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## Editor's Page

For a number of years several members, particularly some members of the Education Committee have been concerned about the very wide differences in Ph.D. training programs in physiology. This has recently been brought to attention again by the announcements from several universities that they are or contemplate, instituting Ph. D. training programs in physiology or some branch of physiology. When one considers the dwindling supply of young Ph. D's in physiology and the increasing demands for such persons it is easy to see why universities are concerned and wish to stimulate interest and training in physiology.

Is now an opportune time to bring to the attention of universities the seeming necessity to have well-trained physiologists with broad adaptability rather than persons with a concentrated training in a very select and narrow specialty? Would it be appropriate for an organization like the American Physiological Society to recommend certain areas of study to which all Ph. D. trainees in physiology should be exposed? It is realized that specialization must be so and that doctorate training is highly influenced by the professor or department sponsoring the candidate, but perhaps there could be a somewhat uniform academic base upon which specialization is built.

As it now stands a person can secure a degree in physiology with a deficiency in one or more of the following - mathematics, physics, biochemistry, cellular physiology, comparative physiology, and in some few cases mammalian physiology. Some of the deficiencies occur before matriculation in graduate school, and some in the graduate curriculum.

There should be no consideration of setting up any form of accreditation or stamp of approval. However, recommendations from the Society could be widely publicized and might be very helpful to universities contemplating a Ph. D. program in physiology. The recommendations should be relatively specific yet broad enough to be adapted to any basic program offered by a qualified university.

Physiology is fast becoming as widely diversified as chemistry. The dictionary definition of a physiologist is "one versed in physiology." To be versed one must be "acquainted or familiar from experience, study, practice, etc.; skilled." Perhaps it is impossible for every physiologist to be versed (skilled) in all phases of physiology. Maybe it would be better to use indicative titles such as neurophysiologist, zoophysiologicalist, psychophysiologicalist, etc. rather than physiologist and not expect any of these to be "versed" in the broad field of physiology. Would this, if widely used, tend toward sectionalization of our Society and eventually to various groups splitting away to form their own societies?

We invite comments from members relative to the idea of proposing recommendations for basic training for the Ph. D. degree in physiology.

# THE AMERICAN PHYSIOLOGICAL SOCIETY

Founded December 30, 1887; Incorporated June 2, 1923

## OFFICERS, 1961-1962

- President - H. W. Davenport, University of Michigan, Ann Arbor, Michigan  
President-Elect - H. S. Mayerson, Tulane University, New Orleans, Louisiana  
Past-President - J. H. Comroe, Jr., University of California Medical Center, San Francisco, California  
Council - J. H. Comroe, Jr. (1962), H. W. Davenport (1963), H. S. Mayerson (1964), J. M. Brookhart (1962), T. C. Ruch (1963), H. Rahn (1964), J. R. Pappenheimer (1965).  
Executive Secretary-Treasurer - R. G. Daggs, 9650 Wisconsin Ave., Washington 14, D. C.  
Administrative Advisor - M. O. Lee

## STANDING COMMITTEES

- Publications - P. Bard (1962), Chairman; A. C. Barger (1963), R. W. Berliner (1964).  
Finance - E. M. Landis (1962), Chairman; H. Davis (1963), A. W. Martin (1964).  
Membership Advisory - J. D. Hardy (1964), Chairman; C. F. Code (1962), L. M. Beidler (1962), W. S. Root (1963), K. Schmidt-Nielsen (1963), R. B. Tschirgi (1964).  
Education - J. R. Brobeck (1964), Chairman; C. A. M. Hogben (1963), R. B. Tschirgi (1963), P. R. Morrison (1964), L. H. Marshall (1965); Representatives of Society of General Physiology - R. R. Ronkin (1963), D. C. Tosteson (1964).  
Use and Care of Animals - B. J. Cohen (1964), Chairman; A. Hemingway (1962), R. Galambos (1963).  
Placement of Senior Physiologists - D. B. Dill (1962), Chairman; E. M. Landis (1962), W. O. Fenn (1962), E. F. Adolph (1963).  
Porter Fellowship - J. K. Hampton (1964), Chairman; T. C. Ruch (1962), R. S. Alexander (1963).  
Program Advisory - T. C. Ruch (1963), Chairman; with power to co-opt.  
International Physiology - R. W. Gerard (1963), Chairman; M. B. Visscher (1965), H. S. Mayerson (1967).

