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THE MARINE BIOLOGICAL LABORATORY

EIGHTIETH REPORT, FOR THE YEAR 1977—NINETIETH YEAR

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I. TRUSTEES

Including Action of 1977 Annual Meeting

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II. CERTIFICATE OF ORGANIZATION

(On File in the Office of the Secretary of the Commonwealth)

No. 3170

We, Alpheus Hyatt, President, William Stanford Stevens, Treasurer, and William T. Sedgwick, Edward G. Gardiner, Susan Mims and Charles Sedgwick Minot being a majority of the Trustees of the Marine Biological Laboratory in complicance with the requirements of the fourth section of chapter one hundred and fifteen of the Public Statutes do hereby certify that the following is a true copy of the agreement of association to constitute said Corporation, with the names of the subscribers thereto:-

We, whose names are hereto subscribed, do, by this agreement, associate ourselves with the intention to constitute a Corporation according to the provisions of the one hundred and fifteenth chapter of the Public Statutes of the Commonwealth of Massachusetts, and the Acts in amendment thereof and in addition thereto.

The name by which the Corporation shall be known is THE MARINE BIOLOGICAL LABORATORY

The purpose for which the Corporation is constituted is to establish and maintain a laboratory or station for scientific study and investigations, and a school for instruction in biology and natural history.

The place within which the Corporation is established or located is the city of Boston within said Commonwealth.

The amount of its capital stock is none.

In Witness Whereof, we have hereunto set our hands, this twenty seventh day of February in the year eighteen hundred and eighty-eight, Alpheus Hyatt, Samuel Mills, William T. Sedgwick, Edward G. Gardiner, Charles Sedgwick Minot, William G. Farlow, William Stanford Stevens, Anna D. Phillips, Susan Mims, B. H. Van Vleck.

That the first meeting of the subscribers to said agreement was held on the thirteenth day of March in the year eighteen hundred and eighty-eight.

In Witness Whereof, we have hereunto signed our names, this thirteenth day of March in the year eighteen hundred and eighty-eight, Alpheus Hyatt, President, William Stanford Stevens, Treasurer, Edward G. Gardiner, William T. Sedgwick, Susan Mims, Charles Sedgwick Minot.

(Approved on March 20, 1888 as follows:

I hereby certify that it appears upon an examination of the within written certificate and the records of the corporation duly submitted to my inspection, that the requirements of sections one, two and three of chapter one hundred and fifteen, and sections eighteen, twenty and twenty-one of chapter one hundred and six, of the Public Statutes, have been complied with and I hereby approve said certificate this twentieth day of March A.D. eighteen hundred and eighty-eight.

CHARLES ENDICOTT
Commissioner of Corporations)

III. ARTICLES OF AMENDMENT

(On file in the office of the Secretary of the Commonwealth)

We, James D. Ebert, President, and David Shepro, Clerk of the Marine Biological Laboratory, located at Woods Hole, Massachusetts 02543, do hereby certify that the following amendment to the Articles of Organization of the Corporation was duly adopted at a meeting held on August 15, 1975, as adjourned to August 29, 1975, by vote of 444 members, being at least two-thirds of its members legally qualified to vote in the meetings of the corporation:

VOTED: That the Certificate of Organization of this corporation be and it hereby is amended by the addition of the following provisions:

> "No Officer, Trustee or Corporate Member of the corporation shall be personally liable for the payment or satisfaction of any obligation or liabilities incurred as a result of, or otherwise in connection with, any commitments, agreements, activities or affairs of the corporation.

"Except as otherwise specifically provided by the Bylaws of the corporation, meetings of the Corporate Members of the corporation may be held anywhere in the United States.

"The Trustees of the corporation may make, amend or repeal the Bylaws of the corporation in whole or in part, except with respect to any provisions thereof which shall by law, this Certificate or the Bylaws of the corporation, require action by the Corporate Members."

The foregoing amendment will become effective when these articles of amendment are filed in accordance with Chapter 180, Section 7 of the General Laws unless these articles specify, in accordance with the vote adopting the amendment, a later effective date not more than thirty days after such filing, in which event the amendment will become effective on such later date.

In Witness whereof and Under the Penalties of Perjury, we have hereto signed our names this 2nd day of September, in the year 1975, James D. Ebert, President; David Shepro, Clerk.

(Approved on October 24, 1975, as follows:

I hereby approve the within articles of amendment and, the filing fee in the amount of $10 having been paid, said articles are deemed to have been filed with me this 24th day of October, 1975.

PAUL GUZZI
Secretary of the Commonwealth)

IV. BYLAWS OF THE CORPORATION OF THE MARINE BIOLOGICAL LABORATORY

(Revised February 13, 1976)

I. (A) The name of the Corporation shall be The Marine Biological Laboratory. The Corporation's purpose shall be to establish and maintain a laboratory or station for scientific study and investigation, and a school for instruction in biology and natural history.

(B) Marine Biological Laboratory admits students without regard to race, color, sex, national and ethnic origin to all the rights, privileges, programs and activities generally accorded or made available to students in its courses. It does not discriminate on the basis of race, color, sex, national and ethnic origin in employment, administration of its educational policies, admissions policies, scholarship and other programs.

II. (A) The members of the Corporation ("Members") shall consist of persons elected by the Board of Trustees, upon such terms and conditions and in accordance with such procedures, not inconsistent with law or these Bylaws, as may be determined by said Board of Trustees. Except as provided below, any Member may vote at any meeting, either in person or by proxy executed no more than six months prior to the date of such meeting. Members shall serve until their death or resignation unless earlier removed, with or without cause, by the affirmative vote of two-thirds of the Trustees then in office. Any Member who has attained the age of seventy years or has retired from his home institution shall automatically be designated a Life Member provided he signifies his wish to retain his membership. Life Members shall not have the right to vote and shall not be assessed for dues.

(B) The Associates of the Marine Biological Laboratory shall be an unincorporated group of persons (including associations and corporations) interested in the Laboratory and shall be organized and operated under the general supervision and authority of the Trustees.

III. The officers of the Corporation shall consist of a Chairman of the Board of Trustees, President, Director, Treasurer and Clerk, elected or appointed by the Trustees as set forth in Article IX.

IV. The Annual Meeting of the Members shall be held on the Friday following the Second Tuesday in August in each year at the Laboratory in Woods Hole, Massachusetts, at 9:30 a.m. Subject to the provisions of Article VIII(2), at such meeting the Members shall choose by ballot six Trustees to serve four years, and shall transact such other business as may properly come before the meeting. Special meetings of the Members may be called by the Chairman or Trustees to be held at such time and place as may be designated.

V. Twenty five Members shall constitute a quorum at any meeting. Except as otherwise required by law or these Bylaws, the affirmative vote of a majority of the Members voting in person or by proxy at a meeting attended by a quorum (present in person or by proxy) shall constitute action on behalf of the Members.

VI. (A) Inasmuch as the time and place of the Annual Meeting of Members are fixed by these Bylaws, no notice of the Annual Meeting need be given. Notice of any special meeting of Members, however, shall be given by the Clerk by mailing notice of the time and place and purpose of such meeting, at least 15 days before such meeting, to each Member at his or her address as shown on the records of the Corporation.

(B) Any meeting of the Members may be adjourned to any other time and place by the vote of a majority of those Members present or represented at the meeting, whether or not such Members constitute a quorum. It shall not be necessary to notify any Member of any adjournment.

VII. The Annual Meeting of the Trustees shall be held promptly after the Annual Meeting of the Corporation at the Laboratory in Woods Hole, Massachusetts. Special meetings of the Trustees shall be called by the Chairman, the President, or by any seven Trustees, to be held at such time and place as may be designated. Notice of Trustees' meetings may be given orally, by telephone, telegraph or in writing; and notice given in time to enable the Trustees to attend, or in any case notice sent by mail or telegraph to a Trustee's usual or last known place of residence, at least one week before the meeting shall be sufficient. Notice of a meeting need not be given to any Trustee if a written waiver of notice, executed by him before or after the meeting is filed with the records of the meeting, or if he shall attend the meeting without protesting prior thereto or at its commencement the lack of notice to him.

VIII. (A) There shall be four groups of Trustees:

(1) Trustees (the "Corporate Trustees") elected by the Members according to such procedures, not inconsistent with these Bylaws, as the Trustees shall have determined. Except as provided below, such Trustees shall be divided into four classes of six, one class to be elected each year to serve for a term of four years. Such classes shall be designated by the year of expiration of their respective terms.

(2) Trustees ("Board Trustees") elected by the Trustees then in office according to such procedures, not inconsistent with these Bylaws, as the Trustees shall have determined. Except as provided below, such Board Trustees shall be divided into

four classes of three, one class to be elected each year to serve for a term of four years. Such classes shall be designated by the year of expiration of their respective terms. It is contemplated that, unless otherwise determined by the Trustees for good reason, Board Trustees shall be individuals who have not been considered for election as Corporate Trustees.

(3) Trustees ex officio, who shall be the Chairman, the President, the Director, the Treasurer, and the Clerk.

(4) Trustees emeriti who shall include any Member who has attained the age of seventy years (or the age of sixty five and has retired from his home institution) and who has served a full elected term as a regular Trustee, provided he signifies his wish to serve the Laboratory in that capacity. Any Trustee who qualifies for emeritus status shall continue to serve as a regular Trustee until the next Annual Meeting whereupon his office as regular Trustee shall become vacant and be filled by election by the Members or by the Board, as the case may be. The Trustees ex officio and emeriti shall have all the rights of the Trustees, except that Trustees emeriti shall not have the right to vote.

(B) The aggregate number of Corporate Trustees and Board Trustees elected in any year (excluding Trustees elected to fill vacancies which do not result from expiration of a term) shall not exceed nine. The number of Board Trustees so elected shall not exceed three and unless otherwise determined by vote of the Trustees, the number of Corporate Trustees so elected shall not exceed six.

(C) The Trustees and Officers shall hold their respective offices until their successors are chosen in their stead.

(D) Any Trustee may be removed from office at any time with or without cause, by vote of a majority of the Members entitled to vote in the election of Trustees; or for cause, by vote of two-thirds of the Trustees then in office. A Trustee may be removed for cause only if notice of such action shall have been given to all of the Trustees or Members entitled to vote, as the case may be, prior to the meeting at which such action is to be taken and if the Trustee so to be removed shall have been given reasonable notice and opportunity to be heard before the body proposing to remove him.

(E) Any vacancy in the number of Corporate Trustees, however arising, may be filled by the Trustees then in office unless and until filled by the Members at the next Annual Meeting. Any vacancy in the number of Board Trustees may be filled by the Trustees.

(F) A Corporate Trustee or a Board Trustee who has served an initial term of at least 2 years duration shall be eligible for re-election to a second term, but shall be ineligible for re-election to any subsequent term until two years have elapsed after he last served as a Trustee.

IX. The Trustees shall have the control and management of the affairs of the Corporation. They shall elect a Chairman of the Board of Trustees who shall be elected annually and shall serve until his successor is selected and qualified and who shall also preside at meetings of the Corporation. They shall elect a President of the Corporation who shall also be the Vice Chairman of the Board of Trustees and Vice Chairman of meetings of the Corporation, and who shall be elected annually and shall serve until his successor is selected and qualified. They shall elect a Treasurer and Clerk to serve one year, and Board Trustees as described in Article VIII (B). They shall appoint a Director of the Laboratory for a term not to exceed five years, provided the term shall not exceed one year if the candidate has attained the age of 65 years prior to the date of the appointment. They may choose such other officers and agents as they may think best. They may fix the compensation and define the duties of all the officers and agents of the Corporation and may remove them at any time. They may fill vacancies occurring in any of the offices. The Board of Trustees shall have the power

to choose an Executive Committee from their own number as provided in Article X, and to delegate to such Committee such of their own powers as they may deem expedient in addition to those powers conferred by Article X. They shall from time to time elect Members to the Corporation upon such terms and conditions as they shall have determined, not inconsistent with law or these Bylaws.

X. (A) The Executive Committee is hereby designated to consist of not more than ten members, including the ex officio Members (Chairman of the Board of Trustees, President, Director and Treasurer); and six additional Trustees, two of whom shall be elected by the Board of Trustees each year, to serve for a three-year term.

(B) The Chairman of the Board of Trustees shall act as Chairman of the Executive Committee, and the President as Vice Chairman. A majority of the members of the Executive Committee shall constitute a quorum and the affirmative vote of a majority of those voting at any meeting at which a quorum is present shall constitute action on behalf of the Executive Committee. The Executive Committee shall meet at such times and places and upon such notice and appoint such sub-committees as the Committee shall determine.

(C) The Executive Committee shall have and may exercise all the powers of the Board during the intervals between meetings of the Board of Trustees except those powers specifically withheld from time to time by vote of the Board or by law.

(D) The Executive Committee shall keep appropriate minutes of its meetings and its action shall be reported to the Board of Trustees.

(E) The elected Members of the Executive Committee shall constitute as a standing "Committee for the Nomination of Officers," responsible for making nominations, at each Annual Meeting of the Corporation, and of the Board of Trustees, for candidates to fill each office as the respective terms of office expire (Chairman of the Board, President, Director, Treasurer, and Clerk).

XI. A majority of the Trustees then in office shall constitute a quorum. A lesser number than a quorum may adjourn any meeting from time to time without further notice.

XII. Any action required or permitted to be taken at any meeting of the Trustees or of the Executive Committee may be taken without a meeting if all the Trustees or members of the Executive Committee, as the case may be, consent to the action in writing and such written consents are filed with the records of meetings. Such a consent shall be treated for all purposes as a vote at a meeting.

XIII. The consent of every Trustee shall be necessary to dissolution of the Marine Biological Laboratory. In case of dissolution, the property shall be disposed of in such manner and upon such terms as shall be determined by the affirmative vote of two-thirds of the Board of Trustees then in office.

XIV. These Bylaws may be amended by the affirmative vote of the Members at any meeting, provided that notice of the substance of the proposed amendment is stated in the notice of such meeting. As authorized by the Articles of Organization, the Trustees, by a majority of their number then in office, may also make, amend, or repeal these Bylaws, in whole or in part, except with respect to (a) the provisions of these Bylaws governing (i) the removal of Trustees and (ii) the amendment of these Bylaws and (b) any provisions of these Bylaws which by law, the Articles of Organization or these Bylaws, requires action by the Members.

No later than the time of giving notice of the meeting of Members next following

the making, amending or repealing by the Trustees of any Bylaw, notice thereof stating the substance of such change shall be given to all Corporation Members entitled to vote an amending the Bylaws.

Any Bylaw adopted by the Trustees may be amended or repealed by the Members entitled to vote on amending the Bylaws.

XV. The account of the Treasurer shall be audited annually by a certified public accountant.

XVI. The Corporation will indemnify every person who is or was a trustee, officer or employee of the Corporation or a person who provides services without compensation to an Employee Benefit Plan maintained by the Corporation, for any liability (including reasonable costs of defense and settlement) arising by reason of any act or omission affecting an Employee Benefit Plan maintained by the Corporation or affecting the participants or beneficiaries of such Plan, including without limitation any damages, civil penalty or excise tax imposed pursuant to the Employee Retirement Income Security Act of 1974; provided, (1) that the Act or omission shall have occurred in the course of the person's service as trustee or officer of the Corporation or within the scope of the employment of an employee of the Corporation or in connection with a service provided without compensation to an Employee Benefit Plan maintained by the Corporation, (2) that the Act or omission be in good faith as determined by the Corporation (whose determination made in good faith and not arbitrarily or capriciously shall be conclusive), and (3) that the Corporation's obligation hereunder shall be offset to the extent of any otherwise applicable insurance coverage, under a policy maintained by the Corporation or any other person, or other source of indemnification (August 13, 1976).

V. REPORT OF THE DIRECTOR

To: The Trustees of the Marine Biological Laboratory

"It is the first step in sociological wisdom, to recognize that the major advances in civilization are processes which all but wreck the societies in which they occur:—like unto an arrow in the hand of a child. The art of free society consists first in the maintenance of the symbolic code; and secondly in fearlessness of revision, to secure that the code serves those purposes which satisfy an enlightened reason. Those societies which cannot combine reverence to their symbols with freedom of revision, must ultimately decay either from anarchy, or from the slow atrophy of a life stifled by useless shadows."

