution of confidential investigation geared to victory, but also reported the good news that research in pure science had not been wholly crowded out by the urgency of combat requirements. In 1944, the "Forecast of Peace" looked toward the revival that has now come, in this summer of 1946, with the resumption of our distinguished Symposia on Quantitative Biology.

So, once again, we are pointed on our true course. In the present Annual Report members may review some of the war work dealing with electronics, aerosols, penicillin, and other experimental matters successfully carried through at Cold Spring Harbor. They may rejoice, too, that findings made under the auspices of the Chemical Warfare Service have turned out to be as important for the art of healing as for the ends of destruction. They will learn also that the relinquishing of our space by Government agencies has left us richer in the possession of surplus technical equipment, but that the problems of housing and other necessities and comforts remain entirely on the agenda of our friends.

The Director's report for 1945 tells a gratifying story of research in pure science and of such advanced and highly specialized instruction as the course in the study of bacterial viruses, which notably widens the approaches to new research. It describes also the usefulness and the limitations of the small electron microscope generously lent us by the Radio Corporation of America. We look forward to the day when a larger instrument of this kind may form part of our permanent equipment.

The range of optical microscopes is restricted by the fact that they can reveal no objects smaller than the wave length of light. The wave of electron flow, a hundred thousand times shorter than that of visible light, can now be focused by magnets, as light is focused by lenses. Magnifications of 200,000 diameters are possible, the meaning of which, as explained by Dr. Hillier, one of the inventors of the electron microscope, is that an inch-long cockroach would attain a length of three miles! The application, however, is not to such gigantic whole animals, but rather to cell structures with dimensions of less than a thousandth part of a milimeter.

Three years ago I wrote: "Mars invariably finds means to keep his helpers going. Next year, as last, we can undoubtedly claim the resources and furnish the housing that should and must take precedence over all else."

That time is now past. The Laboratory is once more exclusively in the hands of its proper crew. It is primarily a Long Island undertaking, probably destined to receive the bulk of its permanent support from that area. When I consider the moderate nature of our fullest wants, the much that can be accomplished with so relatively little, I feel that all we need to do is to state the case. It is its own best advocate. It is something in which every Long Islander can take pride and with which he or she would desire affiliation.

ROBERT CUSHMAN MURPHY, President

The Long Island Biological Association, Inc.

REPORT OF THE DIRECTOR

Our expectations that the end of the war would allow us to return to a state bordering on normalcy have unfortunately not been fulfilled. For the most part, the shortages that existed during the war have not been relieved, and today we are in no better position than we were then to enter upon a badly needed program of physical rehabilitation. The shortage of building materials such as lumber, plumbing, and electrical equipment is so acute, and the building restrictions are so stringent, that we have had to abandon our hope for an early relief of our crowded housing situation. The building of summer cottages has had to be postponed until conditions become more stable.

By utilizing opportunities offered by the disposal of Government surplus property, the Laboratory has acquired at very reasonable expenditure a few pieces of otherwise expensive equipment, including autoclaves and hot-water baths for bacteriological work, a few optical instruments, and some equipment for residences. We hope to profit further from the opportunity offered by the sale of surplus property.

During the year 1945 the Laboratory suffered a heavy loss through the death of two active members and one member emiritus of the Board of Directors—Messrs. Acosta Nichols, Charles M. Bleecker, and H. E. Walter. Mr. Acosta Nichols had been a member of the Board of Directors since 1927 and a member of its Executive Committee from 1930 through 1940. In 1927 he and Mrs. Nichols gave to the Laboratory the funds that made it possible to build the George Lane Nichols Memorial Laboratory. Mr. Charles M. Bleecker had been a member of the Board of Directors since 1926. He was also a member of the governing board of the Wawepex Society, which has generously contributed towards the support of the Laboratory. Dr. H. E. Walter's connection with the Laboratory began in 1906, when he gave a couse in Field Zoology here. Through his effort and ability, this course became one of the best in the country and attracted a large number of students. When in 1924 the Long Island Biological Association was incorporated, he became a member of the Board of Directors, and in 1943 he was elected an emeritus member.

War Research

At the January 1945 meeting of the Board of Directors it was proposed that we obtain for our files a statement about the work conducted in several of our buildings by the Airborne Instruments Laboratory, Columbia University, Division of War Research. In reply to a request for such a statement, the following letter, dated July 31, 1945, was received from Dr. O. W. Towner, Director of the Airborne Instruments Laboratory:

"On behalf of this Laboratory and Columbia University, I wish to express our thanks for the many favors and the sympathetic cooperation of your organization during our use of your Cold Spring Harbor facilities.

"The urgent need for an electrically quiet location for research and testing in the development of anti-submarine devices necessitated the

establishment of a branch laboratory remote from the city. A survey of this area disclosed that your laboratory property was electrically and magnetically satisfactory and we are very grateful for your aid in making a portion of your facilities available to us. This enabled us to materially simplify our development and testing program and undoubtedly shortened the time necessary to get the equipment into operational use. We are told that our equipment contributed substantially to the United Nations anti-submarine warfare program.

"Our branch laboratory at Cold Spring Harbor was established about November, 1942. Activity at this location increased until the staff regularly assigned grew to approximately twenty-four scientists and engineers, with an additional group of wiremen, guards, and janitors. In addition, there was a continual flow of scientific and nonscientific personnel between the Mineola laboratory and the Cold Spring Harbor branch, as required by current research work. The result of this activity was an increasing need for floor space, for which arrangements were readily made, until we occupied the Biophysics Laboratory Building, the Urey Cottage, the Davenport Laboratory and the boathouse. These facilities represented approximately 5000 square feet of laboratory area.

"Another development which resulted from our work at Cold Spring Harbor, was a new technique and the necessary equipment for the measurement of the earth's magnetic field, and this equipment is now in operation at the Magnetic Observatory of the United States Coast and Geodetic Survey, at Tucson, Arizona.

"The successful conclusion of our development work on these projects permitted this Laboratory to turn to other urgent research problems, the execution of which did not require the use of the Cold Spring Harbor facilities. We, therefore, terminated our occupancy in February of this year in order that the buildings which we occupied while our need was urgent, could be used for other important purposes.

"We regret that we cannot, at this time, give you a full account of our activities, but a lengthy technical report is being prepared for the OSRD files, and it will cover all of our activities at the Long Island Biological Association's laboratory at Cold Spring Harbor."

At the January 1946 meeting of the Board of Directors, Harold Abramson, M.D., Lt. Col. M.R.C. was asked to prepare a summary statement about the war research done by the Laboratory under contract with the War Department. Since Dr. Abramson while in the Army was in charge of our research program, he had a good background for the preparation of the desired statement. His report appears on pages 22 and 23.

During the past year the Laboratory carried on two active research projects under contract with the War Department—one for the Technical Division and the other for the Medical Division of the Chemical Warfare Service. A brief progress report prepared by Dr. Vernon Bryson is given in the section on Reports of Investigators.

Research

Simple observations show that living organisms grow and that they reproduce. But the exact processes of this reproduction are not known, and at present the problem of how living matter multiplies is one of the key problems of modern biology. It is being studied by experimentation with various organisms—some highly developed, others simple, unicellular. For a number of years Professor Max Delbruck, of Vanderbilt University, has been studying multiplication in bacterial viruses (bacteriophages), which are classified among the simplest living organisms. Some of his work has been carried out at this Laboratory during past summers, and has been mentioned in our reports. Dr. Delbruck is particularly interested in the analysis of processes connected with the multiplication of two different viruses that attack the same bacterium. He had found earlier that in such cases the two virus particles are mutually exclusive; that is, if one of them grows the other one will not, and vice versa. It appears that this rule, which seemed to be general, breaks down in the case of clearly related viruses, one of which originated as a mutant from the other (T2a and T2b; T4a and T4b). Last summer Dr. Delbruck began work on the solution of this unexpected phenomenon.

Dr. A. H. Doermann, an associate of Dr. Delbruck, studied the problem of "lysis inhibition." Some bacteriophages, when present in a certain number, destroy (lyse) bacteria within 21 to 25 minutes, while if their number is larger it takes almost eight hours to accomplish the destruction. Since this destruction is a consequence of the multiplication of phage within the bacteria, this problem too is essentially a study of the processes involved in multiplication of living organisms .

Miss Phyllis Margaretten, of the University of Illinois, carried on preliminary investigations with a newly isolated strain of bacterial virus, which turned out to require special conditions for its growth.

Dr. Martha Baylor, of the University of Illinois, and Messrs. J. Reynolds of Vanderbilt University, and T. Sigurgeirsson of the University of Rejkjavik (Iceland), tested the applicability of a console model of the R.C.A. electron microscope to problems of bacterial virus morphology. They found that the console model was too small for efficient research with bacteriophages.

Mrs. Jean Palmer, of the Department of Genetics, cooperated with Dr. Delbruck in the development of a technique for study of the internal structure of bacteria. Mrs. Palmer was successful in developing a staining method by means of which nucleus can be differentiated inside a bacterium.

Microscopic study of the structure of yeast cells was carried on by Miss Lillian Nagel, of Washington University, St. Louis, Missouri, who held the Dorothy Frances Rice Scholarship. Miss Nagel was particularly interested in observing the stages of cell division that give rise to the formation of spores.

It is now about 35 years since the little vinegar fly (Drosophila) began to be used as experimental material for the study of heredity. Because of the simplicity with which these flies can be bred, they soon became the most extensively used organisms for research in genetics, and they have contributed to our knowledge of the fundamental laws of heredity more than all the other organisms used in experimentation. Our Laboratory has good facilities for research with Drosophila, and these were well utilized last summer. Dr. E. Mayr, of The American Museum of Natural History, and Professor C. C. Tan, of the University of Chekiang, China, investigated the biological factors that are instrumental in keeping two species of Drosophila isolated from each other. It is known that isolation is one of the important factors in organic evolution, and therefore an understanding of the mechanism producing isolation should contribute towards a better understanding of the processes of evolution.

Dr. J. Schultz, of the Lankenau Hospital Research Institute, Philadelphia, Pennsylvania, studied the penetration of aqueous aerosols of various dyes into the respiratory and digestive tracts of adult Drosophila. Mr. Werner K. Maas, of Columbia University, investigated the chemistry of the eye pigments of various strains of Drosophila; and Mr. B. Spassky, also of Columbia University, spent the summer in building up stock cultures for future experiments.