## REPRESENTATIVES TO OTHER ORGANIZATIONS

- American Association for the Advancement of Science - R. E. Smith (1964), R. G. Daggs  
American Documentation Institute - M. O. Lee (1964).  
American Institute of Biological Sciences - W. O. Fenn (1962).  
National Research Council - Division of Medical Sciences: R. W. Gerard (1964); Division of Biology and Agriculture: J. H. Leatham (1964).  
Council on Medical Education and Hospitals, A.M.A. - J. S. Gray (1964).

APS Members of the U.S. National Committee for the International Union of Physiological Sciences - R. W. Gerard (1963), Chairman; M. B. Visscher (1965), H. S. Mayerson (1967). Federation Public Information Committee - A. C. Guyton (1964).

## PUBLICATIONS

Publications Committee - P. Bard (1962), Chairman; A. C. Barger (1963), R. W. Berliner (1964).

Managing Editor - M. O. Lee

Secretary of Publications - Sara F. Leslie

Editor of The Physiologist - R. G. Dags

Associate Editor of American Journal of Physiology and Journal of Applied Physiology - R. L. Zwemer

Associate Editor of Physiological Reviews - R. G. Dags

## EDITORIAL BOARDS

American Journal of Physiology and Journal of Applied Physiology -

W. R. Adey (1963), R. S. Alexander (1964), E. J. Baldes (1962), S. B. Barker (1964), L. M. Beidler (1963), H. S. Belding (1963), W. J. Bowen (1963), R. W. Brauer (1963), W. A. Briscoe (1963), J. R. Brobeck (1962), E. B. Brown, Jr. (1963), L. D. Carlson (1963), F. P. Chinard (1962), J. A. Clements (1963), A. F. Cournaud (1962), J. O. Davis (1963), R. C. de Bodo (1963), V. P. Dole (1963), I. S. Edelman (1963), R. E. Forster (1963), R. P. Forster (1963), W. S. Fowler (1962), W. F. Ganong (1963), A. S. Gilson, Jr. (1963), C. W. Gottschalk (1964), H. D. Green (1963), Arthur Grollman (1963), M. I. Grossman (1963), A. C. Guyton (1964), H. K. Hartline (1962), A. B. Hastings (1962), Allan Hemingway (1963), Elwood Henneman (1962), H. E. Himwich (1962), B. F. Hoffman (1963), C. A. M. Hogben (1963), Alexander Hollaender (1963), Franklin Hollander (1963), L. B. Jaques (1964), F. H. Johnson (1964), R. E. Johnson (1964), Ernest Knobil (1963), W. J. Kolff (1964), Nathan Lifson (1963), Victor Lorber (1963), W. D. Lotspeich (1963), W. H. Marshall (1963), Jean Mayer (1963), Jere Mead (1963), G. H. Mudge (1962), A. B. Otis (1964), C. A. Owen (1963), H. M. Patt (1963), L. H. Peterson (1963), R. W. Ramsey (1963), J. W. Remington (1963), Sidney Roberts (1962), J. S. Robertson (1963), Sid Robinson (1962), Jane A. Russell (1963), P. F. Salisbury (1964), W. H. Seegers (1962), E. A. Sellers (1963), J. W. Severinghaus (1963), R. H. Shepard (1963), C. W. Sheppard (1963), C. A. Terzuolo (1963), C. D. West (1963), J. W. Woodbury (1963), W. B. Youmans (1963). Consultant Editors: A. Albert (1963), A. C. Burton (1963), J. H. Comroe, Jr. (1964), W. O. Fenn (1962), Alfred Gilman (1962), E. E. Selkurt (1963), M. B. Visscher (1962).