Alfred North Whitehead—*Symbolism*

As it enters the last decade of its first century, the Marine Biological Laboratory must continue to consolidate earlier advances while redefining its objectives to meet the conspicuous needs and opportunities of the time. In the year just past the Laboratory has been extraordinarily rich in people—investigators, instructors, and students—and ideas. Inevitably, change is accompanied by personal and social insecurity; and the search for my successor has engendered anxieties. Happily such fears as may have emerged have already all but disappeared following the announcement on March 24 that Paul R. Gross, currently Graduate Dean and Professor of Biology at the University of Rochester, would become President and Director on July 1, 1978.

The richness of new opportunity, and the Laboratory's unique capacity to seize it, has been abundantly evident throughout the year. Some of our year-round research programs have been recognized as being among the nation's finest, dispelling the fears

expressed within the Corporation just a few years ago that they would fail to measure up to the quality of our renowned summer programs. Thus, in its second report, the Visiting Committee to the Ecosystems Center (E. O. Wilson, Chairman) wrote, in part, "The projects in ecosystem analysis now underway at the Center are original, well conceived, and significant, and we consider them in the aggregate to constitute one of the best such research programs in the world."

The program of the Laboratory of Biophysics of the National Institute of Neurological and Communicative Disorders and Stroke now embraces almost every aspect of modern marine neurobiology from biophysical studies of squid and lobster axons to pioneering explorations of the neural basis of behavior. A vital underpinning of the behavioral studies has been the successful development of techniques for culturing marine nudibranchs.

No less significant are the loosely-knit, informal associations at the Laboratory; witness the several related programs in cell motility and morphogenesis, embracing the laboratories of Ray Stephens, Kenneth Edds, Shinya Inoué and Lewis Tilney, reenforced during the summers not only by more of the world's leaders in the field, but also by an increasing number of promising young investigators.

The continuing emergence of our year-round programs, coupled with the availability of funds to enable young investigators to spend summers at the Laboratory, have resulted in increased competition for space among summer investigators. We have looked forward to a time when the competition would become significant; at this writing it appears that not all qualified applicants will be accommodated in 1978. It seems likely that the problem will be more acute in 1979. Henceforth, the Research Space Committee will be required to set its priorities carefully, especially at the lower end of its scale, for with six investigators on the waiting list at this writing, and with the number of participants in the Steps Toward Independence Program (among others) scheduled to grow in 1979, we should anticipate a shortage of as many as fifteen spaces in 1979.

I am especially pleased to report that the number of able women, both investigators and students, applying for fellowships continues to increase. Leaving aside the Grass Fellowships, which are determined by the Foundation itself, and fellowships in courses, determined by instructors-in-charge (and not known to me at this writing), seventeen of thirty-four major fellowships at the Laboratory in the summer of 1978 have been awarded to women.

Education

Just five years ago the winter teaching at the Laboratory was centered almost entirely in the Boston University Marine Program. In earlier reports I have attested to BUMP's remarkable growth—more evident in quality than in numbers; thus, in this account I will stress the emergence of the Laboratory's own programs. In 1977–1978 over two hundred students will have participated in five January short-term courses and five intensive short courses.

The five January, 1978, courses were outstanding. The intellectual fare was rich and varied, highlighted by our new course in Comparative Pathology of Marine Invertebrates. All five courses will be offered again in January, 1979.

Dr. Morton Maser, who took up his responsibilities as Coordinator of Continuing Education on July 1, 1977, has responded in a way that could have been only dimly anticipated, organizing five one- and two-week residential laboratory courses in the winter and spring of 1977–1978. The imagination of enterprise and the devotion that he brings to his office give a new dimension to life at the Laboratory.

Included in the 1977–1978 offerings were programs in Optical Microscopy and Photomicrography in the Biomedical Sciences, with Robert D. Allen as Instructor-in-

Chief; Electron Microscopy in the Biological Sciences, headed by Blair Bowers and Maser; Stereology, Morphometry and Optical Analysis of Electron Micrographs, headed by Lee D. Peachy; and Computer Reconstruction of Three-Dimensional Biological Structures from Serial Sections, with Eduardo Macagno in charge, joined by Cyrus Levinthal and Peter Sterling. In addition, Maser presented two one-week courses in Electron Microscopy for Technicians.

Maser is constantly on the alert for short courses that cannot be, or at least have not been, incorporated into traditional academic programs, because of considerations either of tradition or of time and scheduling. Their characteristics describe the essence of continuing education in its original and exciting sense and fundamentally are similar to the bases upon which the Laboratory's summer courses are built. But although such short courses could be held in practically any building anywhere, their value is enhanced significantly by the astonishing web of associations that thrive at MBL.

The recently completed short course on Optical Microscopy and Photomicrography in the Biomedical Sciences provided examples of how the short course format and the Laboratory tradition are mutually beneficial. Sixteen student-participants (most of whom are actively engaged in research) gathered for a week surrounded by $500,000 worth of modern optical microscopical equipment and a faculty and support staff of about a dozen to learn not only "nuts and bolts" microscopy but also the most modern and experimental aspects of this science. In spite of the fact that the Instructor-in-Chief, Robert Allen, was physically incapacitated for much of the program, the course was innovative and was satisfactory and rewarding to the entire range of participants. One of the students was Larry Lewis of Millersville State College in Pennsylvania, who will be a Steps Toward Independence Fellow in 1978. It happened that Keigi Fujiwara, one of the guest faculty, also will be a Fellow in the same program. To quote a recent letter from Lewis, "One very tangible result is that I will be collaborating with Keigi Fujiwara this summer."

Nor have the summer courses been immune to change. Our new offering in 1978, Neural Systems and Behavior, with a nationally prominent staff headed by Alan Gelperin, deserves special mention. It replaces the Experimental Invertebrate Zoology course. An invertebrate zoology course has been one of the Laboratory's traditional offerings. In recent years—for about a decade, in fact—ours was a zoology course in name only. It was successively a comparative physiology course and a physiological ecology course. Thus, we decided to face the issue squarely and to rename the course to define its content as accurately as possible. 1978 will see relatively few other changes. David Epel, who has rendered splendid service in recent summers as Co-Instructor-in-Charge of Embryology had to relinquish his responsibilities; he has been replaced by Joan Ruderman. We have also had to say good-bye, again reluctantly, to A. O. W. Stretton, who has stepped aside as Co-Director of the Neurobiology course, which Edward Kravitz will continue to direct.

Management

One of the secrets of the success of our educational programs in 1977–1978 has been Lucena Barth's devoted and wise stewardship of our new Admissions Office. There is much to be said for retiring when one has completed a good year; and Lucena has done just that. She has done a remarkable job of coordinating all of our educational efforts, including not only the summer and winter courses but also the Josiah Macy, Jr. and Steps Toward Independence fellowship programs, developing new procedures for their promotion and for screening candidates. This newly organized office will now become a part of Dr. Maser's responsibilities.

Support: four years in review

This report covers the progress of our funding program for the period beginning January 1, 1974, through March 31, 1978. During this period the Laboratory received over $4.3 million in funds from private sources, this figure representing the total in grants and pledges from foundations, corporations and individuals. All told there were sixty-seven awards from forty-five different foundations and corporations, which are listed below. These awards should provide a firm base on which to build future campaigns. Priorities in the years immediately ahead have been set: capital funding for the Marine Resources Center and the renovation of the Lillie Building, and, equally important, a drive to increase the Laboratory's endowment.

Atlantic Richfield Foundation
Charles Ulrick & Josephine Bay Foundation
Robert Sterling Clark Foundation
The Clowes Fund
Commonwealth Fund
Josephine B. Crane Foundation
Charles E. Culpepper Foundation
Fred Harris Daniels Foundation, Inc.
Arthur Vining Davis Foundations
Henry L. and Grace Doherty Charitable Foundation
Eastern Associated Foundation
Exxon Corporation
Max C. Fleischmann Foundation
Friendship Fund
General Electric Foundation
Gillette Charitable & Educational Foundation
Grace Foundation, Inc.
Grass Foundation
Charles Hayden Foundation
William Randolph Hearst Foundation
Lillia Babbitt Hyde Foundation
IBM Corporation
Edward Bangs Kelley & Elizabeth Kelley Foundation
Charles A. King Trust
Josiah Macy, Jr. Foundation
Andrew W. Mellon Foundation
Richard King Mellon Foundation
Merck Company Foundation
Merck, Sharpe & Dohme Research Laboratories
Mobil Foundation
NL Industries
Jessie Smith Noyes Foundation
Pew Memorial Trust
Pfizer, Inc.
Raytheon Charitable Foundation
Fannie E. Rippel Foundation
Rockefeller Foundation
Rowland Foundation, Inc.
Sandoz Foundation
William E. & Bertha E. Schrafft Charitable Trust
Alfred P. Sloan Foundation
Seth Sprague Educational & Charitable Foundation
Surdna Foundation
UPS Foundation
Edwin S. Weber Foundation

1. The Staff

ECOLOGY

I. Instructors

John M. Teal, Woods Hole Oceanographic Institution, co-director of course
Ivan Valiela, Boston University Marine Program, co-director of course
Kenneth H. Mann, Dalhousie University
William Odum, University of Virginia
Karen Porter, University of Michigan
James Porter, University of Michigan
Thomas Fenchel, University of Aarhus, Denmark
J. Rudi Strickler, Yale University
Charles Hall, Cornell University
Charlene Van Raalte, Hampshire College

II. Assistant

Mike Petrovski, Boston University Marine Program

III. Special Lecturers

Howard Sanders, Woods Hole Oceanographic Institution
Richard Haedrich, Woods Hole Oceanographic Institution
Charles Hollister, Woods Hole Oceanographic Institution
Peter Wiebe, Woods Hole Oceanographic Institution
Laureh Haury, Woods Hole Oceanographic Institution
Frank Carey, Woods Hole Oceanographic Institution
Larry Madin, Woods Hole Oceanographic Institution
George Grice, Woods Hole Oceanographic Institution
Joy Geiselman, Woods Hole Oceanographic Institution
Arthur Humes, Boston University Marine Program
Susan Vince, Boston University Marine Program
Bruce Peterson, The Ecosystems Center
John Hobbie, The Ecosystems Center
John J. McCarthy, Harvard University

IV. Lectures

J. Teal	Introduction to the oceans
J. Teal	Beaches and dunes
J. Teal	The ARGO MERCHANT oil spill
I. Valiela	Structure and function of salt marshes
I. Valiela	Nutrient budgets in a salt marsh
I. Valiela	Experimental studies of salt marsh pollution
R. Haedrich	The nature or oceanic fishes
R. Haedrich	Distribution and natural history of deep benthic fishes
B. Peterson	Primary production laboratory
R. Howarth	The role of sulfur in salt marsh metabolism
H. Sanders	Patterns of recovery in the aftermath of the West Falmouth oil spill
P. Wiebe	The biology of cold core rings
L. Haury	Zooplankton swimming: energetics and other consequences
T. Fenchel	Detritus food chain in aquatic environments
T. Fenchel	The biology of the sulfur cycle
J. Porter	Life in three dimensions: the structure of open ocean communities in contrast to terrestrial ecosystems
J. Porter	Life in two dimensions: the structure of communities in substrate-bounded marine ecosystems
J. Porter	Resource partitioning in space and time for marine ecosystems
K. Porter	Filter feeding as a way of life
K. Porter	Grazing and planktonic community structure
S. Vince	Plant-herbivore interactions in a salt marsh
J. R. Strickler	Zooplankton: life at random?
J. R. Strickler	Orientation of planktonic crustaceans
J. R. Strickler	Do behavior and morphology separate niches?
J. Hobbie	Structure of arctic tundra pond ecosystems
F. Carey	Ecology of tuna
G. Grice	The whale problem
G. Grice	The effects of mercury on pelagic ecosystems: giant bag experiments
L. Madin	The biology of gelatinous plankton

K. H. MANN	Studies on the productivity of kelp in Nova Scotia
K. H. MANN	Seaweeds, sea urchins and lobsters: a problem in resource management
D. BOTKIN	Stability and diversity in ecosystems
K. H. MANN	Some key roles for microbes in coastal ecosystems
J. J. MCCARTHY	The nitrogenous and phosphorus nutrition of ocean phytoplankton—or, getting something from nothing
W. ODUM	The ecology of mangroves
W. ODUM	Detritus feeding in coastal ecosystems
W. ODUM	Management of coastal environments
J. GEISELMAN	Chemical defenses in marine macroalgae
C. HALL	Nutrient dynamics in estuaries
C. HALL	Energetics analysis of salmon ecosystems

EMBRYOLOGY

I. INSTRUCTORS

TOM HUMPHREYS, University of Hawaii, co-director of course
DAVID EPEL, University of California, San Diego, co-director of course
STANLEY COHEN, Vanderbilt University
R. K. HUNT, The Johns Hopkins University
TIM HUNT, University of Cambridge, England, U.K.
BIRGIT ROSE, University of Miami

II. ASSISTANTS

W. STEVEN ADAIR, Wesleyan University
RANDAL GERBER, University of Hawaii
NANCY WRIGHT, Duke University
MARC LAUFER

III. LECTURES

D. EPEL	Fertilization reactions
D. EPEL	Regulation of metabolic activity at fertilization
T. HUMPHREYS	Activation of protein synthesis at fertilization
T. HUNT	Globin synthesis in reticulocytes
T. HUNT	Regulation of the translation of globin mRNA
R. K. HUNT	Development of the *Xenopus* eye
R. K. HUNT	Development of nerve patterns
B. ROSE	Cell communication *via* junctional membrane: regulation by cytoplasmic free Ca^{++}
T. HUMPHREYS	Biochemical studies on aggregation of marine sponges
S. COHEN	Characteristics of growth factors
S. COHEN	Interaction of epidermal growth factor with cells
T. HUMPHREYS	Ribosomal RNA synthesis and growth of sea urchin embryos
W. S. ADAIR	Cell surface changes associated with mating interactions of *Tetrahymena*
J. W. SAUNDERS	Signaling systems in vertebrate limb development
V. GOODENOUGH	Genetic control of gametic differentiation in *Chlamydomonas reinhardii*
J. P. TRINKAUS	Surface interactions of gastrula cells during locomotion

W. WASSERMAN	Cytoplasmic control of meiotic maturation in amphibian oocytes
L. JAFFE	Electrical controls of development
D. FRIEND	Morphological studies of membrane interactions: fusions, junctions, and controls
R. STEINHART	Calcium and pH transients at activation in the sea urchin egg
J. GERHART	Protein phosphorylation in the control of maturation of amphibian oocytes
H. KANATANI	Hormones controlling starfish oocyte maturation
A. MONROY	Sperm-egg interactions in ascidian fertilization
L. JAFFE	Fertilization of voltage-clamped sea urchin eggs
H. KRESS	Regulation of puff formation in *Drosophila* salivary chromosomes
A. WARNER	Changes in membrane properties during specification of the nervous system
A. WARNER	Cell to cell communication in the early amphibian embryo

EXPERIMENTAL INVERTEBRATE ZOOLOGY

I. INSTRUCTORS

MICHAEL J. GREENBERG, Florida State University, director of course
STEPHEN H. BISHOP, Baylor College of Medicine
RICHARD J. HOFFMANN, University of Pittsburgh
WILLIAM R. KEM, University of Florida
LINDA H. MANTEL, The City University of New York
SIDNEY K. PIERCE, JR., University of Maryland
DAVID J. PRIOR, University of Kentucky
J. MALCOLM SHICK, University of Maine

II. CONSULTANTS

F. A. BROWN, JR., Northwestern University
JAMES CASE, University of California, Santa Barbara
ROBERT K. JOSEPHSON, University of California, Irvine
CHARLOTTE P. MANGUM, College of William and Mary
C. LADD PROSSER, University of Illinois
W. D. RUSSELL-HUNTER, Syracuse University
THOMAS J. M. SCHOPF, University of Chicago

III. ASSISTANTS

CHRISTINA MYLES, Manchester Community College
RAYMOND FETTERER, JR., Michigan State University

IV. SECRETARY

TONICIA M. SMITH, Marine Biological Laboratory

V. SPECIAL LECTURERS

JOHN ARNOLD, University of Hawaii
PETER CALOW, University of Glasgow, Scotland, U.K.