In continuing work on war research projects, Dr. V. Bryson and his collaborators studied the ability of germicidal mists to sterilize air and exposed surfaces. They found that hydrogen peroxide aerosol is effective in reducing the bacteria present in dust. In their study of antibiotic aerosols for the treatment of pulmonary diseases, they worked with combinations of substances having possible value for the treatment of pathological conditions, and carried on fundamental studies of lung permeability. The most interesting development resulted from studies of antibacterial synergisms; that is, conditions whereby two or more substances in combination exert on bacteria an effect that is markedly greater than the sum of their individual effects. Very satisfactory clinical results were achieved, in collaboration with Dr. E. J. Grace, in treating chronic osteomyelitis with penicillin-detergent solutions.

Doctors Marta G. and Otto Lowenstein, of New York University, continued their experiments of last summer concerning the relationship between a certain part of the brain and the pupillary movements of the eye. Dr. Leo M. Meyer, of the Kings County Hospital, Brooklyn, studied changes in the bone marrow in experimentally induced mouse leukemia, using animals from the mouse colony of Dr. E. C. MacDowell, of the Department of Genetics.

Doctors Myron Gordon, of the New York Zoological Society, A.B. Novikoff, of Brooklyn College, and M. F. A. Montagu, of Hahnemann Medical College, utilized their stay at the Laboratory for writing. Dr.Gordon completed two papers dealing with the genetics of fishes; Dr. Novikoff prepared lectures for the following academic year, and edited

his book on evolution for children; while Dr. Montagu organized material for a book dealing with the relative sterility of the adolescent female mammal.

Course on Bacteriophages

The primary purpose of this course initiated in the summer of 1945, is to familiarize scientists with new methods that have been developed recently, and to stimulate interest in research with bacterial viruses. This is another pioneer undertaking of the Laboratory. The course was organized and taught by Professor Max Delbruck, of Vanderbilt University. It was very successful.

Lectures

In arrangements for lectures and seminar sessions, there was close cooperation between the Laboratory and the Department of Genetics. The regular thirty-minute seminars held three times a week at the Department of Genetics were attended by the members of the Laboratory. These sessions were devoted to reviews of current literature and brief reports about current research.

Technical lectures were given weekly by members of the Laboratory and of the Department of Genetics. They were held on Thursday afternoon rather than in the evening, in order to accommodate those who work at the laboratories but live at a distance. Arrangements for these lectures were in charge of Dr. Margaret McDonald, chairman of the Seminar Committee at the Department of Genetics. A list of titles is given below:

June 7: W. F. Hollander, Department of Genetics. Hermaphrodites in pigeons.

June 14: Thomas Grubb, Vick Chemical Research Laboratories. Exposed pulps of teeth as possible portal of entry for poliomyelitis virus.

June 21: James F. Crow, Dartmouth College. Isolating mechanisms in the mulleri group of Drosophila.

June 28: Edgar Anderson, Washington University. Modern and prehistoric popcorn.

July 12: A. H. Doermann, Stanford University. The lysineless mutants of Neurospora crassa.

July 19: Alex B. Novikoff, Brooklyn College. The concept of integrative levels and biology.

July 26: James Neel, University of Rochester. Inherited cataract in the B genealogy.

August 2: Rollin D. Hotchkiss, Hospital of the Rockefeller Institute. The antibiotic agents Gramicidin and Tyrocidin.

August 9: Herman M. Kalckar, Public Health Research Institute of the City of New York. New methods for the study of purines and nucleic acids.

August 20: Lillian Nagel, Washington University. The genetics of yeast.

August 23: C. C. Tan, Chekiang University, China. The genetics of the ladybug, Harmonia axyridis.

August 30: M. F. Ashley Montagu, Hahnemann Medical College. Adolescent sterility.

Dining Room

Because of the continuance of the labor shortage and of food rationing, and because no Symposium meeting was held, the Blackford Hall dining room remained closed this summer. Members of the Laboratory who were here for short periods of time, or were unable to provide meals for themselves, were accommodated at the dining room of the Department of Genetics, Carnegie Institution.

Laboratories and Equipment

The George Lane Nichols Memorial Laboratory was used throughout the year for work on the war research projects. The other laboratory buildings were in use during the summer. As has already been reported, the Laboratory acquired several pieces of equipment through the purchase of Government surplus property.

Buildings and Grounds

The only major repairs were made early in the year and consisted of new flooring and repapering in Urey Cottage. This building had been used for two years by the Airborne Instruments Laboratory, and required redecorating. Other work on buildings included minor repairs and 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 Auxiliary Board, under the presidency of Mrs. George S. Franklin, made an important contribution toward the support of the scientific work of the Laboratory; and the House Committee of the Board, under the chairmanship of Mrs. Percy H. Jennings, collected furniture for residences and contributions for the purchase of additional furnishings.

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 the special library fund contributed this year for the second time.

The Laboratory is grateful to the Josiah Macy, Jr. Foundation for its grant in support of the war research project.

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

Acknowledgment is made to the Radio Corporation of America for its loan to the Laboratory of an electron microscope for use during the summer of 1945. We are grateful to Dr. V. K.. Zworykin for arranging this loan, and to Dr. James Hillier for setting up the instrument.

RESEARCH ON WAR PROJECTS

Harold A. Abramson, M.D., Lt. Col. M.C.Res.

Introduction

This is a report on the accomplishments of the Biological Laboratory, Cold Spring Harbor, from the time of its first contract with the Chemical Warfare Service, September, 1942, to approximately March, 1946. The material has been brought together here for the first time, benefiting by the point of view which the writer had as a member of the staff in charge of aerosols of the Commanding General, Technical Division, Chemical Warfare Service. The report must be considered informal and not as representing the attitude of the War Department.

In July, 1942, the Chief of the Chemical Warfare Service was responsible for two classes of chemical warfare agents:

(a) Those agents that produce chemical injury of the lungs, such as mustard, phosgene, and other similar war gases.

(b) Those agents, classified under the heading of biological warfare agents, recently made public in a report by Mr. George Merck. This report has been summarized in a recent issue of "The New York Times". Any deviation from earlier secrecy classification presented in the present report will be justified by the report in "The New York Times". Confidential or highly classified information cannot be released. The agents of biological warfare include bacteria and viruses. None of these may yet be mentioned specifically because of classification restrictions.

Since most of the agents mentioned produce lung injuries, it was quite important to have a group of scientists study methods of prevention and treatment of disease of the lungs produced by both types of chemical warfare agent. It was decided in September, 1942, to set up at the Biological Laboratory, Cold Spring Harbor, where previous work had been done on similar subjects, a fundamental study of aerosols. An aerosol is a mist or cloud, like tobacco smoke, which can, in most cases, be breathed into the respiratory tract and—if the particle size is correct—penetrate deeply into the lungs. It was hoped that aerosols would be found useful either in destroying germs and chemical substances while they were in the air or else in treating the lungs, by means of inhaled therapeutic agents, after lung injury had occurred.

The approval of the Commanding General of the Technical Division was obtained, and financial assistance was given for the project by the Josiah Macy, Jr. Foundation of New York City. At that time, it was deemed desirable to get outside assistance for the medical aspects of the project; and the Macy Foundation supported, in part, the War Department work mentioned throughout this report.

Particle Sizes of Aerosols

It was of very great importance to develop some standard method of finding out how large the particles of aerosols or mists should be in order to penetrate the lungs and affect their healing processes. The first problem of the Biological Laboratory, therefore, was to make a fundamental study of methods for determining the particle-size distribution of different types of mists. Not only therapeutic aerosols were studied, but also germicidal aerosols for decontaminating air outside of the body. Dr. Milislav Demerec, in collaboration with Dr. J. S. Potter and Mr. Sidney Laskin, developed a method for direct visualization of particle size in mists of many types. At that time, 1943, a method of this type had not yet been developed by the members of the Technical Division or of other Divisions of the Chemical Warfare Service, and the reports of the Biological Laboratory were eagerly awaited for information about the way in which many types of commercial atomizers and nebulizers behaved. The importance of particle-size distribution can be appreciated if one recalls that only certain very small particles can enter the lungs and that a slight change in the size of particles may mean that most of the material becomes useless as a therapeutic agent for the lungs. This method of direct study of particle-size distribution was first developed by the Laboratory, and served throughout the war as a standard for calibration of other methods of determining particle-size distribution.

Development of Plastic Nebulizer

In the event of chemical warfare, large numbers of individuals might be injured by toxic and other agents causing lung damage. One of the ways of treating lung damage is to have the patient breathe healing mists deep into the recesses of the lungs to treat the injury and infections. When the Laboratory began the aerosol study, there was no suitable plastic nebulizer rugged enough to be used to set up standards; and the Laboratory collaborated with the Technical Division of the Chemical Warfare Service, as well as with the Office of the Surgeon General, in setting up suitable standards for the development of plastic nebulizers. Contacts were made with commercial firms and, directly as a result of work done at the Laboratory, specifications were set up and pilot models were made. At the close of the war, one company was actually producing a plastic nebulizer for the War Department and another company had a model ready for production if desired. This contribution of the Laboratory effected coordination in the design and development of plastic nebulizers. Different manufacturers of nebulizers had insisted that their models were "the best" for the treatment of the lungs. The Laboratory acted, by virtue of its fundamental studies of particle-size distribution, as a judge on the calibration and acceptability of nebulizers. This opinion was vital, and guided the War Department in the choice of suitable equipment for what would have been one of the most important methods of treating lung casualties if chemical warfare had supervened. Moreover, this method has proved to be of great importance in clinical medicine.

The Cold Spring Harbor Nozzle

In connection with its fundamental studies of aerosols, the Laboratory was asked to perform an almost impossible task; i.e., the development of nozzles for the production of screening smokes, using low pressures. The Laboratory did very ingenious experiments, using steam and hot oil, but the screening smokes set up by the nozzles developed did not match those produced by other methods. However, the Cold Spring Harbor nozzles, which were the first of their kind, produced large-volume aerosols at low pressure. Indeed, one of these nozzles, with a low-pressure source, can set up germicidal mists in a small room in a matter of seconds. These precision instruments were requested by at least one secret and two "top secret" installations during the war. Unfortunately, the secrecy connected with the use of these atomizers was so great that the writer knows only partially the use to which they were put.