Physiological Reviews - C. F. Code (1964), Chairman; C. McC. Brooks (1962), A. P. Fishman (1964), D. J. Ingle (1963), M. G. Larrabee (1963), W. L. Nastuk (1963), J. R. Pappenheimer (1962), J. V. Taggart (1963). Appointees of the Society of General Physiologists - I. M. Klotz (1962), T. H. Bullock (1963). Appointees of the Society of Biological Chemists - DeWitt Stetten (1964), A. E. Wilhelmi (1963). Appointee of the American Institute of Nutrition - Grace

A. Goldsmith (1964). European Editorial Committee - E. M. Crook, N. Emmelin, R. A. Gregory, G. Moruzzi.  
Annual Review of Physiology - V. E. Hall, Editor and Chairman;  
 R. Alexander (1964), J. M. Brookhart (1964), H. Hoagland (1963), R. Riley (1965), Clara Szego (1962).  
Handbook of Physiology - Editorial Committee - M. B. Visscher, Chairman; A. B. Hastings (1963), H. Rahn (1964), J. R. Pappenheimer (1965).

#### PAST OFFICERS

Presidents - 1888 H. P. Bowditch, 1889-90 S. W. Mitchell, 1891-95 H. P. Bowditch, 1896-1904 R. H. Chittenden, 1905-10 W. H. Howell, 1911-13 S. J. Meltzer, 1914-16 W. B. Cannon, 1917-18 F. S. Lee, 1919-20 W. P. Lombard, 1921-22 J. J. MacLeod, 1923-25 A. J. Carlson, 1926-29 J. Erlanger, 1930-32 W. J. Meek, 1933-34 A. B. Luckhardt, 1935 C. W. Greene, 1936-37 F. C. Mann, 1938-39 W. E. Garrey, 1938 W. T. Porter Honorary President, 1940-41 A. C. Ivy, 1942-45 P. Bard, 1946-47 W. O. Fenn, 1948 M. B. Visscher, 1949 C. J. Wiggers, 1950 H. C. Bazett (April to July) D. B. Dill, 1951 R. W. Gerard, 1952 E. M. Landis, 1953 E. F. Adolph, 1954 H. E. Essex, 1955 W. F. Hamilton, 1956 A. C. Burton, 1957 L. N. Katz, 1958 Hallowell Davis, 1959 R. F. Pitts, 1960 J. H. Comroe, Jr.

Secretaries - 1888-92 H. N. Martin, 1893-94 W. P. Lombard, 1895-1903 F. S. Lee, 1904 W. T. Porter, 1905-07 L. B. Mendel, 1908-09 R. Hunt, 1910-14 A. J. Carlson, 1915-23 C. W. Greene, 1924-29 W. J. Meek, 1930 A. C. Redfield, 1931-32 A. B. Luckhardt, 1933-35 F. C. Mann, 1936-39 A. C. Ivy, 1940-41 P. Bard, 1942 C. J. Wiggers, 1943-46 W. O. Fenn, 1947 M. B. Visscher.

Treasurers - 1888-92 H. N. Martin, 1893-94 W. P. Lombard, 1895-1903 F. S. Lee, 1904 W. T. Porter, 1905-12 W. B. Cannon, 1913-23 J. Erlanger, 1924-26 C. K. Drinker, 1927-36 A. Forbes, 1937-40 W. O. Fenn, 1941 C. J. Wiggers, 1942-46 Hallowell Davis, 1947 D. B. Dill.

Executive Secretary-Treasurer - 1948-56 M. O. Lee, 1956 - R. G. Dags

#### CONSTITUTION AND BYLAWS

Adopted at the 1953 Spring Meeting

#### CONSTITUTION

##### ARTICLE I. Name

The name of this organization is THE AMERICAN PHYSIOLOGICAL SOCIETY.

##### ARTICLE II. Purpose

The purpose of the Society is to promote the increase of physiological knowledge and its utilization.

## BYLAWS

(Amended April 1961)

ARTICLE I. Membership

Section 1. The Society shall consist of members, honorary members, associate members and sustaining associates.

Section 2. Members. Any person who has conducted and published meritorious original research in physiology and/or biophysics and who is a resident of North America shall be eligible for membership in the Society.

Section 3. Honorary Members. Distinguished scientists of any country who have contributed to the advance of physiology shall be eligible for proposal as honorary members of the Society.

Section 4. Associate Members. Advanced graduate students in physiology at a predoctoral level, teachers of physiology, and investigators who have not yet had the opportunity or time to satisfy the requirements for full membership shall be eligible for associate membership in the Society provided they are residents of North America.