EDWARD J. CARROLL, JR., University of California, Riverside
A. FARMANFARMAIAN, Rutgers—The State University of New Jersey
G. RICHARD HARBISON, Woods Hole Oceanographic Institution
DENNIS J. MURPHY, Connecticut College
C. LADD PROSSER, University of Illinois

VI. LECTURES

M. J. GREENBERG	Introductory notes
R. J. HOFFMANN	Population and genetic structure of marine invertebrates
R. J. HOFFMANN	Environment and biochemical polymorphism
R. J. HOFFMANN	Cape Cod environment
R. J. HOFFMANN	Physiological possibilities of multiple molecular forms
G. R. HARBISON	Jello plankton: life in the open ocean
S. K. Pierce, JR.	Salinity, osmosis, diffusion and, briefly, membrane structure
S. K. PIERCE, JR.	Mechanisms of salinity tolerance: cellular volume regulation
S. K. PIERCE, JR.	Water balance: functional morphology of excretory systems
L. H. MANTEL	Ionic regulation: the problem and its solutions
L. H. MANTEL	Cellular mechanisms and hormonal control of ionic regulation
A. FARMANFARMAIAN	Membrane transport of sugars and amino acids in intestinal epithelial—some hard facts and popular speculations
M. J. GREENBERG	The distribution of animals with salinity: the horohalinicum as a physiological island
M. J. GREENBERG	Circulation: compartmentalization and filtration
M. J. GREENBERG	Circulation: volume, pressure and flow
S. H. BISHOP	Control of amino acid pool sizes
S. H. BISHOP	Physiological role of ammonia
J. M. SHICK	Ecological physiology and genetics of the colonizing sea anemone, *Haliplanella luciae*
S. H. BISHOP	Nitrogen detoxification and phosphagens
S. H. BISHOP	Metabolic adaptations and facultative anaerobiosis
S. K. PIERCE, JR.	Water balance: a look at some intact animals
J. M. SHICK	Principles of gas exchange; body size, the limitations of diffusion, and respiratory surfaces
J. M. SHICK	Respiratory responses to declining P_{O_2}; external and internal convection
J. M. SHICK	Ecological and bioenergetic aspects of oxygen supply and consumption
E. J. CARROLL, JR.	Cell surface events during sea urchin fertilization
J. M. SHICK	Invertebrate respiratory pigments
J. ARNOLD	Squid mating demonstration
W. R. KEM	Nemertine toxins
W. R. KEM	Coelenterate toxins
W. R. KEM	Annelid, molluscan, and echinoderm toxins
W. R. KEM	Invertebrate digestion: proteases and protease inhibitors
S. H. BISHOP	Phosphoglycoprotein connective tissue components in coelenterates and other invertebrates

D. J. MURPHY	The physiological basis for change in the freezing tolerance of a bivalve mollusc
D. J. MURPHY	Metabolic adaptations of ectothermic animals to temperature changes
L. H. MANTEL	Introduction to neuroendocrine systems
L. H. MANTEL	Neuroendocrine mechanisms in the daily life of invertebrates
L. H. MANTEL	Neuroendocrine regulation of cyclic phenomena in invertebrates
P. CALOW	Gaining time by losing weight; or can a flatworm live forever?
D. J. PRIOR	Nervous systems, neurons and effectors
D. J. PRIOR	Integration: mechanisms of interaction between neurons
C. L. PROSSER	Role of the central nervous system in temperature adaptation
D. J. PRIOR	Neuroethology, I and II
D. J. PRIOR	Neural basis of adaptive behavioral modifications

EXPERIMENTAL MARINE BOTANY

(COMPARATIVE BIOLOGY AND BIOCHEMISTRY OF ALGAE)

I. INSTRUCTORS

JEROME A. SCHIFF, Brandeis University, director of course
JAMES FIORE, Suffolk University, laboratory instructor
DAVID MAUZERALL, The Rockefeller University
ROBERT D. SIMON, University of Rochester, laboratory instructor
ROBERT TROXLER, Boston University

II. CONSULTANTS

ROBERT L. GUILLARD, Woods Hole Oceanographic Institution
FRANK A. LOEWUS, Washington State University
RALPH S. QUATRANO, Oregon State University

III. STAFF ASSOCIATES

HANS GAFFRON, Woods Hole and Sanibel, Florida
AIMLEE LADERMAN, State University of New York at Binghamton

IV. ASSISTANTS

CAROL KENNY, University of Rochester
MICHAEL MISHKIND, State University of New York at Stony Brook
SCOTT SCHATZ, University of Rhode Island

V. SPECIAL LECTURERS

FRANKLIN FONG, Brandeis University
MARTIN GIBBS, Brandeis University
JANE GIBSON, Cornell University
ZIPPORAH GROMET-ELCHANON, The Weizmann Institute
ALFRED LOEBLICH, Harvard University
HARVARD LYMAN, State University of New York at Stony Brook

JOSEPH RAMUS, Yale University
JAMES SEARS, Southern Massachusetts University
RAYMOND E. STEPHENS, Marine Biological Laboratory
ARTHUR STERN, University of Massachusetts, Amherst
ROGER THORNELEY, Sussex University, U.K.

VI. LECTURES

J. A. SCHIFF	Chemical phase of evolution biogeochemistry
J. A. SCHIFF	The appearance of oxygen
J. A. SCHIFF	Evolution of procaryotes
J. A. SCHIFF	Evolution of eucaryotes and organelles
J. A. SCHIFF	Evolution of life cycles
J. A. SCHIFF	Nutritional cycles
J. A. SCHIFF	Metabolism of nitrogen and sulfur
R. TROXLER	Biosynthesis of heme and chlorophyll, early stages
R. TROXLER	Biosynthesis of heme and chlorophyll, later stages
R. TROXLER	Open chain tetrapyrroles
J. GIBSON	Photosynthetic electron transport
A. STERN	Photophosphorylation
Z. GROMET-ELCHANON	Coupling factor ATPase complex of photosynthetic bacteria and its relation to proton transport
D. MAUZERALL	Photochemical principles
D. MAUZERALL	Photochemistry of photosynthesis
J. SEARS	Vertical distribution of subtidal algae
J. RAMUS	Chromatic adaptation in benthic algae
J. FIORE	Life histories of brown algae
R. THORNELEY	Nitrogenase
R. SIMON	Plasmids and nucleic acid
R. SIMON	Cyanophycin granules
J. A. SCHIFF	Structure and continuity of chloroplasts and mitochondria
J. A. SCHIFF	Development of chloroplasts and mitochondria
J. A. SCHIFF	Photoregulation of plastid development
M. GIBBS	Photoproduction of hydrogen
A. LOEBLICH	Unique cytology and molecular biology of dinoflagellates
F. FONG	Phototaxis in *Euglena*
R. E. STEPHENS	Microtubules in plant development
H. LYMAN	Symbiosis of algae and chloroplasts with animal cells
R. SIMON	Culture techniques
J. FIORE	Field and preservation methods
J. FIORE	Chlorophyta, I, II and III
R. SIMON	Pigment methodology
R. SIMON	Photosynthesis methodology
J. A. SCHIFF	Development of single cells from *Prasiola*
J. A. SCHIFF	Euglenophyta
R. SIMON	Cyanobacteria (Blue Green Algae), I and II
R. SIMON	Nitrogen fixation methodology
R. SIMON	Cyanophages
R. SIMON	Phycobilin methodology
J. FIORE	Pheophyta, I, II and III
J. FIORE	Rhodophyta, I, II and III
J. FIORE AND R. SIMON	Chrysophyta, Xanthophyta
J. FIORE AND R. SIMON	Bacillariophyta

J. Fiore and R. Simon	Pyrrophyta
J. Fiore	Algal ecology, I
R. Guillard	Algal ecology, II and III

NEUROBIOLOGY

I. Instructors

Edward A. Kravitz, Harvard Medical School, co-director of course
Antony O. W. Stretton, Wisconsin University, co-director of course
Barbara A. Battelle, Harvard Medical School
Jonathan B. Cohen, Harvard Medical School
Gerald D. Fischbach, Harvard Medical School
Edwin J. Furshpan, Harvard Medical School
John Heuser, University of California, San Francisco
Paul H. O'Lague, University of California, Los Angeles
David D. Potter, Harvard Medical School
Thomas S. Reese, National Institutes of Health
Michel Weber, Harvard Medical School

II. Assistants

Sue Huttner, University of California, Los Angeles
Margaret Livingstone, Harvard Medical School
Mary Rheuban, Pennsylvania State University
Ruth Siegel, Harvard Medical School

III. Special Lecturers

Daniel Branton, Harvard University
Robert Campenot, Harvard Medical School
Don Fischman, State University of New York, Downstate Medical Center
Luis Glaser, Washington University
Stan Goldin, Harvard Medical School
Guido Guidotti, Harvard University
Juan I. Korenbrot, University of California, San Francisco
Mahlon Kriebel, State University of New York, Upstate Medical Center
Raymond J. Lasek, Case Western Reserve University
Cyrus Levinthal, Columbia University
Rodolpho Llinas, New York University
Harvey Pollard, National Institutes of Health
Schlomo Rotshenker, Harvard University
Hennig Stieve, Institut fur Neurobiologie der KFA Julich
Walter Stoeckenius, University of California, San Francisco
Kunitaro Takahashi, Tokyo University

IV. Lectures

T. S. Reese	General cytological features of nervous systems
T. S. Reese	Nonsynaptic junctions in the nervous system
J. E. Heuser	Structure of synapses: presynaptic processes, I and II
T. S. Reese	Structure of synapses: the postsynaptic membrane
J. E. Heuser	Chromatolysis and axoplasmic flow
T. S. Reese	Formation of synapses: cytological aspects

G. D. FISCHBACH	Aspects of nerve and muscle cell differentiation (electrical excitability)
G. D. FISCHBACH	Development of chemoreceptors (ACh)
J. B. COHEN	Isolation of functional postsynaptic membrane in electric fish
G. D. FISCHBACH	Synapse formation: early events
G. D. FISCHBACH	Synapse formation: selectivity
J. B. COHEN	Biochemical characterization of cholinergic receptors
G. D. FISCHBACH	Stability of synapses in development
M. WEBER	Development of neural crest
A. O. W. STRETTON	Acetylcholine
E. A. KRAVITZ	GABA
A. O. W. STRETTON	Catecholamines
E. A. KRAVITZ	CNS, I. Amines and synaptic modulation
B. A. BATTELLE	Cyclic nucleotides
E. A. KRAVITZ	CNS, II. Peptides
G. GUIDOTTI	Structure of membrane transport proteins
D. BRANTON	Control of macromolecular mobility in the erythrocyte membrane
L. GLASER	Membranes as a tool to study cell-cell interactions
W. STOECKENIUS	Function of purple membrane in *Halobacterium halobrium*
J. I. KORENBROT	Reconstitution of membrane transport functions in planar interface films
S. GOLDIN	Resolution *in vitro* of the molecular identity of the Na-K ATPase driven active transport system
K. TAKAHASHI	Intracellular perfusion of the tunicate egg and the effect of ionized calcium upon both Na^+ and Ca^{++} channels
J. BROWN	Intracellular calcium in *Limulus* photoreceptors
M. BENNETT	Electrical transmission
H. STIEVE	The dependence of the electrical light response of *Limulus* photoreceptors on extracellular calcium concentrations
R. LLINAS	Calcium and transmitter release at the squid stellate ganglion
M. KRIEBEL	Quantal release at the neuromuscular junction: nature of the small mode and Schwann cell MEPPs
C. LEVINTHAL	Shape and development of identified cells in identical twins
R. J. LASEK	How do axons stop growing? Some answers from the slow component of axonal transport
R. CAMPENOT	The local control of neurite growth by NGF
S. ROTSHENKER	Specific reinnervation of old endplates
D. FISCHMAN	Immunological studies of embryonic muscle membranes
H. POLLARD	Anion hypothesis for regulation of exocytosis
A. O. W. STRETTON	Anatomy, physiology, and chemistry of the motoneurons of *Ascaris*
R. RAHAMIMOFF	Calcium and transmitter release
T. WIESEL	The processing of visual information
P. PATTERSON	Sympathetic neurons in culture

PHYSIOLOGY

I. INSTRUCTORS

K. E. VAN HOLDE, Oregon State University, director of course
THOMAS BALDWIN, University of Illinois

JAY BROWN, University of Virginia
LEONARD COHEN, Institute for Cancer Research
BENJAMIN HALL, University of Washington
LYNN KLOTZ, Harvard University
RAYMOND STEPHENS, Brandeis University

II. CONSULTANTS

KIMBALL C. ATWOOD III, Columbia University
IRVIN ISENBERG, Oregon State University

III. STAFF ASSOCIATES

JAMES ANDERSON, Harvard University
JEFF BENNETZEN, University of Washington
Al CHRISTOPHER, University of Virginia
LAUREL LOEBLICH, Harvard University
MARK MOOSEKER, Harvard Medical School
KENNETH NEWROCK, Institute for Cancer Research
MIRIAM NICOLI, University of Illinois
KELLEY TATCHELL, Oregon State University

IV. ASSISTANTS

MARTHA BARRETT, University of Colorado at Denver
PATRIC GALVIN, University of Colorado at Denver
DAVID VON HIPPLE, University of Oregon

V. SPECIAL LECTURERS

KIMBALL C. ATWOOD III, Columbia University
JOHN CAMERON, Stanford University
ALFRED GOLDBERG, Harvard University
LOWELL HAGER, University of Illinois
H. O. HALVORSON, Brandeis University
J. W. HASTINGS, Harvard University
TERU HAYASHI, Illinois Institute of Technology
W. C. JOHNSON, Oregon State University
ALEX KEYNAN, Hebrew University, Israel
DAVID LILLEY, Searle Research Laboratory
LAZLO LORAND, Northwestern University
KENNETH NEALSON, Scripps Institution of Oceanography
THOMAS PETES, Harvard University
THOMAS POLLARD, Harvard University
JEFF ROSEN, Baylor College of Medicine
JOEL ROSENBAUM, Yale University
RUTH SAGER, Harvard Medical School
JOHN SCOCCA, The Johns Hopkins University
PAUL SIGLER, University of Chicago
JAMES SPUDICH, University of California, San Francisco
JOHN SPUDICH, Harvard Medical School
ANDREW SZENT-GYORGYI, Brandeis University
O. UHLENBECK, University of Illinois
ERIC WEINBERG, The Johns Hopkins University
J. WOOLEY, Harvard University