Germicidal Aerosols

The Cold Spring Harbor nozzle mentioned in the foregoing section was one of the few methods then available of producing mists to control the bacterial content of the air. Other methods were in a state of development. The Army was interested in glycol aerosols. The Navy was especially interested in ultraviolet decontamination of the air. The Office of the Air Surgeon found it desirable, nevertheless, to collaborate with the Laboratory in studies on the use of sodium hypochlorite aerosols to decontaminate the air of barracks. Experiments were set up at two installations of the Army Air Force, Mitchel Field and Truex Field, where the potentialities of decontamination of the air by means of Cold Spring Harbor nozzles were studied. More recently, Dr. Bryson of the Laboratory has found that hydrogen peroxide aerosols have unique properties. These aerosols actually destroy very resistant microorganisms embedded in dust particles. In view of the possibilities of bacteriological warfare and of radioactive warfare recently publicized, it is evident that these experiments are worthy of special note.

Penicillin Aerosol

The use of penicillin in aerosol form has become—in the short space of two years since the appearance of the first paper published from this Laboratory (Bryson, Sansome, and Laskin, 1944)—a routine technique in most of the hospitals and offices of physicians in the United States and abroad. It bids fair to become one of the most important methods of controlling suppurative disease of the lungs, and may be important in controlling secondary infection in tuberculosis. Following is a biblography of penicillin aerosols, from the Bryson paper in July, 1944, to the spring of 1946:

1944—Bryson, V., Sansome, E., and Laskin, S. Aerosolization of penicillin solution. Science 100: 33.

1945—Barach, A.L., Silberstein, F.H., Oppenheimer, E.T., Hunter, T., and Soroka, M. Inhalation of penicillin aerosol in patients with bronchial

asthma, chronic bronchitis, bronchiectases and lung abcess. Preliminary Report, Ann. Int. Med. 22: 482.
Olsen, A.M. Nebulized penicillin; preliminary report of its role in the management of surgical bronchiectases. Proc. Staff Meet., Mayo Clin. 20: 184.
Segal, M.S., and Ryder, C. Penicillin aerosolization in the treatment of serious respiratory infections. Preliminary Report, New England J. Med. 233: 747.
Mutch, N., and Rewell, R.E. Penicillin by inhalation. Lancet 1: 650.
Hagens, E.W., Karp, M., and Farmer, C.J. Inhalation method for penicillin therapy. Preliminary Report, Arch. Otolaryng. 41: 333.
Vermilye, H.N. Aerosol penicillin in general practice. J. A. M. A. 129: 250.
Hanks, R.J. Nebulized penicillin in treatment of respiratory infections. Texas State J. Med. 41: 253.
Wilson, C.E., Hammond, C.W., Byrne, A.F., and Bliss, E.A. The control of experimental pneumonia with penicillin. I. Comparison of inhalation and injection therapy. Bull. Johns Hopkins Hosp. 77: 411.
1946—Bobrowitz, I.D., Edlin, J.S., Bassin, S., and Wooley, J.S. Penicillin in the treatment of bronchiectases; a preliminary report. New England J. Med. 234: 141.
Sturner, F.X. Pharmacy of penicillin used by inhalation. J. Am. Pharmaceut. A. (Pract. Ed.) 7: 38.

A review of the foregoing papers discloses that penicillin aerosols cure common bacterial pneumonias in animals and man; they retard the progress of chronic suppurative disease of the lungs; they are used routinely at the Mayo Clinic and other institutions to prepare lung patients for operations; and, in general, they may be employed to change the flora of the upper and lower respiratory tract by killing most of the gram positive organisms. Indeed, with the development of new antibiotic substances, the method worked out and standardized by the Laboratory will form the basis for future aerosol therapy of this type.

Conclusions

It is believed that the community has reason to be proud of the role played by the Laboratory during the war. With comparatively small funds, supplied both by the Josiah Macy, Jr. Foundation and the War Department, the Laboratory contributed not only to the war effort but also to fundamental science and to medicine. As in most other installations that aided in carrying out the war, publication is still at a minimum. Indeed, the writer knows of only one paper, aside from War Department reports, that has been published by the Laboratory on its war work: a brief note in "Science" on the use of penicillin aerosols. The personnel of the Laboratory were busy keeping up with the urgent demands of the War Department. Considering the small funds available, the limited personnel, and the short space of time in which the researches were carried out, we can be very proud of the Laboratory's scientific contributions and the application of these contributions to diminish the many ills of suffering humanity.

REPORTS OF INVESTIGATORS

Baylor, Martha B., Reynolds, Joseph, and Sigurgeirsson, Th., University of Illinois, Urbana, Ill., Vanderbilt University, Nashville, Tenn., and University of Reikjavik, Iceland.——During the months of July and August a project to test the applicability of the console, "C", model of the RCA electron microscope to the problems of bacterial virus morphology was carried out in the Davenport Laboratory.——The chief advantages of the instrument are its compactness and simplicity of operation. The entire machine, including pumps and power supply, is about the size of a small office desk and can be easily moved from one room to another. Its cleverly coordinated valve and relay system makes operation of the machine almost foolproof, so that it can be operated by an untrained technician. Therefore this instrument might be preferable to the larger model, in work which does not require the highest magnifications. The test model that we had at our disposal had a magnification of 3500 diameters. The bacterial viruses have diameters around 50 millimicrons. The image size of such particles on the viewing screen (and on the photographic plate) is thus about .17 mm., which is just within the range of visibility of the unaided human eye. If focusing were sufficiently good to warrant it, the micrographs could be enlarged up to ten times for study of detailed morphology.——The larger bacterial viruses were prepared for electron micrograph examination according to the techniques developed by T. F. Anderson, by placing the bacteria with adsorbed virus in broth on the collodion film, allowing the sample to stand for three to five minutes, and washing in the meniscus of distilled water. Samples of viruses T2, T2′, T4, T5, and T6, adsorbed on sensitive bacteria, were prepared and micrographed. Enlargements of the micrographs were observed for clarity of detail of the virus structure, as compared with micrographs of the same viruses obtained earlier with the larger model "B" electron microscope. (Model "B" has magnifications up to 20,000 diameters on the viewing screen.) These comparisons indicated that the micrographs taken with the console model were of considerably inferior quality.——Further experimentation indicated that if a sufficient number of exposures was made through focus on a sufficient number of specimens a few optimal pictures could be obtained. The percentage of usable micrographs, among the total number taken, was at most 5%. The successful micrographs were of the largest virus only and were obtained at great cost of time and energy, since the machine must be evacuated for each exposure and the micrograph must be enlarged before it can be evaluated for certain. The magnification on the screen is not sufficient to allow for exact focusing on the virus particles even if a hand lens is used. The difficulty appears to lie in the low initial magnification and in the grain size of the fluorescent screen when a hand lens is used as an auxiliary magnification agent.——It is the conclusion of the persons involved in this work that the "C" model is not suitable to the problems of research on bacterial viruses. The larger models will yield superior pictures with much less effort.

Bryson, Vernon, Biological Laboratory, Cold Spring Harbor, N. Y.—Tangible evidence of sustained interest by the War Department in scientific contributions of the Laboratory has taken the form of increased responsibilities and an enlarged program given to us during the past year. Involving the initiation of an entirely new field of investigation for the Medical Division of the Chemical Warfare Service, this enlarged program represents in part a mutual desire to utilize more fully the unusual resources and equipment of the Laboratory for studying aerosols. More fundamentally, however, the increased scope of our work stems from the realization that there is no "termination of hostilities" in the ceaseless war against disease. The Laboratory's capacity to aid in this endeavor arises primarily from the unique experience accumulated in recent years in the use of aerosols and in the genetic implications of bacterial resistance to chemo-therapy.——Several lines of investigation have been followed. New work on the ability of germicidal mists to sterilize air and exposed surfaces in rooms contaminated with bacteria shows that hydrogen peroxide possesses particular merit in reducing the bacterial count whenever microorganisms are present in dust or in a relatively dried state. Since certain species of bacteria are notoriously hardy when in a desiccated condition, any method of reducing their numbers may be of value for use in operating rooms, hospital wards, and public places where the presence of pathogenic bacteria and viruses is known to be a potential menace. Control of airborne infection is exceedingly important in large-scale industrial procedures requiring a rigorously sterile technique, as in the manufacture of antibiotics.——The exploratory use of antibiotic aerosols in the treatment of pulmonary disease continues to occupy the attention of our group at Nichols Laboratory. In the interval since 1944 we have seen the inhalation of penicillin, and later streptomycin, develop into an accepted therapeutic procedure, in use not only by military hospitals but also by many civilian medical groups. At the present time, operations for suppurative lung disease at the Mayo Clinic are almost never performed without the previous administration of penicillin aerosol, with consequent reduction in postoperative complications. Our search for new agents or combinations of substances of possible value in the inhalational treatment of pathological conditions of the lung is being pursued, with emphasis on the therapy of experimental pneumonia.——As a corollary to the administration of chemotherapeutic agents in the form of mists, fundamental studies of lung permeability have been started. At the present time the writer is engaged in the inhalation of dyes and other products in order that more precise knowledge will be available about the percentage of excretion of inhaled chemicals from the human body.——One of the most interesting developments of the past year has been an intensive study of antibacterial synergisms. A synergism exists when two or more substances have an effect on bacteria that is markedly more than the mere sum of their individual effects. Our interest in synergism began when it was observed that the combination of a synthetic detergent (dioctyl ester of sodium sulfosuccinate) with penicillin produced

a marked synergism in controlling the growth of Staphylococcus aureus. The remarkable results achieved by our collaborator Dr. E. J. Grace in treating chronic osteomyelitis with penicillin-detergent solutions made it imperative to continue the exploration of synergistic processes. Our first problem was to find a bactericidal substance that would act synergistically with penicillin and that would be relatively unaffected by the presence of blood and other proteins. The powerful and comparatively nontoxic germicidal dye, 9-aminoacridinehydrochloride, proved ideally suited for the purpose. A trace of acridine (two parts per million) will reduce the number of pneumococcal colonies growing in the presence of 0.003 units of penicillin from many thousands to none, under laboratory conditions. It is not yet known if this synergistic combination and others being studied will prove of value in the treatment of infection, either by pneumococcus or by other organisms. The need for an intensive investigation of synergism may reside, not in the mere reinforcing action of synergistic substances in destroying bacteria, but in the possible relation of synergism to the origin of resistant strains of bacteria and to the occurrence of mutation. A determination of these interrelations is bringing our program back to the type of fundamental research for which the Laboratory is ideally adapted; that is, to the study of basic natural phenomena without immediate regard to application. For only on a firm foundation of basic scientific knowledge can medicine and applied science proceed to accomplish their set tasks.