Section 5. Sustaining Associates. Individuals and organizations who have an interest in the advancement of biological or biophysical investigation, may be invited by the President, with the approval of Council, to become sustaining associates.

ARTICLE II. Officers

Section 1. The management of the Society shall be vested in a Council consisting of the President, the President-Elect, the Past-President for the previous year, and four other members. The terms of the President and of the President-Elect shall be one year. The terms of the four additional Councilors shall be four years each and they shall not be eligible for immediate reelection except those who have served for two years or less in filling interim vacancies. A person may serve only one term as President, except that if the President-Elect becomes President after September 30 he shall continue as President for the year beginning the next July 1st.

Section 2. Nomination and election of a President-Elect and Councilor(s) shall be by ballot at the Spring meeting of the Society. They shall assume office on July 1 following their election.

Section 3. The President-Elect shall serve as Vice-President and Secretary. Should he have to function as President prematurely, the Council shall select from among its own members a Secretary.

Section 4. The Council shall be empowered to appoint and compensate an Executive Secretary-Treasurer who shall assist it in carrying on the functions of the Society, including the receipt and

disbursement of funds under the direction of the Council.

Section 5. The Council may fill any interim vacancies in its membership or vacancies on any Board or Committee of the Society, unless otherwise provided.

### ARTICLE III. Dues

Section 1. The annual assessment on members and on associate members shall be determined by the Council and shall be due in advance on July 1.

Section 2. A member whose dues are two years in arrears shall cease to be a member of the Society, unless after payment of his dues in arrears and application to the Council, he shall be reinstated at the next Spring meeting by special vote of the Council. It shall be the duty of the Secretary to notify the delinquent of his right to request reinstatement.

Section 3. A member who has retired from employment because of illness or age may, upon application to the Council, be relieved from the payment of the annual member assessment.

### ARTICLE IV. Meetings

Section 1. A meeting of the Society for transacting business, electing officers and members, presenting communications, and related activities, shall be held in the Spring of each year, with other Societies of the Federation of American Societies for Experimental Biology, except that under exceptional circumstances the Council may cancel such a meeting.

Section 2. A Fall meeting of the Society shall be held at a time and place determined by the Council, for presenting communications and for transacting business except the election of officers.

Section 3. Special meetings of the Society or of the Council may be held at such times and places as the Council may determine.

Section 4. Regional meetings of the Society, for the purpose of presenting scientific communications, may be authorized by the Council.

### ARTICLE V. Publications

Section 1. The official organs of the Society shall be the American Journal of Physiology, the Journal of Applied Physiology, Physiological Reviews and such other publications as the Society may own.

Section 2. A Publications Committee, composed of three members of the Society appointed by the Council shall be responsible for the management of all of the publications of the Society; the Managing Editor, Executive Secretary and President of the Society shall be

members ex-officio, without vote. The Committee shall have the power to appoint a Managing Editor and editorial boards for the Society's publications. The term of each member of the Publications Committee shall be three years; a member may not serve more than two consecutive terms. The Council shall designate the Chairman of the Committee who shall be an ex-officio member of the Council, without vote. The Committee shall present an annual report on publications and policies to the Council for approval and an annual budget to the Finance Committee for its approval.

#### ARTICLE VI. Committees and Representatives

Section 1. The Council may appoint such special and standing committees as it deems necessary or that are voted by the Society.

The Council may name members of the Society as representatives to other organizations whenever it deems such action desirable.

Section 2. A Finance Committee, composed of three members of the Society appointed by the Council shall receive budget proposals annually from the committees, the Council and the Executive Secretary of the Society and shall determine the annual budget, reserve funds and investments of the Society, subject to approval by the Council.

The capital fund of the present Board of Publication Trustees (defined as the investments and unencumbered funds of that Board as of April 1, 1961) shall be a reserve fund for publications and may be used by the Publications Committee to finance new or established publications without authorization of the Finance Committee (though subject to approval by Council). The Finance Committee shall not approve the expenditure of any of this capital fund for non-publication purposes without the consent of the Publications Committee. The Finance Committee shall be responsible for the separate investment of the reserve fund for publications; any capital gains from such investment shall accrue to the fund (capital losses will, however, reduce the value of it). Annual income from the investment of the fund may be used for any of the activities of the Society including publications.