VI. Lectures

K. E. Van Holde	Chromatin structure, I and II
D. Lilley	Structure of chromatin cores
B. Hall	Transfer RNA genes in yeast
I. Isenberg	Nucleoprotein interactions, I and II
J. Wooley	STEM electron microscopy and neutron diffraction of chromatin
T. Baldwin	Techniques of peptide mapping and purification
T. Baldwin	Techniques of amino acid analysis and sequence determination
L. Cohen	Chromatin remodeling in development, I and II
J. Spudich	Actin and myosin, molecules in motion
J. Spudich	Bacterial hemotaxis and nongenetic individuality
L. Lorand	Molecular aspects of blood coagulation
T. Petes	Genetic analysis of yeast ribosomal DNA
T. Pollard	Contractile mechanisms in muscle and nonmuscle cells
L. Hager	Studies on halogenated compounds in marine organisms
A. Szent-Gyorgyi	Regulation of muscle contraction
R. Stephens	Microtubules, I and II
J. Rosenbaum	Control of flagellar growth
M. Mooseker	The association of actin with membranes
J. Scocca	Role of the bacterial cell surface in genetic transformation
T. Hayashi	Actin-myosin interaction
P. Sigler	Studies on the structure of initiator t-RNA-synthetase complex
O. Uhlenbeck	Quantitative *in situ* hybridization
J. Brown	Animal cell membranes: the protein components
J. Brown	Animal cell membranes: the phospholipids
L. Klotz	DNA organization in two primitive eukaryotes: dinoflagellates and yeast, I and II
L. Klotz	A unified theory of DNA renaturation
K. C. Atwood	Limitation of genetic diversity in cell population, I and II
F. Goldberg	Control of protein degradation
K. Nealson	Physiology of bioluminescent bacteria
T. Schuster	Kinetics of protein subunit interactions
J. W. Hastings	Bioluminescence and chemiluminescence
T. Baldwin	Bacterial luciferase
W. C. Johnson	Circular dichroism
A. Keynan	Cell cycle dependence of induction of sporulation in *B. subtilis*
H. O. Halvorson	Amplification of ribosomal RNA genes in yeast
R. Sager	Genetic studies with mammalian cells
B. Hall	Structure and function of yeast t-RNA genes
J. Cameron	Isolation of yeast t-RNA genes by molecular cloning: structural analysis by electron microscope
E. Weinberg	Sea urchin histone genes
J. Rosen	Use of c-RNA probes for quantitation of m-RNA genes
L. Cohen	Optical monitoring of neuron activity
E. Szuts	Vertebrate photoreceptors
A. Fein	Role of intracellular sodium in light adaptation
F. Lang	Synaptic transmission—the soups *vs.* the sparks
F. Lang	Transmitter release; ionic basis of synaptic potentials

F. LANG	Quantal release
F. LANG	Excitation-secretion coupling
R. HOY	Cricket song: analysis of an animal communication system
F. LANG	Origin and fate of synaptic vesicles
F. LANG	Electrical synapses
U. J. MCMAHAN	Topographic specificity at the regenerating neuromuscular junction
E. FRANK	Specificity of peripheral synapse formation
E. FRANK	Formation and development of nerve-muscle synapses in tissue culture
F. LANG	Physiological basis for changes in fight and flight behavior during growth of the lobster
E. A. KRAVITZ	Three neurohormones in the lobster: studies on the cellular localization, release and physiological actions of octopamine, serotonin, and dopamine
C. M. LENT	Organizational and neural properties of leech CNS
A. FEIN	Crustacean stretch receptor
Y. GROSSMAN	Conduction of action potentials along nonhomogenous axons
D. L. ALKON	Associative training in a nudibranch mollusc, *Hermissenda*
E. SZUTS	Vertebrate proprioreception
R. J. FRENCH	Axon channels: asymmetry and selectivity

YEAR-ROUND PROGRAMS
1977

BOSTON UNIVERSITY MARINE PROGRAM

THE STAFF

ARTHUR HUMES, Boston University Marine Program, director
JELLE ATEMA, Boston University Marine Program
BJÖRN GANNING, University of Stockholm, Sweden (Semester I only)
STJEPKO GOLUBIC, Boston University (Semester II only)
FREDERICK LANG, Boston University Marine Program
CHARLES LENT, State University of New York at Stony Brook (Semester II only)
IVAN VALIELA, Boston University

THE ECOSYSTEMS CENTER

GEORGE M. WOODWELL, director

JOHN E. HOBBIE, senior scientist; DANIEL B. BOTKIN, associate scientist; JERRY M. MELILLO, BRUCE J. PETERSON, assistant scientists; CAMERON E. GIFFORD, field research coordinator; RICHARD H. BURROUGHS, senior fellow; JOHN T. FINN, postdoctoral fellow; ERENE V. PECAN, assistant to the director and research associate; RICHARD A. HOUGHTON, PAUL A. STEUDLER, research associates; JOHN V. HELFRICH, DAVID S. SCHIMEL, research assistants; JAMES T. MORRIS, WILLIAM B. BOWDEN, JAMES P. REED, graduate research assistants; MAYBELLINE L. PHILBIN, taxonomist; JEFFERY B. SHELKEY, field assistant; JOAN M. UPTON, secretary; FRANCES R. SEYMORE, typist

JANUARY COURSES 1977

BEHAVIOR

(Offered Jointly by Boston University Marine Program and the Marine Biological Laboratory)

I. Instructors

Jelle Atema, Boston University, director of course
Adrianus J. Kalmijn, Woods Hole Oceanographic Institution
Stewart Jacobson, Boston University
Daniel Alkon, NIH-NINCDS, Woods Hole
James Loy, University of Rhode Island
Douglas Smith, State University of New York at Stony Brook
Ivan Valiela, Boston University
Beverly Greenspan, Bowdoin College
Stanley Fox, Boston University
Margaret Nelson, Harvard Medical School
John Palmer, University of Massachusetts
Bori Olla, Sandy Hook Laboratory
Katy Payne, The Rockfeller University and N. Y. Zoological Society
Roger Payne, The Rockefeller University and N. Y. Zoological Society
Noel Snyder, Patuxent Wildlife Research Center
Timothy Williams, Swarthmore College
George Michel, Boston University
I. Lehr Brisbin, Savannah River Ecology Program
Ronald Larkin, The Rockefeller University
Carl Berg, Marine Biological Laboratory
Dietland Müller-Schwartze, State University of New York at Syracuse

II. Assistants

Daniel Stenzler, Boston University
Vera Kalmijn, Woods Hole Oceanographic Institution

III. Lectures

J. Atema	Introduction
J. Atema	Sensory physiology and behavior
A. J. Kalmijn	Electroreception with and without electric organs
J. Atema	Evolution of chemical senses
A. J. Kalmijn	Electroreception: the detection of inanimate electric fields
J. Atema	Chemo- and mechanoreceptors
A. J. Kalmijn	The physics and physiology of electroreception
I. Valiela	Principles of experimental design in ecology and behavior
A. J. Kalmijn	Electroreception: more questions with or without answers
K. Payne	Annual changes in songs of humpback whales
R. Payne	The possibility of long-range communication between Baleen whales
R. Payne	The southern Right whale
N. Snyder	Limpkins, everglade kites, and apple snails: adaptation for and against predation
N. Snyder	Preserving an almost extinct species: the Puerto Rican parrot

G. MICHEL	Introduction to ethology
G. MICHEL	Role of learning in behavior
G. MICHEL	Hormones and behavior
B. OLLA	Natural history and behavior of marine fishes: the importance of defining habits under natural conditions
B. OLLA	Comparative aspects of the responses of marine fishes to environmental stress
B. OLLA AND J. ATEMA	Tunas and pelagic fish: schooling behavior
I. L. BRISBIN	Ecology, domestication and the behavior of dogs: some principles and their application to present-day problem of men, wolves and dogs
I. L. BRISBIN	The domestic dog today: training and tracking
J. PALMER	Introduction to biological rhythms
J. PALMER	Biological rhythms in shore dwelling animals
J. PALMER	Human rhythms
R. LARKIN	Introduction to bird orientation and navigation
R. HOY	Genetics, physiology and behavior of singing crickets
T. WILLIAMS	Some thoughts on the evolution of bird migration
M. NELSON	Introduction to neural control of behavior
M. NELSON	Hissing and social behavior in cockroaches
B. GREENSPAN	Display and ritualization in courtship
B. GREENSPAN	Leks and other mating systems, particularly in arthropods
B. GREENSPAN	Male reproductive success in the communal courtship system of the fiddler crab, *Uca rapax*
J. ATEMA AND S. JACOBSON	Social behavior of the lobster, *Homarus americanus*
S. FOX	Introduction to territoriality, aggression and dispersal
S. FOX	Natural selection among behavioral phenotypes in lizard
D. SMITH	Introduction to social behavior in birds
D. SMITH	Acoustic and visual signals in redwing blackbirds
D. MÜLLER-SCHWARZE	Predator-prey relations in Antarctic bird communities
D. MÜLLER-SCHWARZE	Introduction to pheromones
D. MÜLLER-SCHWARZE	Mammalian pheromones
J. D. EBERT	Ionic regulation of embryonic development
J. LOY	Introduction to primate sociobiology
J. LOY	Old world monkeys I: Patas and the one-male group
J. LOY	Old world monkeys II: Rhesus and the multi-male group
A. STUART	Social behavior of termites
A. STUART	Termite communication
S. MACKAY	Bio-medical telemetry in behavioral studies
D. ALKON	Associative training in a nudibranch mollusc, *Hermissenda*
D. ALKON	Neural substrates of associative training in *Hermissenda*
J. TODD	The new alchemy

DEVELOPMENTAL BIOLOGY

I. INSTRUCTORS

WALTER S. VINCENT, University of Delaware, director of course
JAMES D. EBERT, Marine Biological Laboratory
KENNETH EDDS, Marine Biological Laboratory
SHINYA INOUÉ, University of Pennsylvania
WILLIAM H. MASSOVER, Brown University
RAYMOND E. STEPHENS, Brandeis University

II. Assistant

Charles Henry, Washington and Jefferson College

III. Special Lecturers

Everett Anderson, Harvard University
Jack Collier, Brooklyn College, The City University of New York
Louis Delanney, Ithaca College
David Francis, University of Delaware
Susan Gerbi, Brown University
Harlyn Halvorson, Brandeis University
June Harrigan, Marine Biological Laboratory
Arthur Humes, Boston University Marine Program
Hans Lauffer, University of Connecticut
Keith Porter, University of Colorado and Marine Biological Laboratory
Richard Tasca, University of Delaware

IV. Lectures

J. D. Ebert	Introduction to the Marine Biological Laboratory
W. S. Vincent	Introduction to course
W. S. Vincent	Origin of germ cells, gonad differentiation
W. S. Vincent	Spermatogenesis
W. H. Massover	Oogenesis, I and II
W. H. Massover	Vitellogenesis
W. H. Massover	Maturation of the oocyte
L. E. Delanney	Amphibian development
L. E. Delanney	Unsolved "classical problems" in development
L. E. Delanney	Immunological recognition and response
L. E. Delanney	Histo-incompatability among invertebrates
R. Payne	Whales
W. S. Vincent	Egg membranes
W. S. Vincent	Fertilization
S. Inoue	Mitosis, I and II
S. Inoue	Theories of chromosome movement
R. E. Stephens	Chemistry of microtubles
S. Inoue	Spicule formation and structure
R. E. Stephens	Ciliogenesis
R. E. Stephens	Cilia, synthesis or assembly?
K. T. Edds	Patterns of cleavage
K. T. Edds	Mechanics of cleavage, I and II
K. T. Edds	Cellular morphogenesis in sea urchins
P. B. Redfield	Development of the zebra fish
R. Hoy	Cricket song, analysis of an animal communication system
S. Gerbi	Molecular cytogenetics and gene regulation, I and II
J. R. Collier	Gene expression in *Illyanassa* development, I and II
A. G. Humes	Larval development in the Copepoda
H. Lauffer	Gene expression in insect morphogenesis
W. S. Vincent	Conservation of gene sequence in phylogeny
R. Tasca	Early mammalian morphogenesis
R. Tasca	Early biochemical events in mammalian development
H. O. Halvorson	Sporulation as a model for development
D. Francis	Genetics of development in cellular slime molds

J. D. EBERT	Birth defects and interacting systems in development
P. M. FYE	Law of the sea
J. D. EBERT	Membrane permeability and ion movement in development
R. E. STEPHENS	Membranes and morphogenesis
K. R. PORTER	Cytoarchitecture
E. ANDERSON	Development of the graafian follicle

ECOLOGY

I. INSTRUCTORS

GEORGE M. WOODWELL, The Ecosystems Center, director of course
DANIEL B. BOTKIN, The Ecosystems Center
CHARLES A. S. HALL, The Ecosystems Center
JERRY M. MELILLO, The Ecosystems Center
BRUCE J. PETERSON, The Ecosystems Center

II. ASSISTANTS

WILLIAM B. BOWDEN, The Ecosystems Center
SUSAN D. COOLEY, The Ecosystems Center
JOHN V. K. HELFRICH, The Ecosystems Center
JAMES P. REED, The Ecosystems Center

III. SPECIAL LECTURERS

KENNETH O. EMERY, Woods Hole Oceanographic Institution
PAUL M. FYE, Woods Hole Oceanographic Institution
RICHARD C. HENNEMUTH, National Marine Fisheries Service
HOLGER W. JANNASCH, Woods Hole Oceanographic Institution
MARILYN J. JORDAN, The Ecosystems Center
THOMAS E. LOVEJOY, World Wildlife Fund
ROGER S. PAYNE, New York Zoological Society
HOWARD L. SANDERS, Woods Hole Oceanographic Institution
LAWRENCE B. SLOBODKIN, State University of New York at Stony Brook
FREDERICK E. SMITH, Harvard University
JOHN M. TEAL, Woods Hole Oceanographic Institution
JOHN TODD, New Alchemy Institute
IVAN VALIELA, Boston University
ROBERT H. WHITTAKER, Cornell University
GARRISON WILKES, University of Massachusetts

IV. LECTURES

G. M. WOODWELL	The structure of the biosphere, I and II
L. B. SLOBODKIN	Evolution
L. B. SLOBODKIN	Group selection
H. L. SANDERS	Natural communities and evolutionary strategies, I and II
K. O. EMERY	Continental drift
G. M. WOODWELL	Climates of the world
J. M. TEAL	Oceanography, I and II
R. S. PAYNE	Whales
G. M. WOODWELL	Primary production and the metabolism of the earth
G. M. WOODWELL	The world carbon budget: the predominance of forests
J. E. HOBBIE	The world carbon budget: the predominance of waters

J. E. Hobbie	Primary productivity in aquatic systems, I and II
C. A. S. Hall	Secondary productivity: I. New Hope Creek
C. A. S. Hall	Secondary productivity: II. Pacific salmon
C. A. S. Hall	Secondary productivity: III. Hudson River fisheries
D. B. Botkin	Succession and primary production
D. B. Botkin	Terrestrial secondary productivity
R. H. Whittaker	Gradient analysis
R. H. Whittaker	Community patterns
R. H. Whittaker	The evolution of communities
T. E. Lovejoy	The tropical forests
H. W. Jannasch	Deep sea microbiology, I and II
G. Wilkes	Saving genes for agriculture
C. A. S. Hall	Nutrient cycles
B. J. Peterson	Nutrient limitation in freshwater systems
G. M. Woodwell	Nutrient cycles and communities
M. J. Jordan	Industrial pollution
J. M. Melillo	Nutrient cycling in terrestrial systems: Hubbard Brook
J. M. Melillo	Nutrient cycles: nitrogen
I. Valiela	Nutrient cycling in a salt marsh
G. M. Woodwell	Ecosystems, energy and world politics
D. B. Botkin	The stability of ecosystems
D. B. Botkin	Endangered species
P. M. Fye	Law of the sea
K. O. Emery	Mineral resources of the deep sea and international politics
R. C. Hennemuth	The future of fish, I and II
F. E. Smith	Some aspects of human ecology
F. E. Smith	Urban ecology, I and II
J. Todd	The new alchemy
G. M. Woodwell	Biotic impoverishment and the threshold dilemma

NEUROBIOLOGY

(Offered jointly by Boston University Marine Program and the Marine Biological Laboratory)

I. Instructors

Alan Fein, Marine Biological Laboratory, director of course
Frederick Lang, Boston University Marine Program, director of course
Edward F. MacNichol, Jr., Marine Biological Laboratory, laboratory director
Frederick A. Dodge, The Rockefeller University
Ferenc Harosi, Marine Biological Laboratory
Charles H. Lent, State University of New York at Stony Brook

II. Assistant

Russell H. Hill, Boston University Marine Program

III. Special Lecturers

William J. Adelman, nih-nincds, Woods Hole
Daniel L. Alkon, nih-nincds, Woods Hole
Jelle Atema, Boston University Marine Program