Delbruck, M., Vanderbilt University, Nashville, Tenn.—The breakdown of the mutual exclusion mechanism.—When bacteria are simultaneously attacked by two different virus particles, only one of these particles will multiply in the bacterial cell and be liberated upon lysis of the bacterium. Two such viruses in one bacterium are mutually exclusive. If one of them grows, then the other one will not grow, and vice versa. Recently, Hershey discovered a breakdown of this mutual-exclusion mechanism in the case of two viruses, T2a and T2b, the second one being a mutant of the first. We have confirmed Hershey's discovery (also for the analogous pair T4a, T4b) and have found that in these cases, where the two viruses are very closely related, there is practically no mutual exclusion at all. Every mixedly infected bacterial cell will yield, upon lysis, a mixture of the two infecting viruses. We have searched for other pairs of viruses that might show such a breakdown of the mutual-exclusion mechanism, since it might be expected that such exceptional cases would yield valuable clues regarding the mechanisms involved. The pair T4a, T4b does not lend itself very well to finer studies because these two viruses are too similar. Their similarity makes it difficult to differentiate between them in the assays. It would be desirable to have a pair the members of which differ in their latent periods of growth, so that the influence of the growth of one virus upon the latent period of the other virus, growing in the same bacterium, could be studied.——Of the 21 pairs that can be formed of the seven viruses of the T system, five pairs,—namely (1,5), (3,4), (3,7), (4,7) and (2,6)—cannot, at present, be studied in the same fashion as the others, because no suitable indicator strains are available. The remaining 16 pairs all gave

complete or very nearly complete mutual exclusion, except the pairs (4,6) and (2,4). The pair (4,6) was studied in greater detail. When bacteria are simultaneously and multiply infected with these two viruses, about 3% of the bacteria will give a mixed yield of both viruses, the remaining 97% of the bacteria yielding T4 only or T6 only. It may be recalled that T4 and T6 are serologically and morphologically related viruses. Their relationship, however, is certainly not so close as that between T4a and T4b.—— An attempt was made to study more closely the conditions that determine lysis of the bacteria which liberate both T4 and T6. These two viruses have nearly the same latent period. The bacteria were first infected with T6 and five minutes later with T4. It was hoped to obtain in such an experiment a sufficient percentage of bacteria with mixed yields, permitting a decision whether the time of lysis of these bacteria is determined by the time of entry of the first or by that of the second virus. It turned out, however, that under the stated conditions the fraction of bacteria giving mixed yields is only .85%, too small for the intended analysis.

Doermann, A. H., Vanderbilt University, Nashville, Tenn.—The major portion of the summer of 1945 was spent in attempting to find a technique for attacking the problem of "lysis inhibition." This phenomenon may be characterized as follows: The three viruses, T2, T4, and T6, will lyse strain B of E. coli after a latent period of 21-25 minutes, as has previonsly been shown in one-step growth experiments. This is true at concentrations of B below ca. 10^8 cells/ml. When the concentration of B is as high as 5×10^7 cells/ml., clearing of the culture does not take place in the expected time even though all the bacteria are multiply infected by virus; clearing takes place 6-8 hours later.——One condition that should be useful in attacking this problem is the fact (discovered by Hershey) that these viruses occasionally mutate to a new form, which can be designated by calling the parent strains T2a, T4a, and T6a, and the mutant strains T2b, T4b, and T6b. These mutants differ in only two known respects from the parents. They will clear high-titer B cultures in the expected time (within one hour after infection), and they form clear halos around the plaques that are produced when plated with B. The parent strains form very turbid halos or no halos at all.——In the hope of finding another difference between the **a** and **b** forms, ten bacterial strains resistant to T4a, and ten resistant to T4b, were isolated. The B/4a strains were all resistant to T4b and the B/4b strains were all resistant to T4a. This is in agreement with Demerec and Fano's claim that T4a and T4b react similarly to all resistant mutants of B.——We attempted to analyse the lysis inhibition phenomenon along two lines: first by trying to induce inhibition in the **b**-infected cultures through the action of fractions from **a**-infected cultures; second, by trying to prevent lysis inhibition in **a** lysates by removal of some of the components.——From preliminary experiments by Delbruck it appeared that the inhibition was due to virus liberated from a few early bacterial bursts. Assuming this to be true, one would think that free T2a might be added to a T2b-infected culture very shortly before clearing was expected and that clearing might then be delayed. Numerous

experiments were done, adding T2a to T2b-infected cultures at various times ranging from 6 to 21 minutes after T2b infection. The amounts of T2a added ranged up to a 100-fold excess over the number of bacteria present. With this procedure, clearing was never delayed more than 15 minutes.——This led to the question whether "nascent" T2a virus differed in some way (e.g., by being temporarily covered with an enzyme) from the T2a stock that was at least several days old. If this were the case it seemed possible that antiserum against T2a might not attack it. Nevertheless, antiserum did inactivate "nascent virus."——In a further attempt to duplicate the phenomenon of inhibition in cultures infected with T2b, the following experiment was done. A suspension of B was infected with T2a (multiplicity of 10) and incubated with aeration for thirty minutes, which is nine minutes after lysis should have begun. Then B was centrifuged out and the supernatant tested for inhibitory power against T2b-infected bacteria. None could be demonstrated.——Preliminary experiments by Delbruck had also indicated that the inhibition was counteracted by antisera to phages T1, T2, and T7. Although a number of attempts were made, it was not found possible to repeat this result with any of the presently available antisera against T1, T2, T3, T4, T5, T6, or T7.——From these experiments it seemed that the inhibition is not due to the virus itself; and, in the hope that the inhibiting agent might be of relatively small molecular dimensions, attempts were made to dialyse the inhibitor through cellophane and to inhibit T4b cultures with the dialysate. Sporadic positive results were obtained, but the fact that turbidity comparisons had to be made by eye cast doubt on these experiments. In any event, the inhibition did not approach the degree of persistence of a T2a-infected culture.——Another method was tried to separate and demonstrate a dialysable, non-virus inhibitor. Plates were prepared with penicillin cups and into these was placed 0.1-0.2 ml. of T2a-inhibited lysate. Then T2b was plated around the cups with the agar-layer method. Here, if a dialysable inhibitor were produced, it should have prevented or diminished halo production. No positive results were obtained with this technique.——The conclusions drawn from these experiments are as follows: (1) The inhibition of lysis is not neutralized by antiserum against the phages. (2) If inhibition is possible in bacteria infected with b-type phage, then the following factors may be eliminated as the inhibiting agent: (a) a low-molecular-weight substance which will dialyse readily through cellophane or diffuse rapidly from penicillin cups; (b) the virus as such (nascent virus may yet be the inhibitor); (c) a factor remaining in the supernatant of a centrifuged inhibited lysate. (3) It is possible that the inhibition is dependent on the presence of a-type virus inside of the bacteria whose lysis is to be inhibited. If this is the case, the factors listed under (2) cannot be excluded as inhibiting agents.

Gordon, Myron, New York Aquarium, New York Zoological Society, New York 60, N. Y.—The summer of 1945 was spent at the Biological Laboratory chiefly in the preparation of papers. One of these is entitled "Speciation in Fishes. I. The Distribution in Time and Space of Seven Dominant Multiple Alleles in Platypoecilus maculatus." In this paper,

data obtained from field and laboratory were correlated. It was shown that the platyfish of southern Mexico is extremely variable with respect to color markings. When these color markings were defined and their frequencies plotted it was found that each of the four large river systems—the Rio Jamapa, Rio Papaloapan, Rio Coatzacoalcos, and the Usumacinta—contained distinctive, genetically identifiable populations; although taxonomically the fishes from the four rivers were identical, not being separable into subspecies. The genetic proof for the heritability of the many markings was first presented; then the data on gene frequency distributions were shown for the four rivers, based on more than 5,000 adult specimens. Later it was shown that, within the same river, small, local populations differ in a smaller measure from neighboring populations. The species was studied from specimens stored in various museums of the country; one collection was found dating back to 1867, another to 1902. These fishes were compared with those that we collected in 1932 and 1939; and it was found that, for the most part, the gene frequencies, based on color markings, that characterized the populations in recent times were similar to those representing populations of 70 years ago.——Another paper, entitled "Introgressive Hybridization in Domesticated Fishes. I. The Behavior of the Comet—A platypoecilus maculatus gene in Xiphophorus hellerii," described the behavior of the wild gene, Co, characteristic of the platyfish, in a hybrid mating between the wild platyfish and the wild swordtail. It was found that the comet pattern, which is recognizable by two thin, widely flaring lines on the tail fin of the platyfish, is transformed into the so-called wagtail complex, in which all the fins of the body become black. This behavior is similar to that found in the color pattern of the Siamese cat. The modifier responsible for the change from the comet to the wagtail pattern is present in a homozygous state in the swordtail, Xiphophorus hellerii. This modifier, called E, was also found in most of the domesticated varieties of the platyfish. The suggestion is made that the modifier E introgressed in the domesticated populations of the platyfishes through some previous mating involving the swordtail. The subject of introgressive hybridization is discussed, and it is shown that while the phenomenon is relatively rare in animals (introgression has been reported by botanists), more instances of it might be recognized if we knew the complex history of our domesticated animals.