The term of each member of the Finance Committee shall be three years; a member may not serve more than two consecutive terms. The Managing Editor, the President and the Executive Secretary shall be ex-officio members, without vote. The Council shall designate the Chairman of the Committee who shall be an ex-officio member of the Council, without vote.

#### ARTICLE VII. Standing Rules

1. Election to Membership. Two members of the Society must join in proposing a person for membership, in writing and with a statement of his qualifications. The Council may, from the persons so proposed, nominate candidates for election to membership. Nominations shall be presented at Spring and Fall meetings; a two-thirds majority vote of the members present and voting at the next following

Fall or Spring meeting shall be necessary for election.

If a Spring or Fall meeting of the Society is not held, the procedures of nomination and/or election of new members may be effected by mail.

The names of the candidates nominated by the Council for membership and statements of their qualifications signed by their proposers shall be available for inspection by members during the Society meetings at which their election is considered.

2. Election to Honorary Membership. The proposal of an honorary member shall be made by two members of the Society to the Council in writing. The Council may, from the candidates so proposed, make nominations to the Society at a Spring meeting. A two-thirds majority vote of the members present shall be necessary for election.

Honorary members shall have the privilege of attending business sessions of the Society but shall have no vote. They shall pay no membership fees.

3. Election to Associate Membership. Associate members shall be proposed, nominated and elected in the same manner as full members.

Associate members shall have the privilege of attending business sessions of the Society but shall have no vote. Associate members may be nominated for full membership.

4. Presentation of Papers. At a Spring meeting of the Society, held in conjunction with the Federation meetings, a member or honorary member may present orally or by title, be co-author of, or introduce not more than one scientific paper, except upon invitation of the Council. An associate member or a non-member may present orally one scientific paper only if sponsored by a full member of the Society. At a Fall meeting, a member, honorary member, or associate member may present orally not more than one paper, except upon invitation of the Council.

Upon invitation by the Council, a member may contribute papers to specially designated sessions of the Society without forfeit of his privilege of presenting a regular scientific communication.

5. There shall be a Committee on Membership appointed by and advisory to the Council.

6. There shall be a Program Advisory Committee appointed by the Council.

#### ARTICLE VIII. General

Section 1. Amendments. These Bylaws, except Article VII, may be amended at any Spring meeting of the Society by a three-fourths majority vote of the members present.

The Standing Rules of Article VII may be amended by a majority vote of the members present at either a Spring or Fall meeting of the Society.

Section 2. Quorum. At all business meetings of the Society fifty members shall constitute a quorum.

Section 3. Parliamentary Authority. The rules contained in Roberts Rules of Order shall govern the conduct of the business meetings of the Society in all cases to which they are applicable and in which they are not inconsistent with the Bylaws or special rules of order of the Society.



#### TWO MORE SOCIETIES TO ESTABLISH OFFICES AT BEAUMONT

The American Society for Pharmacology and Experimental Therapeutics has had its editorial office at Beaumont for some time. On October 1, 1961, the Society established a full-time Executive Officer at Beaumont. He is Dr. Ellsworth B. Cook who retired as Commander MSC, US Navy. Dr. Cook has his Ph. D. in pharmacology and has had considerable experience in research, organizational work and editing. As Executive Officer he will be charged with the ongoing managerial affairs previously delegated particularly to the Secretary and the Treasurer. The responsibility of these officers of the Society will become henceforth more of a supervisory or advisory nature.

The American Society of Biological Chemists established a central office at Beaumont on September 1, 1961. Mr. Robert A. Harte is the full-time Executive Secretary of the Society. Mr. Harte came from the position of Coordinator of Scientific Information at Merck Sharp and Dohme. His research interests have been in immunochemistry and nutrition. He has had considerable experience on national and international committees and in scientific communication and documentation. The Executive Secretary's office will handle functions previously carried out by the Secretary, including correspondence with members on Society affairs, the receipt of nominations for membership, and of abstracts for the annual meeting. The Executive Secretary will coordinate the activities of the Society as they relate to the Federation and will assume a major responsibility in developing the program of the Educational Affairs Committee.