MELVIN J. COHEN, Yale University
ERIC FRANK, Harvard Medical School
ROBERT J. FRENCH, NIH-NINCDS, Woods Hole
ALFREDO GORIO, The Rockefeller University
YORAM GROSSMAN, NIH-NINCDS, Woods Hole
RONALD HOY, Cornell University
ADRIANUS KALMIJN, Woods Hole Oceanographic Institution
EDWARD A. KRAVITZ, Harvard Medical School
ALEXANDER MAURO, The Rockefeller University
U. J. MCMAHAN, Harvard Medical School
ETE SZUTS, Marine Biological Laboratory

IV. LECTURES

F. LANG, A. FEIN, E. F. MACNICHOL, Jr.	Introduction
A. FEIN	Cell permeability and the plasma membrane
U. J. MCMAHAN	Microscopic anatomy of the nervous system
U. J. MCMAHAN	The structure of synapses
J. ATEMA	Evolution of chemical senses
M. J. COHEN	Evolution of neuron structure and function
A. KALMIJN	Field studies of navigation in magnetic fields
A. FEIN	The resting membrane potential
A. FEIN	Cable properties of neurons
A. FEIN	Action potentials
A. FEIN	Saltatory conduction in myelinated axons
W. J. ADELMAN	Neuronal current, channels, spaces and clefts
F. A. DODGE	Biophysics and behavior of *Limulus* vision, I and II

LABORATORY OF BIOPHYSICS, NINCDS–NIH

WILLIAM J. ADELMAN, JR., chief of the laboratory and head, section on neural membranes
DANIEL L. ALKON, head, section on neural systems
KENNETH S. COLE, senior scientist; JAY WELLS, staff scientist; DAVID E. GOLDMAN, guest worker; ROBERT J. FRENCH, visiting associate; TERRY CROW, staff fellow; IZJA LEDERHENDLER, visiting fellow; JONATHAN SHOUKIMAS, Alan Hancock fellow; FERENC I. HAROSI, THOMAS JERUSSI, IPA fellows; WESLEY CORSON; ALAN KUZIRIAN, DANIEL STENZLER, guest workers

LABORATORY OF SENSORY PHYSIOLOGY

EDWARD F. MACNICHOL, JR., director
ALAN FEIN, assistant scientist and deputy director; BARBARA ANN COLLINS, senior laboratory technician; J. SHERWOOD CHARLTON, ETE Z. SZUTS, NIH postdoctoral fellows; FERENC I. HAROSI, Assistant Professor of Physiology, Boston University; HAROLD E. JOHNSON, computer technician and programmer; ISHIK C. TUNA, computer programmer; JOSEPH LEVINE, graduate student, Harvard University; KATHLEEN FRENCH, graduate student, Boston University Marine Program; JANE VINCENT, ROBERT ENOS, research assistants

NATIONAL FOUNDATION FOR CANCER RESEARCH

ALBERT SZENT-GYORGYI, director
JANE A. MCLAUGHLIN; PETER GASCOYNE; RICHARD MEANY; RONALD PETHIG, lecturer University College of North Wales; JOHN T. LEWIS, Professor, University College

of North Wales; STEPHEN BONE, graduate student, University College of North Wales; DIANA CLARK, KATY CLARK, CHARITY SMITH, part-time glassware cleaners; BLENDA ANTONELLIS, MICHAEL DISPEZIO, temporary

INDEPENDENT YEAR-ROUND PROGRAMS

RAYMOND STEPHENS, principal investigator
MELANIE PRATT; EDWARD D. SALMON

SHINYA INOUÉ, principal investigator
DANIEL P. KIEHART

AUDREY E. V. HASCHEMEYER, principal investigator
RITA W. MATHEWS; JENNIFER B. K. NIELSEN; MICHAEL A. K. SMITH

KENNETH EDDS, principal investigator
PATRICIA WADSWORTH

ERIC BALL, principal investigator

BEHRUS JAHAN-PARWAR, principal investigator
SUSAN PERRITT

JAMES OSCHMAN, principle investigator
BETTY WALL, principal investigator

TIMOTHY WILLIAMS, principal investigator
JANET WILLIAMS; BRUCE COHEN; KATHY CALDWELL

JUDITH GRASSLE, principal investigator
FERN BIRTWISTLE; CYNTHIA LANYON-DUNCAN; ROBIN GROSS

RUTH D. TURNER, principal investigator
CARL J. BERG; TIM COLE; SCOTT GALLAGER; BRAD CALLOWAY, graduate student

ROBERT RICE, principal investigator
PRISCILLA ROSLANSKY; SUSAN CASE; ANN CORNELL-BELL; JUDITH HELDMAN; NATALIE PASCOE

YEAR-IN-SCIENCE
1976–1977

The Year-in-Science program at the MBL is for advanced undergraduates and beginning graduate students. For undergraduates the program is equivalent to a university honors program; for beginning graduate students it is designed to accommodate those who require the staff and special facilities of the laboratory in support of their research. Students join staff of the MBL in a variety of studies, participate in courses at the Woods Hole Oceanographic Institution, the Boston University Marine Program, and in regularly scheduled seminars with staff of The Ecosystems Center and others at the MBL.

THE STAFF

GEORGE M. WOODWELL, director, The Ecosystems Center
DANIEL B. BOTKIN, associate scientist
CHARLES A. S. HALL, assistant scientist
JOHN E. HOBBIE, senior scientist
JERRY M. MELILLO, assistant scientist
BRUCE J. PETERSON, assistant scientist

THE LABORATORY STAFF

(Including all whose services began or ended during the year)

HOMER P. SMITH, *General Manager*
MARIE B. ABBOTT, *Curator, Gray Museum*
LUCENA J. BARTH, *Director of Admissions*
FRANCIS P. BOWLES, *Coordinator of Research Services*
TERESA M. BRAUN, *Assistant Editor, The Biological Bulletin*
EDWARD G. CASEY, *Controller*
JANE FESSENDEN, *Librarian*
A. ROBERT GUNNING, *Superintendent, Buildings and Grounds*
LEWIS M. LAWDAY, *Assistant Manager, Supply Department*
ANNE C. MAHER, *Public Relations Officer*
MORTON D. MASER, *Coordinator of Continuing Education*
WESLEY N. TIFFNEY, *Curator, Gray Museum*
JOHN J. VALOIS, *Manager, Supply Department*
GEORGE M. WOODWELL, *Director, The Ecosystems Center*

EDUCATION OFFICE

ESTER M. BROWNE

DIRECTOR'S OFFICE

MAUREEN M. MORRIS

GENERAL MANAGER'S OFFICE

FLORENCE S. BUTZ
ELAINE C. CROCKER
AGNES L. GEGGATT

PUBLIC RELATIONS OFFICE

FERN P. CALLIS

CONTROLLER'S OFFICE

RUTH B. CAMPBELL
DORIS C. DAVIS
NANCY L. ELLIS
JOAN E. HOWARD
LORRAINE A. RUDDICK
ANNE S. WILLIAMS

LIBRARY

JUDITH A. ASHMORE
REBECCA J. BAILEY
NANCY M. CAPUANO
LYNNE A. DOELLING
DAVID J. FITZGERALD
CHARLOTTE F. GOUDREAU
JOAN H. GRICE
E. LENORA JOSEPH
HOLLY E. KARALEKAS
THERESA K. MCKEE
M. ANN WHITE

BUILDINGS AND GROUNDS

RICHARD AUDETTE
LEE E. BOURGOIN
GLENN R. ENOS
CHARLES K. FUGLISTER
ELIZABETH J. GEGGATT
RICHARD E. GEGGATT, JR.
ROBERT L. GROSCH
MARCIA JOSEPHSON

THOMAS N. KLEINDINST
ELIZABETH KUIL
DONALD B. LEHY
RALPH H. LEWIS
SOFIEA LEWIS
WILLIAM M. LOCHHEAD
DANIEL LOEWUS
RICHARD A. LOVERING
ALAN G. LUNN
JOHN B. MACLEOD
JOHN E. MAURER
STEPHEN A. MILLS
SIMONE ST. JEAN
GLENN I. SHEAR
GILBERT F. SILVIA
CHRISTOPHER A. STONE
FREDERICK E. THRASHER
FREDERICK E. WARD
RALPH D. WHITMAN
WILLIAM WHITTAKER

DEPARTMENT OF RESEARCH SERVICES

THOMAS R. ANTHONY
FRANKLIN D. BARNES
JOHN S. BARNES
CAROL E. BLOOM
JULIE A. CAISSIE
M. GALE CLARK
LINDA M. GOLDER
ROBERT J. GOLDER
KATHRYN L. HELFRICH
ANDREW D. HODGDON
DAVID JUERS
LOWELL V. MARTIN
JOAN A. PETERS-GILMARTIN
FRANK E. SYLVIA

SUPPLY DEPARTMENT

EDWARD G. ENOS, JR.
JOYCE B. ENOS
ROBERT M. HEBDEN
MARK W. MUNSON
JOHN H. RYTHER, JR.
EUGENE A. TASSINARI
BRUNO F. TRAPASSO
JOHN M. VARAO

2. INVESTIGATORS; RESEARCH FELLOWSHIPS; STUDENTS

Independent Investigators, 1977

ADELMAN, WILLIAM J., JR., Chief, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
AIZU, SEIEI, Postdoctoral Fellow, CMDNJ, Rutgers University Medical School
AKAIKE, TADASHI, Visiting Associate, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
ALKON, DANIEL L., Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
ARMSTRONG, CLAY M., Professor of Physiology, University of Pennsylvania
ARMSTRONG, PETER B., Associate Professor of Zoology, University of California
ARNOLD, JOHN M., Professor of Cytology, University of Hawaii
ATWOOD, H. L., Professor, University of Toronto
BALDWIN, THOMAS O., Assistant Professor, University of Illinois
BALL, ERIC G., Independent Investigator, Marine Biological Laboratory
BARLOW, ROBERT B., JR., Professor, Syracuse University
BARRETT, MARTHA BARCALOW, Instructor, University of Colorado at Denver
BATTELLE, BARBARA-ANNE, Research Fellow, Harvard Medical School
BAUER, G. ERIC, Professor of Anatomy, University of Minnesota
BAUMGOLD, JESSE, Staff Fellow, NIMH, National Institutes of Health
BEAUGÉ, LUIS A., Associate Professor of Biophysics, University of Maryland School of Medicine
BENNETT, MICHAEL V. L., Professor of Neuroscience, Director, Division of Cellular Neurobiology, Albert Einstein College of Medicine of Yeshiva University
BERNARD, GARY D., Associate Professor, Yale University
BEZANILLA, FRANCISCO, Visiting Lecturer, University of Pennsylvania
BISHOP, STEPHEN H., Assistant Professor of Biochemistry, Baylor College of Medicine

BORGESE, THOMAS A., Associate Professor of Biology, Herbert H. Lehman College, The City University of New York
BRINLEY, F. J., JR., Professor of Biology, University of Maryland
BRODWICK, MALCOLM S., Assistant Professor, University of Texas Medical Branch
BROWN, JAY C., Associate Professor, University of Virginia School of Medicine
BROWN, JOEL E., Professor of Physiology and Biophysics, State University of New York at Stony Brook
BURDICK, CAROLYN J., Associate Professor of Biology, Brooklyn College, The City University of New York
BURGER, MAX M., Chairman of the Biocenter, University of Basel, Switzerland
BURKART, WERNER R., Scientific Assistant, Biozentrum, University of Basel, Switzerland
CHANG, DONALD C., Assistant Professor, Baylor College of Medicine
CHAPPELL, RICHARD L., Associate Professor, Hunter College, The City University of New York
CHARLTON, M. P., Postdoctoral Fellow, University of Toronto
CHRISTOPHER, ALAN R., Research Associate, University of Virginia
CLAUDE, PHILIPPA, Assistant Scientist, University of Wisconsin
COHEN, FREDRIC S., Research Fellow, Albert Einstein College of Medicine
COHEN, JONATHAN B., Assistant Professor of Pharmacology, Harvard Medical School
COHEN, LAWRENCE B., Associate Professor, Yale University School of Medicine
COHEN, LEONARD H., Senior Member, Institute for Cancer Research
COHEN, STANLEY, Professor of Biochemisty, Vanderbilt University
COHEN, WILLIAM D., Associate Professor of Biological Sciences, Hunter College, The City University of New York
COLE, KENNETH S., Senior Scientist, National Institutes of Health
COOPERSTEIN, SHERWIN J., Professor of Anatomy, University of Connecticut
CROW, TERRY J., Postdoctoral Fellow, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
DEFELICE, LOUIS J., Associate Professor, Emory University
DE GROOF, ROBERT C., Instructor, Thomas Jefferson University
DENTLER, WILLIAM L., Assistant Professor, University of Kansas
DETERRA, NOEL, Research Associate Professor, Hahnemann Medical College
DE WEER, PAUL, Associate Professor of Physiology and Biophysics, Washington University School of Medicine
DIPOLO, REINALDO, Associate Investigator, Instituto Venezolano de Investigaciones Cientificas, Venezuela
DOWLING, JOHN E., Professor of Biology, Harvard University
DUBOIS, ARTHUR B., Director, John B. Pierce Foundation Laboratory
DUNHAM, PHILIP B., Professor of Biology, Syracuse University
EATON, DOUGLAS C., Assistant Professor of Physiology and Biophysics, University of Texas Medical Branch
EBERHARD, ANATOL, Associate Professor of Chemistry, Ithaca College
ECKBERG, WILLIAM R., Assistant Professor, Howard University
EDDS, KENNETH T., Assistant Scientist, Marine Biological Laboratory
EHINGER, BERNDT E. J., Professor, University of Lund, Sweden
EHRENSTEIN, GERALD, Research Physicist, National Institutes of Health
ELLISON, REBECCA P., Postdoctoral Fellow, The Population Council, The Rockefeller University
EPEL, DAVID, Professor, University of California, San Diego
ETTIENNE, EARL M., Associate Professor of Physiology, University of Massachusetts Medical School
FARMANFARMAIAN, A., Professor of Physiology, Rutgers–The State University of New Jersey
FINKELSTEIN, MORRIS C., Associate Research Scientist, New York University Medical Center
FIORE, JAMES, Associate Professor of Biology, Suffolk University
FISCHBACH, GERALD, Associate Professor of Pharmacology, Harvard Medical School
FISCHMAN, DONALD A., Professor and Chairman, Department of Anatomy and Cell Biology, State University of New York, Downstate Medical Center
FISHMAN, GEORGE S., Professor of Operations Research and Systems Analysis, University of North Carolina at Chapel Hill

FISHMAN, HARVEY M., Associate Professor of Physiology and Biophysics, University of Texas Medical Branch
FOHLMEISTER, JURGEN, Lecturer, University of Minnesota
FLETCHER, DONALD JAMES, Postdoctoral Research Investigator, Emory University
FREEMAN, GARY, Associate Professor, University of Texas, Austin
FRENCH, ROBERT J., Visiting Associate, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
FURSHPAN, EDWIN J., Professor of Neurobiology, Harvard Medical School
GAINER, HAROLD, Head, Section of Functional Neurochemistry, National Institutes of Health
GIBSON, JANE, Associate Professor of Biochemistry, Cornell University
GILBERT, DANIEL L., Research Physiologist, NINCDS, National Institutes of Health
GOLDMAN, DAVID E., Guest Worker, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
GOLDSMITH, PAUL K., Biologist, NIAMD, National Institutes of Health
GOODMAN, LESLEY JEAN, Senior Lecturer, Queen Mary College, London
GREENBERG, MICHAEL JOHN, Professor, Florida State University
GRINVALD, AMIRAM, Postdoctoral Associate, Yale University School of Medicine
GROSCH, DANIEL S., Professor of Genetics, North Carolina State University
GROSS, CORDELL E., Chief Resident in Neurosurgury, State University of New York, Upstate Medical Center
GROSSMAN, ALBERT, Professor, New York University School of Medicine
GROSSMAN, YORAM, Visiting Fellow, Laboratory of Biophysics, IRP, NINCDS, National Institutes of Health
GUTTMAN, RITA, Professor of Biology, Brooklyn College, The City University of New York
HALL, B. D., Professor of Genetics, University of Washington
HALVORSON, HARLYN O., Director, Rosenstiel Basic Medical Sciences Research Center, and Professor of Biology, Brandeis University
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ZIMMERMAN, MORRIS, Senior Research Fellow, Merck Institute for Therapeutic Research