Palmer, Jean, Carnegie Institution, Cold Spring Harbor, N. Y.—During the months of August and September attempts were made to standardize a technique for the staining of bacteria of strain B of E. coli, a strain which has been used in work with bacterial viruses. The technique was patterned after that described by G. F. Robinow, in an addendum to the book "The Bacterial Cell," published recently by R. J. Dubos. This technique has been reported to give differentiation between the cytoplasm and what has been assumed to be the nuclear apparatus of the cell.——Essentially, the technique consisted of the steps outlined in the following directions: (1) Fix in OsO_4 vapor for two minutes, or in formalin for 20 minutes. (2) Rinse briefly in distilled water. (3) Hydrolyze in 1N HCl at 60°C. for 7-10

minutes. (4) Rinse briefly in buffer solution. (5) Stain in standard Giemsa solution (buffered at pH7) for 30 minutes at room temperature. (6) Decolorize in 50% alcohol for 5 seconds. (7) Rinse in distilled water. (8) Dry by draining or by blotting slide with filter paper.——The cultures used, 2.5-hour nutrient broth cultures, were subinoculated from 24-hour aerated broth cultures and had a titer of approximately 5×10^7 bacteria/ml. The preparation was not allowed to dry during the staining in the majority of cases. Phosphate buffer at pH 7 was used.——Principal modifications of the procedure were: drying the slides before or after fixation, increase of the temperature of the HCl bath to 75° C., prolongation of the time the slide was kept in either the Giemsa or the alcohol, and variation in percentage of the alcohol used for decolorization. None of these modifications seemed to improve the quality of the stain.——When optimum conditions were observed, differentiation between the cytoplasm and the nuclear apparatus was excellent, and conformed in every respect to Robinow's description. The cytoplasm stained a light pinkish blue, the nuclei appeared as rod-like structures with their long axes perpendicular to the long axis of the cell. The cells themselves were seen to occur singly or in pairs, with a small percentage of long forms. Each cell contained a minimum number of two "nuclei," the long forms containing a large number of them, in proportion to their lengths.——The method did not give consistently good results, however. The inconsistencies may have been due, among other factors, to non-uniformity of the stain or of the cleanliness of the slides, or to slight variations in the time the slides were left in the HCl and the alcohol. Further work may serve to eliminate these inconsistencies.

Lowenstein, Marta G., and Lowenstein, Otto, New York University, Medical College, New York, N. Y.—During the summer of 1945 we continued our experiments concerning the function of the pineal body. One series of experiments dealt with further research on the antagonistic relationship between pineal body and pituitary gland, the existence of which had been suggested to us by our previous experiments. In these previous experiments the pineal body had been transplanted; and the same was done now with pituitary glands, taken from cats and transplanted into pigeons. Pupillographical examination, before and after transplantation, showed that the parasympathetic part of the reaction was intensified, whereas transplantation of the pineal body had resulted in intensification of the sympathetic part of the reaction. These experiments are being completed by special experimental analysis of the roles of the different lobes of the pituitary gland, especially the intermediate lobe.——A second series of experiments dealt with the question of whether or not light and darkness influence the functioning of the two glands. The effects of light and darkness as such were examined in experiments on pigeons kept under conditions of continuous light or continuous darkness for a certain length of time (up to four weeks). Pupillographical examination then showed that continuous light results in increased function of the parasympathetic part of the autonomous nervous system; continuous darkness, however, results in increased function of the sympathetic part of the autonomous nervous

system.——The question of whether or not this reaction can be related to an influence of light and darkness on the activity of the pineal body and pituitary gland, respectively, is being examined in the following ways: (1) Histological investigation, based on material experimentally prepared during the summer in Cold Spring Harbor. (2) Observation, and comparison with controls, of the reaction of melanophores of tadpoles, which have been fed with pineal body and pituitary glands taken from animals kept under conditions of light and darkness. So far, it appears that the melanophore reaction of animals that have been fed with pineal body taken from animals exposed to light shows an intermediate stage between the melanophores of animals fed with ordinary pituitary and those fed with ordinary pineal body. (3) Transplantation into test animals (pigeons) of pineal body and pituitary glands taken from animals kept under conditions of light and darkness, followed by pupillographic examination.—— Our results, although preliminary, are indicative of a relationship between the pineal body and the sympathetic part of the autonomous nervous system, on the one hand, and the pituitary gland and the parasympathetic part of the autonomous nervous system on the other hand—the activity of both glands being influenced by light and darkness, thereby affecting the reactions of the autonomous nervous system.

Maas, Werner K., Columbia University, New York 27, N. Y.—The two eye pigments of Drosophila melanogaster, the red and the brown pigment, have been investigated to elucidate the action of genes during development. The many genes that influence eye color do so by controlling the amounts of either or both of these pigments. For the brown pigment diffusible precursors have been found, which when supplied to the pupa will produce brown pigment formation in those mutants that do not ordinarily form this pigment. Moreover, by using different precursors, the specific step in the formation of the brown pigment affected by each of these genes could be demonstrated. For the red pigment no such diffusible precursors are known. It was the purpose of the summer's work to study the nature of the red pigment in order to provide a basis for developmental and genetic studies.——The pigment was extracted from cinnabar flies, which lack the brown pigment completely, with 30% alcohol, pH 2.O (AEA of Ephrussi). In order to find out the approximate molecular weight, the diffusion constant was measured in a Tiselius apparatus. The molecular weight is about 300, a relatively small molecule. The ultraviolet-light absorption of the diffused solution was much lower than that of the undiffused, as compared with differences in the absorption of visible light, indicating that a certain amount of impurities had been removed from the preparation. During a second and third diffusion, however, there was no further relative reduction of ultraviolet absorption. This means either that the pigment solution was completely purified, or, more likely, that there were other substances that diffused together with the pigment. Several other diffusion cells, such as an Anson-Northrop glass membrane cell, were tried to purify the pigment solutions, but they were no more efficient than the Tiselius cell.——The pigment solutions were then analyzed by means

of a chromatographic adsorption column. Powdered talc was used as adsorbent. The pigment was adsorbed from neutral buffer solutions, the chromatogram was developed with dilute acid, and the pigment was eluted with 30% acid alcohol. Later it was found that a mercury salt of the pigment was better suited for this type of analysis than the untreated pigment. After the development of the chromatogram one can distinguish four colored bands on the column, which are, from top to bottom: pink, brown, deep red, and yellow. The yellow band, on rechromatographing, yielded a yellow band only. The other three bands were not rechromatographed because of elution difficulties. Thus, the red pigment consists of several components, possibly as many as four.——Various tests on the chemical nature of the pigment were carried out. They showed that the substance is soluble in methyl alcohol, water, "carbitol," and ethylene glycol, but insoluble in most other organic solvents, including dioxane; that it is reversibly reducible with sodium hydrosulfite; and that it is easily converted into a brown degradation product, by heating in dilute acid solution, or just by concentrating it in acid solution at room temperature.——Several other sources of the red pigment were investigated, such as scarlet and vermilion flies, all of which yielded a pigment identical in its behaviour with that derived from cinnabar flies.

Margaretten, Phyllis, University of Illinois, Urbana, Ill.—During the course on bacteriophages several new bacterial viruses had been isolated from fecal samples. An attempt was made to study one of these viruses, preliminarily called TPM, in greater detail. In particular, it was desired to find out whether this new virus was serologically related to any of the viruses of the T system and to test its reaction with a variety of mutants of strain B that exhibit specific resistance patterns. It was hoped also that electronmicrographs of the new virus might be obtained. However, considerable difficulties were encountered in obtaining reliable assays of the new virus, as well as in the production of stocks of sufficiently high titer. Such difficulties are likely to be met with in many new viruses. As a matter of fact, the ease of manipulation of the strains commonly used in bacteriological laboratories may well be due to a process of selection by the investigators, as "difficult" viruses—i. e., viruses that do not grow well under standard conditions—are likely to be thrown out at an early stage. It was therefore of interest to see how far it would be possible to get such a "difficult" virus under control.——The new virus was originally obtained from an isolated plaque on a plate on which the filtered fecal sample had been plated with strain B of E. coli. One might have expected, therefore, that by this method automatically a virus had been selected that would give plaques under our standard conditions of plating. It turned out, however, that the plating efficiency of this virus was very sensitive to the amount of broth present in the agar. If the plates had been poured a little too thin, no plaques were obtained unless the agar had been made up with twice the standard amount of broth. The plating efficiency was also strongly dependent on the concentration of NaCl, there being no plaques in the absence of salt, and fewer with .5% than with 1% NaCl.——Greater

difficulties were encountered in the attempts to make high-titer stocks. No clearing of liquid cultures in broth with varying concentrations of NaCl ever occurred, and no stocks could be obtained in this way. Recourse had therefore to be had to the method of washing plates, on which many plaques had been produced, with broth. After centrifugation and filtration such plate washings gave titers around 10^8/ml. With the aid of these stocks attempts were made to obtain liquid-clearing lysates. $MgCl_2$ and Na_2SO_4 were combined with NaCl in varying concentrations. Na_2SO_4 had no effect on clearing, while $MgCl_2$ in combination with 1% NaCl gave some clearing. Unfiltered, the clearing lysates gave fairly high titers. However, the titers obtained were not in proportion to the degree of clearing. On the contrary, the highest titers were obtained from the salt combination 1% NaCl + .1% $MgCl_2$, which gave only moderate clearing. Much lower titers were obtained from completely clear lysates with 1% NaCl + 1% $MgCl_2$.——Because of these difficulties no detailed information on other properties of this virus has yet been obtained. A qualitative test with antisera against the viruses of the T system seemed to indicate, however, that the new virus is not closely related to any of the viruses of the T system.——The procedure followed in this work is in one sense the reverse of the usual one. Usually, a new bacterial virus is obtained by serial liquid subculture of filtrates until clearing of the cultures is obtained. In this way viruses are selected which will certainly give lysis in liquid cultures under standard conditions. The next task is then to obtain conditions which will give reliable plaque count assays, i.e. which will give good lysis on solid media. In the present work, the new virus was selected from a plating of a fecal filtrate. In that case one is assured of having a method of assay, but must expect to run into difficulties in the production of liquid lysates. Presumably both methods will be necessary if it is desired to obtain the greatest variety of viruses occurring in nature and capable of acting in one host.