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WARNER, ANN, Senior Lecturer in Anatomy and Embryology, University College, London, England

Alexander Forbes Lecturers, 1977

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KEHOE, JACSUE, Lecturer, Laboratoire de Neurologie, Paris, France

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HILL, ANITA V., Assistant Professor of Biology, Grambling State University
HOWZE, GWENDOLYN, Assistant Professor, Texas Southern University
LANGFORD, GEORGE M., Assistant Professor, Howard University
SUTTON, WILLIAM W., Assistant Professor, Dillard University

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LYN-COOK, L. E., Howard University

Summer Research Scholarships, 1977
(Steps Toward Independence)

ARMETT-KIBEL, CHRISTINE, Assistant Professor of Biology, University of Massachusetts
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ROSENBERG, EVELYN K., Professor of Biology, Jersey City State College
SAGER, RUTH, Professor, Sidney Farber Cancer Institute and Harvard Medical School
SAUNDERS, JOHN W., Professor of Biology, State University of New York at Albany
SCOTT, GEORGE T., Professor of Biology, Oberlin College
SHEMIN, DAVID, Professor and Chairman of Biochemistry and Molecular Biology, Northwestern University
SHEPRO, DAVID, Professor, Boston University
SHERMAN, IRWIN W., Professor and Chairman, University of California, Riverside
SPECK, WILLIAM T., Director of In-Patient Services, Case Western Reserve University
SPECTOR, ABRAHAM, Professor of Ophthalmic Biochemistry, Columbia University
STAFFAN, M. E. MAGNUSSON, Atdehings Leder, University of Aarhus, Denmark
SUSSMAN, MAURICE, Professor and Chairman, Department of Life Sciences, University of Pittsburgh
STEINHARDT, JACINTO, Emeritus Professor of Chemistry, Georgetown University
TANZER, MARVIN L., Professor of Biochemistry, University of Connecticut Health Center
TRINKAUS, JOHN PHILIP, Professor of Biology, Yale University
WAINIO, WALTER, Professor of Biochemistry, Rutgers—The State University of New Jersey
WALKER, CHARLES A., Dean and Professor, Florida A & M University
WEBB, H. MARGUERITE, Professor of Biological Sciences, Goucher College
WEISS, LEON, Chairman, Department of Animal Biology, Professor of Cell Biology, University of Pennsylvania School of Veterinary Medicine
WHEELER, GEORGE E., Professor of Biology, Brooklyn College, The City University of New York
WILSON, THOMAS H., Professor of Physiology, Harvard Medical School
WITTENBERG, JONATHAN B., Professor of Physiology, Albert Einstein College of Medicine
YNTEMA, CHESTER L., Professor Emeritus, State University of New York, Upstate Medical Center
ZACKS, SUMNER IRWIN, Pathologist-in-Chief, The Miriam Hospital, and Professor of Pathology, Section Chairman of Pathology, Brown University

Students, 1977

All students listed completed the formal course programs. Asterisk indicates completing post-course research programs.

Summer Programs 1977

ECOLOGY

ADLER, HILARY
BARBACCI, ELSA
BRANSFIELD, MARK
DEPAMPHILIS, CLAUDE
DIONNE, MICHAEL
GUZIK, LINDA
HARRIES, WILLIAM
HARVEY, RONALD
JANIS, RICHARD
KREZOSKI, JOHN
MORGAN, HILARY
OLSON, JOHN
RADOMSKI, WILLIAM
ROBINSON, MARY
ROBISON, MARGARET
SLADOVICH, HEDY
SMITH, PATRICIA
STOUT, HEATHER
THOMASON, PHILIP

EMBRYOLOGY

ANDERSON, KENNETH
AUNE, THOMAS
BADER, DAVID
BEACH, DAVID
BEAN, CHARLES
BLACK, VIRGINIA
CUMMINS, JOSEPH
EMMERLING, MARK
FRASER, SCOTT
GARLING, DAVID
HOSKINS, SALLY
JERDAN, JANICE
JOHNSTON, RANDAL
JONES, ESTRALITA
LOPO, ALINA
NAFTEL, JOHN
POOLE, THOMAS
RHO, JAI-HYON
ROBINSON, AUDREY
THOMPSON, HOLLY
TONELLI, QUENTIN
TOSNEY, KATHRYN
TUCKER, EDWARD
WILEY, HENRY
WILLIAMS, EDWARD

EXPERIMENTAL INVERTEBRATE ZOOLOGY

BEN-ELIAHU, MAXINE
*BERES, LINDA
*BIRCHARD, GEOFFREY
BROOKS, ALFRED
*CARBONELL COLETTE
DENYS, CHARLENE
*DOLLIVER, ELIZABETH
DROLET, LAWRENCE
*GARCIA-ARRARAS, JOSE
GIBSON, MARCIA
HENRY, JOSEPH
JOHNS, PRISCILLA
JOHNSTON, JAMES
KAYER, SUSAN
KIRKPATRICK, STEVEN
KLOTZ, ALAN
KOHN, BARBARA
KOUMJIAN, LAUREN
LUDEL, JACQUELINE
MAHAFFEY, JAMES
MARCUS, PAULA
*MCILVAIN, JAMES
*MEYER, CAROL
MITCHELL, BRIAN
MONAHAN, KEVIN
MORGAN, CHARLES
NAKASHIMA, RICHARD
ORTIZ-CORPS, EDGAR
PIERPONT, NINA
*SANDRIDGE, PAUL
SMULLIN, DAVID
*SOLONDZ, LEONARD
SCOTT, JAMES D.

EXPERIMENTAL MARINE BOTANY

BURNS, PATRICIA
DAVIDSON, DIONNE
DAVIDSON, ERIC
*DWYER, DEBORAH
*GATES, CYNTHIA
HARRIS, GORDON
KERBY, NIGEL
*LANE, MELODY
LEE, DEBBIE
MILLER, LINDA
PRICE, ELLEN
*SCHNEIDER, REBECCA
*SCOTT, BRUCE
SCOTT, LAURA
THORINGTON, GLYNE
*TURETSKY, OXANA

NEUROBIOLOGY

ACEVES-PINA, EFRAIN
FEINSTEIN, SUSAN
HARRIS, ROGER
KASS-SIMON, GABRIELE
NISHI, RAE
OLSON, JULIE
PENG, HSIAO-MING
ST. MARIE, RICHARD
SALPETER, SHELLY
SIGWORTH, FREDERICK
STEVENSON, BRUCE
STIEVE, HENNING

PHYSIOLOGY

*Arisaka, Fumio
Baldwin, Albert
Binder, Michael
*Boothby, Mark
Brenner, Stephen
Bryan, Philip N.
Burks, Douglas
*Caron, Joan
*Cypher, Christopher
Dill, Kenneth
Dillon, Peter
Esmailzadeh, Ardalan
*Frosch, Matthew
Herlands, Louis
*Howe, Christine
*Hurwitz, Julia
Ierardi, Lynne
Johnson-Muller, B.
*Lassar, Andrew
Leipzig, George
*Lerner, Ethan
*Matsudaira, Paul
Matteson, Donald
*Mercurio, Arthur
*Merritt, Margaret
*Ohriner, William
*Porter, Mary
*Price, David H.
Reeve, Carole
Sellers, James
Seminara, Daniela
Setzer, David
Sweetman, Harold
Whittaker, Carla

January Programs 1977

BEHAVIOR

Berry, Ronald R.
Bratton, Bradford O.
Cavanaugh, Colleen M.
Chambers, David B.
Dourdeville, Theodore A.
Frick, Jane A.
Friedlander, Amy I.
Gemperline, Clare H.
Giblin, Anne E.
Greene, Sharon I.
Hanych, David A.
Hickman, Roberta A.
Howes, Brian L.
Hutton, Edward W.
Pappas, Georgia
Perkins, Judith S.
Roberts, Sandra F.
Rose, Kenneth J.
Watkins, Brenda F.
Werme, Christine E.

DEVELOPMENTAL BIOLOGY

Bischoff, Kimberly J.
Dinsmore, Christine G.
Donahue, Robert E.
Ecker, Marilyn M.
Gildea, Janet C.
Harris, Gordon
Hawkins, Willie J.
Henry, Joseph M.
Hunter, Joyce M.
Loftfield, Katherine
Lyndes, Harry E. III
May, Sarah E.
Spanjers, Mary A.
Urushihara, Hideko

ECOLOGY

Beese, Lorena S.
Bouwkamp, Carl A.
Charles, Ann M.
Coney, Debra S.
Haas, Eric N.
Hoar, Peter R.
Hope, Stephen L.
Neilson, Ronald P.
Pearlmutter, Gary
Rosenberg, Andrew A.
Saxe, Michael R.
Shamonsky, Margie
Thoreson, Brian
Turner, K. Alta
Unger, Geri E.
White, Mark N.
Younger, Dana R.

NEUROBIOLOGY

ANDERSON, CARL B.
AVNET, MARK S.
BRYANT, BRUCE P.
BURKE, BRIANT E.
CALOF, ANNE LEIGHTON
CAMELIO, ELSIE
CLEVELAND, MARK V. B.
COLE, JAMES J.
JACOBSON, MYRNA E.
LEDERHENDLER, ISRAEL I.
MAXWELL, JOHN A.
MELLIN, THEODORE N.
ROY, BONNITTA
SAHLEY, CHRISTIE L.
SARTOR, ALTON OLIVER
SMITH, RONALD E.
STETTEN, GEORGE D.
STRASSMAN, JEFFREY C.
VITALE, ANTHONY J.
WANG, CHING CHUNG
WHETZEL, THOMAS P.
WILSON, DONELLA J.

BOSTON UNIVERSITY MARINE PROGRAM

ASHKENAS, LINDA
BOTERO, LEONOR
CLEVELAND, MARK
COLE, JAMES
COLE, TIMOTHY
COSTELLO, WALTER
CUSHMAN, MARY
DAVIS, CABELL
DERBY, CHARLES
DEVINE, DANA
DOJIRI, MASAHIRO
DOURDEVILLE, THEODORE
DUNCAN, THOMAS
EISEN, JUDITH
FAFORD, THERESA
FOREMAN, KENNETH
FRENCH, KATHLEEN
GIBLIN, ANNE
GIBSON, DANIEL
GREENE, SHARON
HEINEN, JOHN
HILL, RUSSELL
HOWES, BRIAN
JACOBSON, STEWART
JORDAN, THOMAS
KENT, KARLA
KIPP, KATRINA
KOLBA, CLIFFORD
MACIOLEK, NANCY
OGONOWSKI, MARK
PASCOE, NATALIE
PIOTROWSKI, MICHAEL
REID, ROBERT
STENZLER, DANIEL
THORINGTON, GLYNE
WERME, CHRISTINE
WIER, SUSAN
WILLIAMS, ISABELLE

YEAR-IN-SCIENCE

Spring 1977

WILLIAM BOWDEN
COLLEEN CAVANAUGH
HILARY MORGAN
JAMES MORRIS
JAMES REED

Summer 1977

WILLIAM BOWDEN
COLEEN CAVANAUGH
JAMES MORRIS
JAMES REED

Fall 1977

WILLIAM BOWDEN
PAUL DETWILER
MICHELLE DIONNE
GARY GULKA
JAMES MORRIS
JAMES REED

3. SCHOLARSHIPS, 1977

Bio Club: PAULA MARCUS

Gary H. Calkins: CHARLENE DENYS

Lucretia Crocker: REBECCA SCHNEIDER

Macy:

January

CARL B. ANDERSON
DAVID CHAMBERS
GORDON HARRIS
WILLIE J. HAWKINS
JOYCE HUNTER
SANDRA ROBERTS
RONALD SMITH
BRENDA WATKINS
DONELLA WILSON

Summer

YVONNE COLLINS
GORDON HARRIS
ESTRALITA JONES
AUDREY ROBINSON
MARY G. ROBINSON
PAUL SANDRIDGE
GLYNE THORINGTON
CARLA WHITTAKER

Society of General Physiologists: LOUIS HERLANDS
MARK BOOTHBY
MARY PORTER

4. TRAINING PROGRAMS

RESEARCH PROGRAM IN MICROBIAL ECOLOGY

I. INSTRUCTORS

HOLGER W. JANNASCH, Woods Hole Oceanographic Institution, director of course
JANE A. GIBSON, Cornell University
ROBERT E. HUNGATE, University of California, Davis
ALEX KEYNAN, The Hebrew University, Jerusalem
EDWARD R. LEADBETTER, Amherst College

II. CONSULTANTS

HARLYN O. HALVORSON, Brandeis University
J. WOODLAND HASTINGS, Harvard University
ROGER Y. STANIER, Institut Pasteur, Paris
EDWARD O. WILSON, Harvard University

III. STAFF ASSOCIATES

RUSSELL CUHEL, Woods Hole Oceanographic Institution
JAMES G. FERRY, Virginia Polytechnic Institute
HELGE LARSEN, University of Trondheim, Norway
JEANNE S. POINDEXTER, Public Health Research Institute, New York
CRAIG D. TAYLOR, Woods Hole Oceanographic Institution

IV. PROGRAM ASSISTANT

JAMES A. DORSCH, Amherst College

V. SPECIAL LECTURERS

ARNOLD L. DEMAIN, Massachusetts Institute of Technology
ROBERT R. FINN, Cornell University
JOEL C. GOLDMAN, Woods Hole Oceanographic Institution
J. WOODLAND HASTINGS, Harvard University
HARLYN O. HALVORSON, Brandeis University
GALEN E. JONES, University of New Hampshire
MARGOT KOGUT, University of London, King's College, U.K.
KENNETH H. NEALSON, Scripps Institute of Oceanography
DANIEL POPE, Rensselear Polytechnic Institute
JOHN H. RYTHER, Woods Hole Oceanographic Institution
ROBERT D. SIMON, University of Rochester
IVAN VALIELA, Marine Biological Laboratory
JOHN B. WATERBURY, Woods Hole Oceanographic Institution
CARL R. WOESE, University of Illinois, Urbana
MEYER J. WOLIN, New York Department of Public Health, Albany

VI. TRAINEES

*YVONNE E. COLLINS
DAVID R. DICKSON
*THOMAS D. DURANT
*KURT W. HANSELMANN
WYTOLD R. LEBING
CAROL J. MCINTYRE
DANA C. PEDERSEN
FRANCIS J. SANSONE
*MARK A. SCHNEIDER
*KEVIN R. SOWERS

VII. LECTURES

H. W. JANNASCH	Introduction to microbial ecology I and II
H. W. JANNASCH	Theory and practice of the chemostat
H. W. JANNASCH	Continuous culture in microbial ecology
H. W. JANNASCH	Deep sea microbiology
H. W. JANNASCH	Topics in marine microbiology
E. R. LEADBETTER	Ways of making a living. anaerobes
E. R. LEADBETTER	Ways of making a living: aerobes
E. R. LEADBETTER	Comparative aspects of nitrate utilization
E. R. LEADBETTER	Microbiological aspects of hydrocarbon utilization
E. R. LEADBETTER	Microbial ecology and the toth surface
J. A. GIBSON	The photosynthetic bacteria I and II
J. A. GIBSON	Uptake measurements in microbial ecology
A. KEYNAN	Cell biology, a refresher I and II
R. E. HUNGATE	The rumen as an ecosystem I and II
R. E. HUNGATE	Comparative microbiology of digestion
R. E. HUNGATE	Microbial cellulose digestion
H. LARSEN	Extremely halophilic bacteria
H. LARSEN	Extreme halophilism
H. LARSEN	Microbial biochemistry of fish spoilage I and II
H. LARSEN	Anerobic respiration of trimethylamine oxide I and II
J. S. POINDEXTER	The bacterial prostheca: occurrence and ultrastructure
J. S. POINDEXTER	Obligate differentiation: *Caulobacter crescentus*
J. S. POINDEXTER	Environmental influences on how far to go
J. G. FERRY	Microbial ecology of the salt marsh
J. G. FERRY	Ecology of sulfate reduction
J. G. FERRY	Anaerobic hydrogen metabolism
C. D. TAYLOR	The biology and ecology of methane formation I and II
R. CUHEL	Psychrophilic bacteria
A. DEMAIN	Function of antibiotics in natural microbial populations
R. R. FINN	Applications of continuous culture in research
J. C. GOLDMAN	Continuous culture of algae
J. W. HASTINGS	Bacterial bioluminescence I and II
G. E. JONES	Trace metals in bacterial growth
M. KOGUT	Moderately halophilic bacteria
K. H. NEALSON	Genetics in marine bacteria
K. H. NEALSON	Autotrophy and manganese oxidizing bacteria
D. POPE	Low temperature and high pressure in bacterial growth
J. H. RYTHER	Aquaculture I and II
I. VALIELA	The Sippewisset marsh
J. B. WATERBURY	Cyanobacteria which reproduce by multiple fission
C. R. WOESE	Studies in bacterial phylogeny
M. J. WOLIN	Species interaction in anaerobic systems