Mayr, Ernst, The American Museum of Natural History, New York 24, N. Y.—Studies of the isolating mechanisms between Drosophila pseudoobscura and D. persimilis were continued. A method of direct observation was introduced, and quantitative studies of the numbers of displays, of attempted copulations, and of completed copulations were carried out. The influence of light, temperature, and age on the degree of isolation was studied. It appeared that males display to females of the alien species almost as frequently as to females of their own species. Drosophila pseudoobscura males attempted copulation with Drosophila persimilis females with high frequency. Not one successful copulation was observed during many observation periods of thirty minutes each. It thus appears that the stimuli adequate to evoke the male's sexual attempts are not species-specific, or only slightly so, but that some as yet unidentified species difference (possibly concerned with the morphology of the genitalia) prevents the completion of attempted matings. Preliminary experiments with sterile male hybrids between the two species indicate that they completely lack sexual behavior.

Meyer, Leo M., Kings County Hospital, Brooklyn, N. Y.—During the summer of 1945 a series of investigations was begun to study the changes in the bone marrow in experimentally induced mouse leukemia. Daily observations made on peripheral blood and bone marrow disclosed an initial leukopenia immediately after the intraperitoneal injection of leukemic spleen. This was followed by a distinct rapid rise in the leukocytes and the development of a typical picture of acute leukemia. During the leukopenic phase the bone marrow assumed a hypoplastic condition. With the appearance of immature leukocytes in the peripheral blood, a coincidental involvement of the bone marrow was noted. The preceding report represents a preliminary survey of only part of the material taken. Examination of organs for leukemic involvement are still in progress and will be reported on at a later date. The results so far appear to further the thesis suggested by some hematologists that there is a reciprocal relationship between myeloid and lymphoid tissues, and that this balance is lost when leukemia develops.

Montagu, M. F. Ashley, Hahnemann Medical College and Hospital, Philadelphia 2, Pa.—A thoroughly delightful stay of six weeks at Cold Spring Harbor enabled me to study and organize the materials gathered during the last ten years on the problem of the relative sterility of the adolescent female mammal. That a period of anovulatory, and ovulatory, sterility exists during the adolescence of all the mammals thus far studied (mouse, rat, cow, rhesus monkey, chimpanzee, and man) is now well established. The problem has been to determine, as far as possible, the exact nature of the physiological changes underlying the phenomena associated with the adolescent sterility period. The period of the first oestrus, or in the higher primates the first menstruation (menarche), is taken to be the commencement of adolescence, and the period when the organism becomes capable of conceiving and viably carrying a fetus to term is taken to be its terminal point and the beginning of maturity, that is to say, reproductive maturity or the period of nubility. In man the mean duration of the adolescent sterility interval is about three years. There is, as would be expected, a considerable amount of variation in this respect. The adolescent sterility interval turns out to be simply the overt reflection of normal developmental processes which lead to efficient reproduction. These are the elaboration of gonadotrophic hormones and prolactin emanating from the anterior pituitary. The follicle-stimulating hormone (FSH) causes the ovary to elaborate oestrogen, initiates the development of the secondary sexual characters, and produces menstruation. A second gonadotrophin, the interstitial-cell-stimulating hormone (ICSH) or luteinizing hormone (LH), causes the ovum to rupture through the ovary, leaving behind its follicular investment, which in the wall of the ovary, under the influence of prolactin, undergoes reorganization into a secretory luteal body, the secretion of which, progesterone, prepares the uterus for pregnancy. It is not until this third stage that successful pregnancy becomes possible. It is the interval between the follicle-stimulating period and the prolactin-progesterone-stimulating period of development that determines the duration of the adoles-

cent sterility interval. A lecture on this subject was delivered on Thursday, July 30, at the Laboratory, and the materials have been organized into a book, which is to be published early in 1946.

Nagel, Lillian, Washington University, St. Louis, Mo.—Study of the cytology of yeast was continued at Cold Spring Harbor during the summer, with special emphasis on the phenomena accompanying sporulation. Part of the summer was spent in attempts to adapt the aceto-carmine type of smear technique to this material. Various strengths and mixtures of aceto-, lacto-, and propionic carmine and orcein were tried, as well as a large number of pretreatments and mordants, but none was satisfactory. Sporulation was observed in living material. In a hanging drop culture (pH about 4) sporulation could be watched in individual cells if shreds of lens paper were placed in the medium to prevent Brownian motion. Early stages were obscured by the granular cytoplasm, but the formation of the spore walls was observed. Sporulation was extremely slow and sporadic if cells were placed in an agar medium, in oil, or in a liquid medium without access to air. Robinow's Giemas technique for staining bacteria was adapted to the study of the yeast cell, and proved to be the most successful of any used to date. It was found that mercuric chloride fixation or fixation with an iodine-formalin-glacial acetic acid mixture was more satisfactory than osmic acid vapor for yeast, although the latter could be used if drying was avoided. Difficulty with fading of the finished slides has since been overcome by neutralizing the balsam. This technique was worked out so late in the summer that only a rapid preliminary study of meiotic material could be made. The counsel of Dr. Barbara McClintock was valuable and greatly appreciated.

Novikoff, Alex B., Brooklyn College, Brooklyn 10, N. Y.—Most of the summer was spent in preparing a series of lectures in General Biology to be given the following year at Brooklyn College, and in collecting material for a book on the same subject. Part of the time was devoted to final editing of a book on evolution for children, called "Climbing Our Family Tree," and to the preparation of an article to appear in Science, entitled "Continuity and Discontinuity in Evolution."

Reynolds, Joseph, Vanderbilt University, Nashville, Tenn.—Strain B of E. coli is capable of a number of different mutations that render it resistant to one or more of the viruses of the T system. These mutations have been studied by several authors, in greatest detail by Demerec and Fano. These authors have also studied to some extent the mutational possibilities of the mutant strains, and have made the important discovery that in many cases the mutations of the mutants are similar to the mutations of the original strain, indicating that the various mutations of the original strain are independent of one another, in the sense that the occurrence of one mutation does not affect the probability of occurrence or the mode of expression of other mutations.——An attempt was made to subject this conclusion to a somewhat more stringent test, by producing a multiply mutant strain carrying five different mutations. This was done by the usual technique of plating a large number of bacteria in the presence of a

large number of virus particles of one or another strain. The bacteria that are sensitive to the action of this particular virus are then destroyed, and any mutant bacteria that may be present and that carry the character "resistance to the virus" will be able to form colonies. Each such mutant was purified by twice streaking and re-picking on virus-free plates.——Using the terminology of Demerec and Fano, the multiple mutant finally constructed may be designated as follows: B/4,3/2/5,1/7/6. Each bar designates an isolation of a mutant in the presence of the virus whose number follows immediately after the bar. Each such mutant was tested for resistance with all seven viruses of the T system, and any virus to which it is resistant in addition to the one in whose presence it was isolated is added in the designation after a comma. The designation thus reflects the steps in which this multiple mutant became resistant to all seven viruses. If one compares these steps with the mutational steps of which the original strain B is capable, as described by Demerec and Fano, one will note that the multiple mutant here described represents a simple superposition of a variety of steps of which the original strain is capable. Furthermore, the frequencies with which the mutants occurred seemed to accord with the frequencies observed in the original strain, with the exception of the step involving resistance to T2, which is very rare in the original strain.——It should be noted that the strain before its final mutation was resistant to all viruses of the T system except T6. This intermediate mutant is therefore a useful tool for rapid identification of T6. Furthermore, the final strain, while resistant to all viruses of the T system, was still sensitive to the mutants of T3′ of T3, and T7′ of T7. In work of this kind such residual sensitivity is useful for distinguishing mutants from contaminations.

Schultz, Jack, Lankenau Hospital Research Institute, Philadelphia, Pa.—In cooperation with M. Demerec, W. E. Baty, and Zlata Demerec, of the Department of Genetics of the Carnegie Institution, observations were made of the penetration of aqueous aerosols of various dyes into adult Drosophila. The dyes used were the familiar toluidine blue, neutral red, janus green, trypan blue, among the vital stains. In addition, tests were made with acriflavin, because of its known effects on amphibian sperm; with the chromatin stains crystal violet, methyl green, and safranin O; and with the cytoplasmic and chromosomal counterstain fast green. Adult wild-type flies were subjected to aerosols containing maximal concentrations of these dyes, and observed for various periods following the beginning of treatment. The atmosphere of the culture bottle was renewed every half-hour, so that concentration of the aerosol was maintained at an approximately constant level.——These experiments, then, gave a picture of the course of entry of the dyes. Almost invariably, the first region to show the dye was the crop. Later, in the case of toluidine blue, neutral red, and acriflavin, the stain was visible in the cells of the midgut, with characteristic differences in detail. The staining was not uniform in all cells of the gut, but bands of cells at intervals were affected, indicating either a rhythm in the release of the material from the crop, or the existence of periodicities in the receptivity of the cells to the dye. At later

stages, these dyes were observed in the Malpighian tubules and—most interesting—in the pigment granules of the testis sheath and in cysts of spermatogonia (moribund?). With other stains no absorption was evident; the dye was simply passed along the lumen of the gut for excretion. The final picture in all treatments was one of excretion of masses of pigment from the lumen of the hindgut.——The impression is strong that chemicals are taken in by feeding on the film at any exposed surface, and also by swallowing aerosol. Very little, if any, is taken up by the tracheae.——A more detailed report of this investigation is published in the Carnegie Institution of Washington Year Book No. 44 (1945).

Spassky, B., Columbia University, New York 27, N. Y.—Building up of the working collection of Drosophila willistoni was continued. Twice during the summer D. willistoni males were treated with X-rays, and several mutations were detected among the offspring of these males. Crossover experiments were carried on, results of which made it possible to locate most of the mutations on the chromosomes and also to arrange the mutations in useful combinations. At present there are more than 35 mutations in the collection.——The selection experiment involving the second and fourth chromosomes of D. pseudoobscura has reached the 40th generation. Each strain has been kept in four substrains, as follows: (1) Homozygous for a wild-type autosome; fathers of every generation given 1000 r units of X-ray; the strain kept in large populations. (2) Heterozygous for the same autosome; fathers of every generation given 1000 r units of X-ray; the strain kept in small populations. (3) Homozygous for the same autosome; no X-ray treatment; kept in large populations. (4) Heterozygous for the same autosome; no X-ray treatment; kept in small populations.

Tan, C. C., University of Chekiang, China, and Columbia University, New York 27, N. Y.—As a preliminary to a study of the genetics of the sexual isolation mechanism between Drosophila pseudoobscura and Drosophila persimilis, the summer's work consisted of two parts: (1) experimental testing of sexual preferences between various mutant strains of Drosophila pseudoobscura as well as between each mutant strain and the wild type, and (2) building up of hybrid stocks containing a specific combination of chromosomes from the two species and having appropriate markers.——The mutant strains used were (1) yellow, singed, vermilion, compressed, short (y sn v co sh), (2) orange (or), (3) orange, purple (or pr), (4) white (w), (5) aristapedia (ast), and (6) Bare, Curly (Ba Cy). Freshly hatched females and males were separated and aged for 5 to 6 days before being placed together for from 8 to 14 hours and allowed to mate. In each test 20 females—10 each of the two strains to be tested—were placed with 5 males belonging to one of the two strains. Of all the different combinations tried, the results showed that only when y sn v co sh flies were used as males was there a definite preference of like for like.——The building of hybrid stocks was started by mating D. pseudoobscura females carrying the X-chromosome mutant genes y, sn, v, co, and sh, and the second-chromosome dominant Ba, to males heterozygous for the fourth-chromosome Curly (Cy) inversion. Those daughters that

showed Ba and Cy were selected and mated again with y sn v co sh males. Among the offspring only y sh Ba Cy females were used to mate with D. persimilis males homozygous for the third-chromosome mutant orange (or). The hybrids that show Ba and Cy characters are thus heterozygous for five inversions; namely, in the right and left limbs of the X chromosome, in the second chromosome, in the third chromosome, and in the fourth chromosome. When these hybrids are backcrossed to y sn v co sh or pseudoobscura males, the progeny will consist of 16 different classes, each of which, being marked by certain characters, represents a specific chromosome combination. Some flies will have all chromosomes of D. pseudoobscura origin, and others will have one chromosome of each pair from pseudoobscura and the other from persimilis. Using these 16 different classes of backcross hybrids, and the corresponding mutant stocks of pure species of D. pseudoobscura, sexual preference experiments are being continued in the Department of Zoology, Columbia University.

COURSE ON BACTERIOPHAGES

July 23 — August 11, 1945

Instructor: M. Delbruck, Vanderbilt University, Nashville, Tennessee.

Assistants: A. H. Doermann, J. Reynolds.

Bacteriophages exhibit many of the properties of viruses and can serve as models for the study of fundamental problems in virus research. The bacteriophages are also a useful tool for the study of mutations in bacteria.

Since 1941, research on bacteriophages has been carried on during the summer months by several investigators (Cordts, Delbruck, Gest, Luria, Spizizen) at the Biological Laboratory of the Association. Reports on this work may be found in previous annual reports of the Association. Moreover, since 1943, work on bacteriophages has also been carried on at the Department of Genetics of the Carnegie Institution (Demerec and Fano), as recorded in the annual reports of that Department.

While this work has aroused some interest among biologists, the number of investigators actually involved and intimately acquainted with the techniques of such work is exceedingly limited. It seemed worthwhile and appropriate, therefore, to offer at the Laboratory a short but intensive laboratory course in the techniques and problems of this field. Enrollment in the course was solicited by mailing the following outline to interested persons.

> The purpose of the course is to acquaint the student with some of the techniques used in bacteriophage research, and with recent results of such work.
>
> The course will consist of about nine half-day laboratory periods (Mon., Wed., Fri.), and nine half-day study periods (Tues., Thurs., Sat.) for the evaluation and discussion of the experiments performed by the students. No outside work should be planned by the student, since it may be expected that his full time will be occupied by this course.
>
> Prerequisites: Facility in the processes of multiplication and division of large numbers; elements of calculus; properties of exponential functions.
>
> An admission test on these subjects will be given.
>
> The following experiments are planned.
>
> First Period: (A) Preparation of a phage stock by adding a small amount of phage to a growing culture of bacteria. Observation of mass lysis and of secondary bacterial growth. (B) Assay of a high-titer stock of phage, by plating dilutions for plaque count. Spreading technique and agar layer technique. Plating of phage in high concentration to obtain colonies of resistant bacterial mutants. These mutants will be isolated and used in later experiments. (C) Isolation of a new phage from fecal material.

Second Period: (A) Microscopic observation of lysis. (B) First transfer of resistant mutants.

Third Period: (A) Inactivation of phages by specific antisera. Serological classification of phages. Rates of inactivation. Homologous and heterologous titers of antisera. (B) Second transfer of resistant mutants. Next day preparation of stock cultures of the resistant mutants.

Fourth Period: Tests of the mutants for resistance to several phages. Cross-resistance grouping of phages. Efficiency of plating. Occurrence of phage mutants with extended host range.

Fifth Period: One-step growth experiment (exploratory). Single infection. Estimation of the latent period of intracellular phage growth and of the average yield of phage per bacterium.

Sixth Period: (A) Action of specific antisera on phage adsorbed on bacteria. (B) Plating with mixed indicator strains.

Seventh Period: One-step growth experiment (precision). Single infection.

Eighth Period: One-step growth experiment. Multiple infection.

Ninth Period: Mixed multiple infection. Mutual exclusion effect.

Following is a list of the students who enrolled in the course:

Dr. Martha Barnes Baylor, Research Associate, Department of Chemistry, University of Illinois, Urbana, Ill.

Dr. R. D. Hotchkiss, Research Associate, Rockefeller Institute for Medical Research, New York, N. Y.

Dr. H. M. Kalckar, Research Associate, New York City Public Health Research Institute, New York, N. Y.

Phyllis Margaretten, graduate student, Department of Chemistry, University of Illinois, Urbana, Ill.

Dr. Stuart Mudd, Professor of Bacteriology, University of Pennsylvania Medical School, Philadelphia, Pa.

Mag. Sc. Th. Sigurgeirsson, University of Reikjavik, Iceland; International Fellow of The Rockefeller Foundation.

The course lasted three weeks. Several of the students stayed for a larger part of the summer and undertook minor research projects more or less closely related to the material of the course. These projects are reported separately by the respective investigators.

The course and the research work were housed in the Davenport Laboratory.

SUMMER RESEARCH INVESTIGATORS

Abramson, Harold A.—Chemical Warfare Service, Edgewood Arsenal, Md.
Anderson, Edgar—Missouri Botanical Garden, St. Louis, Mo.
Anderson, Thomas F.—University of Pennsylvania, School of Medicine, Philadelphia, Pa.
Baylor, Martha Barnes—Chicago, Ill.
Brown, William L.—Missouri Botanical Garden, St. Louis, Mo.
Delbruck, Max—Vanderbilt University, Nashville, Tenn.
Dobzhansky, Th.—Columbia University, New York
Doermann, August H.—Vanderbilt University, Nashville, Tenn.
Gordon, Myron—New York Zoological Society, New York, N. Y.
Hershey, Alfred D.—Washington University Medical School, St. Louis, Mo.
Hotchkiss, Rollin D.—Hospital of the Rockefeller Institute for Medical Research, New York, N. Y.
Kalckar, Herman M.—The Public Health Research Institute of the City of New York, New York, N. Y.
Lowenstein, Marta—New York, N. Y.
Luria, Salvador—Carnegie Institution, Cold Spring Harbor, N. Y.
Maas, Werner K.—Columbia University, New York
Margaretten, Phyllis—Perth Amboy, N. J.
Mayr, Ernst—American Museum of Natural History, New York, N. Y.
Meyer, Leo—Brooklyn, N. Y.
Mirsky, Alfred—The Rockefeller Institute for Medical Research, New York.
Montagu, M. F. Ashley—Hahnemann Medical College and Hospital, Philadelphia, Pa.
Mudd, Stuart—University of Pennsylvania, School of Medicine, Philadelphia, Pa.
Nagel, Lillian—The Henry Shaw School of Botany, Washington University, St. Louis, Mo.
Novikoff, Alex B.—Brooklyn College, Brooklyn, N. Y.
Reynolds, Joseph M.—Vanderbilt University, Nashville, Tenn.
Schultz, Jack—Lankenau Hospital Research Institute, Philadelphia, Pa.
Sigurgeirsson, Thorbjorn—Rejkjavik, Iceland (University of Copenhagen)
Spassky, B.—Columbia University, New York, N. Y.
Tan, C. C.—University of Chekiang, Hangchow, China.

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY

List of 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.

*Out of print

LABORATORY STAFF

Bryson, Vernon—Research biologist
Demerec, M.—Director
Dorsey, Henry—Laborer
Holmes, Joseph—Outside handyman
Klem, Dorothy V.—Secretary
Kriger, David—Animal man
Reddy, William—Laborer
Reiss, Albert M.—Bacteriologist
Skinner, Elizabeth—Clerical assistant

REPORT OF THE SECRETARY

The 49th meeting of the Board of Directors was held at the Down Town Association in New York City on January 23, 1945. The report of the Director, Dr. M. Demerec, on the work of the Laboratory during 1944 opened with an account of the war research being continued under contract with the Chemical Warfare Service, which is summarized elsewhere in this Annual Report. Dr. Demerec reported that the group of scientists from the Airborne Instruments Laboratory, who had been using three of the Biological Laboratory buildings during the past two years for research under contract with the Office of Scientific Research and Development, would complete this part of their work and release the buildings in February. In an ensuing discussion it was decided to request the preparation of a report covering this work, for eventual release to the Laboratory. The Director reported also on research done at the Laboratory during the previous summer, and on the success of the nature study course for young people. Consideration of replacements of trees destroyed by the hurricane in September 1944 was commended to the Buildings and Grounds Committee. The Treasurer's Report, presented by Dr. Demerec, was accepted, and it was voted that the invested reserve be increased in the amount of $2,000. In general discussion it was proposed that the Charles Benedict Davenport Memorial Fund be kept open, and that contributions to that fund be invested by the Finance Committee as sufficient amounts accumulate. A proposed budget for 1945 was presented and approved after discussion. A program for the Eleventh Cold Spring Harbor Symposium on Quantitative Biology, on the subject of heredity and variations in microorganisms, was presented and discussed. After full and careful consideration of the questions involved, it was decided to plan this symposium for the summer of 1946 instead of 1945. Dr. Chambers reported briefly on the opportunities of the Association to assist in the post-war reestablishment of scientific activities in this and other countries, through the distribution of books and by providing working places for distinguished scientists.