5. TABULAR VIEW OF ATTENDANCE, 1973–1977

	1973	*1974*	*1975*	*1976*	*1977*
INVESTIGATORS—TOTAL	523	508	511	535	501
Independent	312	302	301	312	280
Library Readers	86	75	81	93	82
Research Assistants	125	131	129	130	139

STUDENTS—TOTAL	135	158	212	249	212
Summer courses					
Experimental Invertebrate Zoology	32	30	34	36	33
Embryology	20	21	24	24	25
Physiology	41	40	33	41	34
Experimental Marine Botany	15	11	14	16	16
Ecology	15	14	18	18	
Marine Ecology					19
Neurobiology	12	12	12	12	12
January courses					
Developmental Biology		30	20	32	14
Behavior			17	17	20
Biosphere			17		
Ecology				29	17
Neurobiology			23	24	22
TRAINEES—TOTAL	38	41	31	9	10
TOTAL ATTENDANCE	696	707	754	793	723
Less persons represented in two categories	0	0	0	1	0
	696	707	754	792	723
INSTITUTIONS REPRESENTED—TOTAL	239	222	237	234	226
FOREIGN INSTITUTIONS REPRESENTED	40	31	26	33	33

6. INSTITUTIONS REPRESENTED, 1977

Alabama, University of
Albert Einstein College of Medicine
American Museum of Natural History
Amherst College
Atlanta University
Bates College
Baylor College of Medicine
Boston College
Boston University
Boston University School of Medicine
Brandeis University
Bridgewater State College
Brooklyn College, The City University of New York
Brown University
Buena Vista College
Buxton School
California, University of, Berkeley
California, University of, Davis
California, University of, Irvine
California, University of, Los Angeles
California, University of, Riverside
California, University of, San Diego
California, University of, San Francisco
California, University of, Santa Barbara
California, University of, Santa Cruz
Carnegie-Mellon University
Case Western Reserve University
Central Connecticut State College
Chatham College
Children's Hospital Medical Center, Boston
Chicago, University of
Cincinnati, University of
Cincinnati, University of, College of Medicine
City College, The City University of New York
Clark University
Cleveland State University
Colby College
Cold Spring Harbor Laboratory
College of Mount St. Joseph on the Ohio
Colorado, University of
Colorado College
Colorado Women's College
Columbia University
Connecticut, University of
Connecticut, University of, Health Center
Connecticut College
Cornell University
Dartmouth College
Delaware, University of
Delaware State College
De Paul University
De Pauw University
Dillard University
Drew University
Duke University
Duke University Medical Center
Eisenhower College
Emory University
Florida, University of
Florida A & M University
Florida State University
Framingham State College

General Electric Research and Development Center
George Washington University
Georgetown University
Goucher College
Grambling State University
Grass Foundation
Guilford College
Hahnemann Medical College
Hampshire College
Harvard Medical School
Harvard University
Hawaii, University of
Herbert Lehman College, The City University of New York
Howard University
Hunter College, The City University of New York
Illinois, University of
Illinois Institute of Technology
Indiana University
Institute for Cancer Research
Ithaca College
Jersey City State College
John B. Pierce Foundation Laboratory
Johns Hopkins University, The
Johns Hopkins University, The, School of Hygiene
Johns Hopkins University, The, School of Medicine
Kansas, University of
Kansas State University
Kentucky, University of
Kentucky State University
Kenyon College
Kresge Eye Institute
Laboratory of Sensory Physiology, MBL
Louisiana State University
Lowell, University of
Loyola College
Maine, University of, Orono
Manchester Community College
Marine Research, Inc.
Marietta College
Marine Science Institute, Nahant
Maryland, University of
Maryland, University of, School of Medicine
Massachusetts, University of, Amherst
Massachusetts, University of, Boston
Massachusetts, University of, Medical Center, Worcester
Massachusetts Eye and Ear Infirmary
Massachusetts General Hospital
Massachusetts Institute of Technology
Mayo Clinic
Mellon Institute of the Carnegie-Mellon University
Merck Institute for Therapeutic Research
Miami, University of
Miami, University of, School of Marine and Atmospheric Science
Miami, University of, School of Medicine
Michigan, University of
Michigan State University
Millersville State College
Minnesota, University of
Miriam Hospital, The
Montana, University of
Montefiore Hospital and Medical Center
Mount Holyoke College
National Institute of Arthritis, Metabolism and Digestive Diseases
National Institute of Mental Health
Nebraska, University of
New Hampshire, University of
New York Aquarium
New York University
New York University Medical Center
New York University School of Medicine
North Carolina, University of, at Chapel Hill
North Carolina State University, Raleigh
North Dakota, University of
Northeastern University
Northwestern University
Notre Dame, University of
Oakland University
Oberlin College
Ohio State University
Oregon, University of
Oregon State University
Osborn Laboratories of Marine Sciences
Pennsylvania, University of
Pennsylvania, University of, School of Medicine
Pennsylvania, University of, School of Veterinary Medicine
Pennsylvania State University
Pittsburgh, University of
Pittsburgh, University of, School of Medicine
Population Council, The
Princeton University
Purdue University
Radcliffe College
Reed College
Rhode Island, University of
Rice University
Rochester, University of
Rochester, University of, School of Medicine and Dentistry
Rockefeller University, The
Rollins College
Rush Medical College
Russell Sage College
Rutgers—The State University of New Jersey
Rutgers University Medical School
St. Jude Children's Research Hospital
St. Lawrence University

Seton Hill College
Shriners Burns Institute
Sidney Farber Cancer Center
Siena College
Simmons College
Smith College
South Florida, University of
Southampton College
Stanford University
State University of New York, Downstate Medical Center
State University of New York, Upstate Medical Center
State University of New York at Albany
State University of New York at Binghamton
State University of New York at Buffalo
State University of New York at Stony Brook
State University of New York at Syracuse
Suffolk University
Swarthmore College
Syracuse University
Temple University
Temple University Medical School
Tennessee, University of
Tennessee State University
Texas Southern University
Texas, University of, Austin
Texas, University of, Medical Branch
Thomas Jefferson University
Trinity College
Tufts University
Tulane University
U. S. Army Environmental Hygiene Agency
Upsala College
Upjohn Company, The
Utah, University of
Vanderbilt University
Vanderbilt University School of Medicine
Vermont, University of
Veteran's Administration Hospital, Brooklyn
Virginia, University of
Virginia, University of, School of Medicine
Virginia Polytechnic Institute
Washington & Jefferson College
Washington, University of
Washington University, St. Louis
Washington University, School of Medicine
Wayne State University
Wesleyan University
Wheaton College
Wisconsin, University of
Wistar Institute
Woods Hole Oceanographic Institution
Worcester Foundation Experimental Biology
Yale University
Yale University School of Medicine
Yeshiva University

Foreign Institutions Represented, 1977

Aarhus, University of, Denmark
Basel, The University of, Switzerland
Calgary, University of, Canada
Cambridge University, England
Caribbean Marine Biological Institute, Netherlands
Colegio Universitario de Humacai, Puerto Rico
College de France, France
Dalhousie University, Canada
Edinburgh, University of, Scotland
Flinders University of South Australia, Australia
Glasgow, University of, Scotland
Guelph, University of, Canada
Hebrew University, The, Israel
Institut fur Neurobiologie der KFA, West Germany
Instituto Venezolano de Investigaciones, Venezuela
King's College, London, England
Leeds, University of, England
London, University of, England
Lund, University of, Sweden
McGill University, Canada
National University of Mexico, Mexico
North Wales, University of, Wales
Ottawa, University of, Canada
Philips Research Laboratory, Holland
Queen Mary College, London, England
Rijksuniversiteit Groningen, The Netherlands
Scarborough College, Canada
Toronto, University of, Canada
Trondheim, University of, Norway
Universidad Nacional Autonoma de Mexico, Mexico
Universita Cattolica Facolta Dimedicina, Italy
Université Laval, Canada
University College, London, England
Zurich, University of, Switzerland

7. Friday Evening Lectures, 1977

June 24

Helge Larsen.....Gas vacuoles in bacteria
Norwegian Institute of
Technology; University of
Trondheim; Rand Fellow, MBL

July 1

PERRY W. GILBERT, Cornell University; Mote Marine Laboratory — Sharks as barbarians and benefactors

July 8

DANIEL TOSTESON, Harvard Medical School — Lithium, membranes and mania

July 14

PHILIPPE ASCHER, Laboratoire de Neurobiologie, Ecole Normale Supérieure, Paris; Alexander Forbes Lecturer, MBL — Acetylcholine-induced channels in *Aplysia* neurons

July 15

JACSUE KEHOE, Laboratoire de Neurobiologie, Ecole Normale Supérieure, Paris; Alexander Forbes Lecturer, MBL — Hidden receptors in *Aplysia* neurons

July 22

LINCOLN P. BROWER, Amherst College — The ecological chemistry of the monarch butterfly

July 29

BERT W. O'MALLEY, Baylor College of Medicine — Studies on the regulation of gene expression in eucaryotes

August 5

PHILIP LEDER, National Institute of Child Health and Human Development — Cloning specific segments of the mammalian genome: bacteriophage lambda containing mouse globin and surrounding gene sequences

August 12

LEON D. HARMON, Case Western Reserve University — Artificial intelligence and natural stupidity

August 19

CLARA FRANZINI-ARMSTRONG, University of Pennsylvania — Muscle membranes and excitation-contraction coupling

August 26

HOWARD L. SANDERS, Woods Hole Oceanographic Institution — Evolutionary ecology and the deep-sea benthos

8. Members of the Corporation, 1977

Including Action of 1977 Annual Meeting

Life Members

Adolph, Dr. Edward F., University of Rochester, School of Medicine and Dentistry, Rochester, New York 14627
Barth, Dr. Lester G., Marine Biological Laboratory, Woods Hole, Massachusetts 02543
Beam, Dr. Harold W., Department of Zoology, State University of Iowa, Iowa City, Iowa 52240
Behre, Dr. Ellinor H., Black Mountain, North Carolina 28711
Bertholf, Dr. Lloyd M., 307 Phoenix Ave., Bloomington, Illinois 61701
Bodansky, Dr. Oscar, 16 Hawks Nest Road, Stony Brook, New York 11790
Bold, Dr. Harold C., Department of Botany, University of Texas, Austin, Texas 78712
Bridgman, Dr. A. Josephine, 715 Kirk Rd., Decatur, Georgia 30030
Brown, Dr. Dugald E. S., Cape Haze, Box 426, Placida, Florida 33946
Burdick, Dr. C. Lalor, The Lalor Foundation, 4400 Lancaster Pike, Wilmington, Delaware 19805
Carpenter, Dr. Russell L., 60 Lake St., Winchester, Massachusetss 01890
Clarke, Dr. George L., 44 Juniper Road, Belmont, Massachusetts 02178
Clement, Dr. Anthony C., Department of Biology, Emory University, Atlanta, Georgia 30322
Colwin, Dr. Arthur L., 320 Woodcrest Rd., Key Biscayne, Florida 33149
Colwin, Dr. Laura H., 320 Woodcrest Rd., Key Biscayne, Florida 33149
Costello, Dr. Helen M., Morgan Rd., Woods Hole, Massachusetts 02543
Crouse, Dr. Helen V., Institute of Molecular Biophysics, Florida State University, Tallahassee, Florida 32306
Diller, Dr. Irene C., 2417 Fairhill Avenue, Glenside, Pennsylvania 19038
Diller, Dr. William F., 2417 Fairhill Avenue, Glenside, Pennsylvania 19038
Elliott, Dr. Alfred M., P.O. Box 564, Woods Hole, Massachusetts 02543
Ferguson, Dr. James K. W., 56 Clarkson St., Thornhill, Ontario, Canada
Fischer, Dr. Ernst, 3110 Manor Drive, Richmond, Virginia 23230
Fries, Dr. Erik F. B., 3870 Leafy Way, Miami, Florida 33133
Gaffron, Dr. Hans, P.O. Box 308, Sanibel, Florida 33959
Galtsoff, Dr. Paul S., National Marine Fisheries Service, Woods Hole, Massachusetts 02543
Gray, Dr. Irving E., Department of Zoology, Duke University, Durham, North Carolina 27701
Grundfest, Dr. Harry, Department of Neurology, Columbia University, College of Physicians and Surgeons, New York, New York 10032
Hamburger, Dr. Viktor, Department of Zoology, Washington University, St. Louis, Missouri 63130
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WHITNEY, MR. AND MRS. GEOFFREY G., JR.
WICHTERMAN, DR. AND MRS. RALPH
WICKERSHAM, MR. AND MRS. A. A. TILNEY
WICKERSHAM, MRS. JAMES H., JR.
WILBER, DR. AND MRS. CHARLES G.
WILHELM, DR. HAZEL S.
WILSON, MR. AND MRS. ROBERT E., JR.
WITMER, DR. AND MRS. ENOS E.
WOLFINSOHN, MR. AND MRS. WOLFE
WOODWELL, MRS. GEORGE
YNTEMA, DR. AND MRS. CHESTER L.
ZINN, DR. DONALD J.
ZWILLING, MRS. EDGAR

VI. REPORT OF THE LIBRARIAN

In 1977 the library applied to the Regional Medical Library in Boston to become a MEDLARS Search Center for the medical community of Cape Cod and the Islands. MEDLARS is a computer based retrieval system of the National Library of Medicine, which provides immediate access to over half a million citations for the biomedical journals. Our library holds 760 medical journals in a collection of over 5,000 journal titles, and we are now offering this on-line access to the literature to the members of the health services on the Cape and Islands. A staff member, Judy Ashmore, attended two training sessions in Washington, and we offered the service to our own scientists during the summer months. We have demonstrated the system at the Falmouth, Hyannis, Martha's Vineyard and Tobey Hospitals and also at two Media Sessions at the Health Resources Center at the Cape Cod Community College. The physicians and nurses in the area seem very pleased with this new service and have used it extensively. In addition to the medical data bases, we also offer access to the citations contained in the Lockheed and Bibliographic Retrieval Services data banks. Three members of the library staff are now trained to offer literature searches.

Space is now a critical problem. Room 304 was taken from the library for administrative office space, and we were not granted Room 205 (next to the library office), a Library Committee request of long standing. Many journals are now shelved out of alphabetical order, and work space for the staff services is very crowded. Both MBL and WHOI are adding hundreds of volumes every year, and the collection is expanding rapidly. We added 98 new journal titles this year, 50 of them through exchange arrangements. The total number of volumes held in the library is now over 164,000.

VII. REPORT OF THE TREASURER

The Marine Biological Laboratory reported an operating loss of $85,414 in 1977, exclusive of a depreciation charge of $281,291, as compared to a surplus of $106,197 in 1976. As you recall from the Treasurer's report last year, approximately $110,000 of revenues recognized in 1976 was applicable to services rendered in 1975. Therefore, the loss for 1977 is comparable to approximately break-even operations in 1976.

Total revenues in 1977 amounted to $2,081,494, an increase of $161,000 over the prior year. Increases in tuition, dormitory and dining hall revenues were approximately offset by a decline in laboratory rentals due to recording the retroactive adjustment in 1976 revenues.