On July 31, 1945, the 22nd Annual Meeting of the Association was held in Blackford Hall, following an exhibit of current activities in the Davenport Laboratory. In a brief review of the progress of work since the last Annual Meeting, the Director of the Laboratory stated that the group of scientists at the Laboratory that summer was considerably larger than in any year since the war began. The Treasurer's Report for the year 1944 was presented and discussed by Dr. Demerec, who commented on the formation of a reserve fund to improve living accommodations as soon as materials shall become available. The report was accepted by unanimous vote. The Secretary presented a resolution recording with deep regret the death of Acosta Nichols, one of the founders of the Laboratory, in February 1945. The following were elected members of the Board of

Directors, Class of 1949: Harold A. Abramson, M. Demerec, Henry Hicks, Stuart Mudd, Robert Cushman Murphy, and John K. Roosevelt.

The 50th meeting of the Board of Directors was held on July 31, 1945, immediately following the Annual Meeting. The Director of the Laboratory presented a financial statement for the period of January 1 to June 30, 1945, and a statement of estimated income and expenditures for the remainder of the year. Mrs. G. S. Franklin was nominated for membership on Executive Committee, to replace Dr. Harold C. Urey, who wished to be excused on the basis of his continued absence from the vicinity. With this exception, the existing Executive Committee was re-elected for the following year. Dr. M. Delbruck's class on bacteriophages was commented on, as an excellent example of the Laboratory's policy of providing opportunities not elsewhere available. It was suggested that the Board watch carefully for opportunities to help in meeting the desperate deficiency of trained scientists that has resulted from the war.

E. Carleton MacDowell
Secretary

REPORT OF THE TREASURER

The Treasurer reports total income for the year of $27,984.17 and disbursements of $23,952.64.

The Women's Auxiliary Board, under the leadership of Mrs. George S. Franklin, President; Mrs. Van Santvoord Merle-Smith, Vice-President; Mrs. Alvin Devereux, Secretary; Mrs. George Nichols, Treasurer; Mrs. Percy H. Jennings, Chairman of the House Committee; and Mrs. John C. Hughes, Chairman of the Membership Committee, contributed $1,446.38 to the work of the Laboratory and also made many valuable gifts of furnishings for the houses on the grounds.

The Wawepex Society continued its annual grant, this year of $1,250 plus $250.00 for the John D. Jones Scholarship and $200.00 for Library expenses. Officers of the Wawepex Society are: Charles M. Bleeker, Governor; Jesse Knight, Scribe; and T. Bache Bleecker, Custodian. In addition to its annual financial support, the Wawepex Society leases certain lands and buildings to the Association, free of rent, and carries the insurance on these buildings.

Mr. William F. Dean audited the books for the year. The balance sheet and income-and-expense accounts of the Association follow herewith:

BALANCE SHEET — 1945

ASSETS

Current:		
Cash in banks	17,994.03	
Accounts Receivable	4,140.51	
		22,134.54
Securities held by Bankers Trust Co.:		
U. S. Savings Bonds Series G	14,000.00	
Other Securities	8,856.00	
Bonds	6,600.00	
		29,456.00
Land:		
Land Purchased	69,590.52	
Land on 50-year lease	13,500.00	
Henry W. de Forest Gift	12,000.00	
Land (improvement)	2,898.01	
Land (Airslie)	5,000.00	
		102,988.53
Buildings:		
Blackford Hall*	19,000.00	
Jones Laboratory*	10,000.00	
Davenport Laboratory	8,500.00	
George L. Nichols Memorial Laboratory	13,700.00	
Williams House	11,300.00	
Stewart Cottage	3,000.00	
Hooper House*	13,200.00	
Wawepex Laboratory*	7,500.00	
Osterhout Cottage*	5,500.00	
Dr. Walter B. James Laboratory	13,500.00	
Reginald G. Harris House	8,500.00	
Urey & Cole Cottages	4,765.00	
Henry W. de Forest Building	15,000.00	
Machine Shop and Garage	2,000.00	
Airslie	5,000.00	
		140,465.00
Equipment:		
General	38,577.27	
Biophysics	16,849.90	
Physiology	2,513.15	
		57,940.32
		352,984.39

* Situated on property on 50 years' lease from Wawepex Society

LIABILITIES

Current:		
Medical Division	1,839.66	
Accounts Payable	1,281.24	
War Research Project	683.69	
Library Fund	127.95	
Rockefeller Symposia Fund Interest	900.00	
Charles B. Davenport Memorial Fund	4,924.75	
		9,757.29
Special Funds:		
Blackford Memorial Fund	5,000.00	
Temple Prime Scholarship Fund	2,500.00	
Dorothy Frances Rice Fund	2,000.00	
Dr. William J. Matheson Fund	20,000.00	
Rockefeller Symposia Fund	12,000.00	
		41,500.00
Balance:		
Long Island Biological Association	152,950.32	
Value of Leasehold—Wawepex Society	39,153.74	
January 1, 1944	104,002.66	
Gain in Capital—December 31, 1944	5,620.38	
		301,727.10
		352,984.39

The Biological Laboratory
Income and Outgo — Year Ended December 31, 1945

	TOTAL		NET	
	Received	Paid	Received	Paid
Balance forward from 1944:				
Cash in Banks	16,984.52			
Payables and Receivables	743.12	905.87		
	17,727.64	905.87	16,821.77	
Deduct: Special Funds			9,759.90	
			7,061.87	
Current Accounts:				
Dues and Contributions	2,544.00		2,544.00	
Women's Auxiliary	1,446.38		1,446.38	
Wawepex Society	1,250.00		1,250.00	
Income of W. B. James Trust	179.34		179.34	
W. J. Mathèson Bequest	375.00		375.00	
Research	1,765.00	188.83	1,576.17	
Sale of Books	919.43	66.00	853.43	
J. D. Jones Scholarship	250.00	250.00		
D. F. Rice Scholarship	75.00	75.00		
Temple Prime Scholarship	75.00	75.00		
Summer Course Tuition	120.00		120.00	
Insurance		804.54		804.54
Residences and Dormitories:				
R. G. Harris House	745.47	470.06	275.41	
Hooper House	1,014.98	583.93	431.05	
Williams House	739.36	482.01	257.35	
Osterhout Cottage	441.66	146.89	294.77	
Urey Cottage	285.75	157.07	128.68	
Cole Cottage	267.45	152.68	114.77	
Stewart Cottage	612.85	124.15	488.70	
Henry de Forest House	725.33	192.12	533.21	
Airslie	600.00	101.40	498.60	
Allocated to D. R. Rice and Temple Prime Scholarship		150.00		150.00

Laboratory Buildings and Grounds		1,914.07		1,914.07
de Forest Property Taxes		973.27		973.27
General Expense:				
Administration Salaries		943.20		943.20
Administration Expense		112.74		112.74
Telephone and Stamps		169.09		169.09
Stationery and Printing		375.80		375.80
Capital and Special Accounts:				
Library	200.00	244.75		44.75
Symposia Fund Interest	300.00		300.00	
Macy Foundation and War Contract	5,987.17	9,735.93		3,748.76
Medical Division Contract	7,000.00	5,160.34	1,839.66	
Charles B. Davenport Memorial Fund	25.00		25.00	
Land	40.00		40.00	
Receivables		303.77		303.77
	27,984.17	23,952.64	13,571.52	9,539.99
Deduct Payments			9,539.99	
			4,031.53	
Add—Balance of 1944			16,821.77	
Balance December 31, 1945	17,994.03			
Payables and Receivables	4,140.51	1,281.24		
	22,134.54	1,281.24	20,853.30	
Less: Special Funds			7,876.05	
Net Balance			12,977.25	

Special Funds:	
Macy Foundation	683.69
Library	127.95
Symposia Interest	900.00
Davenport Fund + $600 Bonds	4,324.75
Medical Division Contract	1,839.66
	7,876.05

SPECIAL FUNDS

TEMPLE PRIME SCHOLARSHIP FUND

Donor: Cornelia Prime. Original Principal, $2,500. (1913)

"In memory of my brother, Temple Prime, the entire annual income to be expended each year for the payment of the tuition and other expenses of a male, or female, student in biology, who is working at the Laboratory at Cold Spring Harbor, New York, during that year."

Allocated, 1945	$75.00
Scholarship, support of research	75.00

BLACKFORD MEMORIAL FUND

Bequest of Frances L. Blackford. Principal, $5,000. (1924)

" . . . to be used in the maintenance of the Blackford Memorial at Cold Spring Harbor, Long Island, as the trustees may deem to be for the best interest of said Memorial."

No income, 1945

DOROTHY FRANCES RICE FUND

Donor: Oran W. Rice. Original Principal $2,000. (1926)

Income to be applied as follows: (1) one-sixth to be added annually to principal of fund, (2) remaining five-sixths to be paid over each year to a woman student, preference of selection being given to students working in the botanical sciences and particularly worthy of such recognition.

Allocated, 1945	$75.00
Scholarship, support of research	75.00

DR. WALTER B. JAMES FUND

Bequest, in trust, of Dr. Walter B. James. Principal, $5000.

"By his will, Walter B. James, who died in 1927, bequeathed $5,000. to Equitable Trust Company in trust in accordance with the Resolution and Declaration of Trust creating The New York Community Trust and expressed the desire that the net income thereof be devoted to the support of the Long Island Biological Association of Cold Spring Harbor, Long Island.

Income received, 1945	$179.34
Transferred to Income Account	179.34

DR. WALTER J. MATHESON FUND

Bequest of Dr. William J. Matheson. Bequest, $20,000.
Cost of securities, $20,116.18 (1931)

"I give and bequeath to Biological Laboratory, of Cold Spring Harbor, Long Island, for its endowment fund, the sum of Twenty Thousand Dollars."

Interest, 1945	$375.00
Transferred to Income Account	375.00

Marshall Field, Treasurer
William F. Dean, Assistant Treasurer and Auditor