Investment income in 1977 amounted to $321,915, an increase of 6.5% over 1976. At December 31, 1977, the Laboratory's restricted and unrestricted investments amounted to $5,396,175 at cost and $5,379,045 at market value. The Budget Committee has recently commenced an evaluation of various alternatives aimed at maximizing investment income and increasing the total return from endowment funds.

Unrestricted gifts in 1977 amounted to $158,850, an increase of 65% over 1976. The Laboratory was the beneficiary of substantial grants from four foundations, which represents a new record level of giving. All of us associated

with the Laboratory are most grateful for this very generous financial support.

Operating expenditures increased 19% to $2,166,908. However, a substantial portion of the increase was associated with new courses that generated revenue that more than offset the incremental expenses. However, like all organizations, the Laboratory's general expense for salaries, utilities and other ongoing costs increased at approximately the same rate as the increase in the cost of living.

During the past several months, the Executive Committee has made an intensive analysis of the Laboratory's revenue sources and operating expenditures. The conclusion of its analysis is that the Laboratory is operating at peak capacity during its summer months and tuition and laboratory rentals cannot be further increased without substantially impairing the utilization of facilities. Operating expenditures have been carefully reviewed and budgeted recurring operating expenditures for 1978 are only 5% greater than actual expenditures for 1977.

During 1978, the Laboratory will develop a more detailed and comprehensive program to increase the amount of unrestricted gifts and will introduce additional programs for utilizing laboratory space and dormitories during the non-summer months. We are confident that these efforts will result in improved financial results for the Laboratory in 1978.

The following is a statement of the auditors:

To the Trustees of Marine Biological Laboratory, Woods Hole, Massachusetts:

We have examined the balance sheets of Marine Biological Laboratory as of December 31, 1977 and 1976, and the related statements of current funds revenues, expenditures, and other changes and changes in fund balances for the years then ended. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included confirmation from the custodians of securities owned at December 31, 1977 and 1976, and such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As more fully described in Note B to the financial statements, the Laboratory excludes certain costs of buildings and equipment from the balance sheet. In our opinion, generally accepted accounting principles require that such costs be included as investment in plant in the financial statements.

In our opinion, except for the effects on the financial statements of the matter discussed in the preceding paragraph, the aforementioned financial statements present fairly the financial position of Marine Biological Laboratory at December 31, 1977 and 1976, and its current funds revenues, expenditures and other changes and the changes in fund balances for the years then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

The summary of investments included herein was obtained from the Laboratory's records in the course of our examination and, in our opinion, is fairly stated in all material respects in relation to the basic financial statements taken as a whole.

Boston, Massachusetts
April 7, 1978

COOPERS & LYBRAND

MARINE BIOLOGICAL LABORATORY

BALANCE SHEET

December 31, 1977 and 1976

Assets	*1977*	*1976*
Current Funds:		
Unrestricted:		
Cash, including deposits at interest	$ 517,513	$ 213,950
Accounts receivable, net of allowance for uncollectible accounts of $12,955 in 1977 and $15,566 in 1976	540,743	446,741
Other assets	15,996	6,141
Due to restricted current funds	(294,485)	(124,371)
Due from invested funds	105,133	65,557
Total unrestricted	884,900	608,018
Restricted:		
Cash	87,013	1,959
Investments, at cost; market value: 1977—$1,118,917; 1976—$1,339,892 (Note A, Schedule I)	1,112,683	1,305,084
Due from unrestricted current fund	294,485	124,371
Due from invested funds	173,191	136,124
Total restricted	1,667,372	1,567,538
Total current funds	$ 2,552,272	$ 2,175,556
Invested Funds:		
Cash	102,031	3,297
Accounts receivable	—	1,435
Investments, at cost; market value: 1977—$3,799,434; 1976—$4,482,948 (Note A, Schedule I)	3,822,798	4,092,770
Due to unrestricted current fund	(105,133)	(65,557)
Due to restricted current funds	(173,191)	(136,124)
Total invested funds	$ 3,646,505	$ 3,895,821
Plant Fund:		
Land, buildings and equipment at cost (Note B)	12,374,587	12,345,587
Less accumulated depreciation	3,778,545	3,497,254
Total plant fund	$ 8,596,042	$ 8,848,333

The accompanying notes are an integral part of the financial statements.

MARINE BIOLOGICAL LABORATORY

Balance Sheet

December 31, 1977 and 1976

Liabilities and Fund Balances	*1977*	*1976*
Current Funds:		
Unrestricted:		
Accounts payable and accrued expenses	$ 195,418	$ 173,387
Deferred income	62,131	60,335
Fund balance	627,351	374,296
Total unrestricted	884,900	608,018
Restricted:		
Fund balances:		
Unexpended gifts and grants	1,597,841	1,507,577
Unexpended income of endowment funds	69,531	59,961
Total restricted	1,667,372	1,567,538
Total current funds	$ 2,552,272	$ 2,175,556
Invested Funds:		
Endowment funds	2,172,160	2,147,067
Quasi-endowment funds	934,143	1,260,509
Retirement fund (Note C)	540,202	488,245
Total invested funds	$ 3,646,505	$ 3,895,821
Plant Fund:		
Invested in plant	8,596,042	8,848,333
Total plant fund	$ 8,596,042	$ 8,848,333

The accompanying notes are an integral part of the financial statements.

MARINE BIOLOGICAL LABORATORY

STATEMENTS OF CURRENT FUNDS REVENUES, EXPENDITURES, AND OTHER CHANGES

for the years ended December 31, 1977 and 1976

	Unrestricted		*Restricted*		*Total*	
	1977	*1976*	*1977*	*1976*	*1977*	*1976*
Revenues:						
Instruction:						
Tuition	$ 164,495	$ 129,605	$ 35,200	$ 43,100	$ 199,695	$ 172,705
Grants and contracts:						
Government	7,468	5,394	128,197	125,301	135,665	130,695
Private			33,258	26,916	33,258	26,916
Research (Note D):						
Laboratory rentals	424,631	483,952			424,631	483,952
Grants and contracts:						
Government	166,970	192,101	646,497	373,454	813,467	565,555
Private	84,917	132,115	457,896	473,181	542,813	605,296
Dormitory	285,285	245,349			285,285	245,349
Dining Hall	134,454	38,985			134,454	38,985
Library	126,652	120,318			126,652	120,318
Biological Bulletin	85,430	71,727			85,430	71,727
Support departments:						
Research services	142,420	138,771			142,420	138,771
Supply	85,131	80,104			85,131	80,104
Investment income	158,361	147,625	39,359	28,016	197,720	175,641
Gifts	158,850	96,185	101,013	105,834	259,863	202,019
Other	56,430	38,291			56,430	38,291
Total revenues	2,081,494	1,920,522	1,441,420	1,175,802	3,522,914	3,096,324

	Unrestricted		*Restricted*		*Total*	
	1977	*1976*	*1977*	*1976*	*1977*	*1976*
Operating expenditures:						
Instruction	123,037	86,351	71,349	109,347	194,386	195,698
Research	1,386	5,029	1,104,393	846,635	1,105,779	851,664
Scholarships and stipends			216,736	158,982	216,736	158,982
Dormitory	140,358	111,590			140,358	111,590
Dining Hall	130,349	36,300			130,349	36,300
Library	208,149	185,669	22,043	19,075	230,192	204,744
Biological Bulletin	77,165	79,625			77,165	79,625
Support departments:						
Research services	305,847	243,891	20,415	2,500	326,262	246,391
Supply	216,278	197,919	255	45	216,533	197,964
Administration	462,479	398,868	4,048	4,671	466,527	403,539
Plant operation	501,860	469,083	2,181	34,547	504,041	503,630
Total expenditures	2,166,908	1,814,325	1,441,420	1,175,802	3,608,328	2,990,127
Excess of (expenditures) revenues	(85,414)	106,197	—	—	(85,414)	106,197
Transfers and additions:						
Excess of restricted gifts, grants and investment income received over amounts expended			99,834	128,337	99,834	128,337
From plant fund—proceeds of sale of plant assets	3,000	29,040			3,000	29,040
From quasi-endowment fund	335,469	199,800			335,469	199,800
Net transfers and additions	338,469	228,840	99,834	128,337	438,303	357,177
Net increase in fund balances	$ 253,055	$ 335,037	$ 99,834	$ 128,337	$ 352,889	$ 463,374

The accompanying notes are an integral part of the financial statements.

MARINE BIOLOGICAL LABORATORY

STATEMENTS OF CHANGES IN FUND BALANCES

for the years ended December 31, 1977 and 1976

	Current Funds		*Invested Funds*			
1976	*Unrestricted*	*Restricted*	*Endowment*	*Quasi-Endowment*	*Retirement*	*Plant Fund*
Balances at December 31, 1975	$ 39,259	$1,439,201	$1,905,920	$1,462,894	$ 438,255	$9,129,270
Increases:						
Unrestricted current fund revenues	1,920,522					
Grants and gifts		1,453,746	62,830			
Realized net gains (losses) on sale of investments			178,317	(2,585)		
Investment income		136,903			17,794	
Proceeds of sale of equipment						29,040
Addition to pension fund					52,136	
Tuition		43,100				
Decreases:						
Instruction, research and general expenditures	(1,814,325)	(1,175,802)				
Book value of equipment sold						(386)
Indirect costs		(329,610)				
Payments to pensioners					(19,940)	
Depreciation						(280,551)
Transfers—additions (deductions):						
Proceeds of sale of equipment	29,040					(29,040)
Transfer to current funds	199,800			(199,800)		

1977	Current Funds		Invested Funds			Plant Fund
	Unrestricted	*Restricted*	*Endowment*	*Quasi-Endowment*	*Retirement*	
Balances at December 31, 1976	374,296	1,567,538	2,147,067	1,260,509	488,245	8,848,333
Increases:						
Unrestricted current fund revenues	2,081,494					
Grants and gifts		1,622,821				29,000
Realized net gains on sale of investments			25,093	9,103		
Investment income		142,588			20,966	
Proceeds of sale of equipment						3,000
Addition to pension fund					50,150	
Tuition		35,200				
Decreases:						
Instruction, research and general expenditures	(2,166,908)	(1,441,420)				
Indirect costs		(259,355)				
Payments to pensioners					(19,159)	
Depreciation						(281,291)
Transfers—additions (deductions):						
Proceeds of sale of equipment	3,000					(3,000)
Transfer to current funds	335,469			(335,469)		
Balances at December 31, 1977	$ 627,351	$1,667,372	$2,172,160	$ 934,143	$ 540,202	$8,596,042

The accompanying notes are an integral part of the financial statements.

MARINE BIOLOGICAL LABORATORY

Notes to Financial Statements

A. *Significant Accounting Policies:*

Basis of Presentation—Fund Accounting

In order to ensure observance of limitations and restrictions placed on the use of resources available to the Laboratory, the accounts of the Laboratory are maintained in accordance with the principles of "fund accounting." This is the procedure by which resources are classified into separate funds in accordance with activities or objectives specified. In the accompanying financial statements, funds that have similar characteristics have been combined.

Externally restricted funds may only be utilized in accordance with the purposes established by the source of such funds. However, the Laboratory retains full control over the utilization of unrestricted funds. Restricted gifts, grants, and other restricted resources are accounted for in the appropriate restricted funds. Restricted current funds are reported as revenue when expended for current operating purposes. Unrestricted revenue is reported as revenue in the unrestricted current fund when received.

Endowment funds are subject to restrictions requiring that the principal be invested and only the income utilized. Quasi-endowment funds have been established by the Laboratory for the same purposes as endowment funds, however, any portion of these funds may be expended.

Investments

Investments purchased by the Laboratory are carried at cost. Investments donated to the Laboratory are carried at fair market value at date received. For determination of gain or loss upon disposal, cost is determined based on the specific identification method.

Investment Income and Distribution

The Laboratory follows the accrual basis of accounting except that investment income is recorded on a cash basis. The difference between such basis and the accrual basis does not have a material effect on the determination of investment income earned on a year-to-year basis.

Investment income includes income from the investments of specific funds and from the pooled investment account. Income from the pooled investment account is distributed to the participating funds on the basis of the market value at the beginning of the quarter, adjusted for the cost of any additions or disposals during the quarter.

Indirect Cost Recovery

Through 1976, the Laboratory recovered indirect costs by charging occupants of laboratory space fees based on an estimated indirect cost rate for the period the space was occupied. The estimated rate was adjusted on a retroactive basis upon determination of actual indirect costs for the year. Beginning in 1977, fixed rates are used currently. When actual rates are subsequently determined, the difference is reflected in the next fixed rate negotiated.

B. *Land, Buildings and Equipment:*

Following is a summary of the plant fund assets:

Classification	*1977*	*1976*
Land	$ 639,693	$ 639,693
Buildings	10,143,088	10,143,088
Equipment	1,591,806	1,562,806
	12,374,587	12,345,587
Less accumulated depreciation	3,778,545	3,497,254
	$ 8,596,042	$ 8,848,333

The original cost of land, buildings and related initial furnishing equipment is capitalized when the assets are acquired. The cost of subsequent additions and purchases, repairs and remodeling is expensed when incurred. Equipment and remodeling expenditures amounted to approximately $110,000 and $52,000 in 1977 and 1976, respectively.

Depreciation is computed using the straight-line method over estimated useful lives of 40 years for buildings and 20 years for equipment.

C. *Retirement Fund:*

The Laboratory has a noncontributory pension plan for substantially all full-time employees which complies with the requirements of the Employee Retirement Income Security Act of 1974. The actuarially determined pension expenses charged to operations in 1977 and 1976 were $64,277 and $54,973, respectively. The Laboratory's policy is to fund pension costs accrued.

D. *Research Revenues:*

The 1976 research revenues include approximately $111,000 of retroactive overhead rate adjustments to amounts previously billed in 1975, as described in Note A.

E. *Pledges and Grants:*

As of December 31, 1977 and 1976, the following amounts remain to be received from previous gifts and grants for specific research and instruction programs, and are expected to be received as follows:

	December 31	
	1977	*1976*
1977		$ 891,000
1978	$1,697,486	269,000
1979	115,000	114,000
1980		6,000
	$1,812,486	$1,280,000

SCHEDULE I

MARINE BIOLOGICAL LABORATORY

SUMMARY OF INVESTMENTS

December 31, 1977 and 1976

	Cost		*Market*		*Investment Income*	
	1977	*1976*	*1977*	*1976*	*1977*	*1976*
Invested Funds:						
U. S. Government securities	$ 444,638	$ 603,324	$ 448,295	$ 626,116	$ 40,923	$ 17,714
Corporate bonds	770,012	914,634	676,789	801,032	48,681	52,191
Common stocks	2,080,655	2,112,140	2,189,492	2,597,619	125,462	112,465
Commercial paper	—	326,367	—	326,367 (1)	10,990	21,823
Preferred stocks	83,032	118,756	61,072	114,265	4,468	5,229
Units in combined pension fund	426,912	—	406,237	—	9,394	—
Real estate	17,549	17,549	17,549 (1)	17,549 (1)		
Total	$3,822,798	$4,092,770	$3,799,434	$4,482,948	239,918	209,422
Less custodian fees					11,835	10,760
					228,083	198,662
Current Restricted Funds:						
U. S. Government securities	1,112,683	1,297,254	1,118,917	1,332,062		
Certificate of deposit	—	7,830	—	7,830 (1)		
Total	$1,112,683	$1,305,084	$1,118,917	$1,339,892	86,748	99,126

Current Unrestricted Funds:		
Earned on corporate savings account	7,084	4,534
Net investment income	$321,915	$302,322
Disposition of investment income:		
Restricted for current use:		
Research	95,789	101,985
Scholarships	25,289	17,067
Library	21,510	17,851
	142,588 (2)	136,903 (2)
Retirement fund	20,966	17,794
Unrestricted—utilized in current operations	158,361	147,625
	$321,915	$302,322

(1) At cost.
(2) $39,359 in 1977 and $28,016 in 1976 was utilized in current restricted operations.