## APS MEMBERSHIP STATUS

Status as of 1 October, 1961

Regular members .....	2002
Associate members .....	139
Retired members .....	128
Honorary members .....	16
Total membership...	2285

### SUSTAINING ASSOCIATES

Abbott Laboratories  
Ayerst Laboratories  
Burroughs Wellcome and Co.  
CIBA Pharmaceutical Products, Inc.  
Ethicon, Inc.  
Gilford Instrument Laboratories, Inc.  
Gilson Medical Electronics  
Grass Instrument Co.  
Harvard Apparatus Co.  
Hoffman-La Roche, Inc.  
Labline, Inc.  
Mead Johnson Research Center  
Eli Lilly and Co.  
Merck Sharp and Dohme Research Laboratories  
McNeil Laboratories, Inc.  
The Norwich Pharmacal Co.  
Chas. Pfizer and Co., Inc.  
Riker Laboratories, Inc.  
A. H. Robins Co., Inc.  
Schering Foundation, Inc.  
Sherman Laboratories  
Smith Kline and French Laboratories  
The Squibb Institute for Medical Research  
Ivan Sorvall, Inc.  
Tektronix, Inc.  
The Upjohn Co.  
Wallace Laboratories  
Warner-Lambert Research Institute  
Wyeth Laboratories

### DECEASED MEMBERS

The Society received notices during 1961 of the deaths of the following.

N. R. Blatherwick (R) - Daytona Beach, Florida  
Emilio Bulatao (R) - Manila, P.I.  
Edward L. Corey - Prof. Physiol., Univ. Virginia

Elmer A. K. Culler (R) - Rochester, New York  
 Robert L. Farrow (A) - Cleveland, Ohio  
 Worth Hale (R) - Monson, Mass.  
 J. W. Jailer - Assoc. Prof. Med., Columbia Univ.  
 Norman Jolliffe - Bureau Nutrition, New York City  
 Hampden C. Lawson - Prof. Physiol., Louisville Med. Sch.  
 Valy Menkin - Prof. Pathol., Kansas City Sch. Dent.  
 Arthur E. Meyer (R) - Hunt, Texas  
 K. E. Paschkis - Prof. Physiol., Jefferson Med. Coll.  
 H. Morrow Sweeney (R) - Austin, Texas

#### NEWLY ELECTED MEMBERS

The following, nominated by the Council, were elected to membership in the American Physiological Society at the Fall meeting, 1961.

#### FULL MEMBERS

BARANY, Michael: Assoc. Member, Inst. Muscle Dis, Inc., New York  
 BAUM, Siegmund J.: Radiation Biologist, Douglas Aircraft Co.  
 BERRY, Levette J.: Prof. Biol., Byrn Mawr Coll.  
 BLANK, Irvin H.: Assoc. Dermatol., Harvard Med. Sch.  
 BOUCEK, Robert J.: Senior Invest., Howard Hughes Med. Inst.  
 BRAMANTE, Pietro O.: Asst. Prof. Physiol., St. Louis Univ.  
 BRANDFONBRENER, Martin: Asst. Prof. Med., Northwestern Univ.  
 BRESLER, Emanuel H.: Dir. Research, VA Hosp., New Orleans  
 CHINARD, Francis P.: Assoc. Prof. Physiol. Chem. & Med., Johns Hopkins Univ.  
 DIDISHEIM, Paul: Instr. Med., Univ. Utah  
 DOBSON, Richard L.: Asst. Prof. Med., Head Dermatol., Univ. N. C.  
 ELLISON, Lois T.: Asst. Res. Prof. Physiol. & Surg., Med. Coll. Ga.  
 FIELD, James B.: Senior Invest., Clin. Endocrinol., NIH  
 FOWLER, Noble O.: Assoc. Prof. Med., Univ. Cincinnati  
 FRASHER, Wallace G., Jr.: Res. Assoc., CV Res. Lab., Coll. Med. Evangelists  
 FREDRICKSON, Donald S.: Member, Sr. Res. Staff, Lab. Cell. Physiol., NIH  
 GEBER, William F.: Assoc. Prof. Med., Univ. S. D., Invest. Heart Assoc.  
 GORDON, Malcolm W.: Dir., Biochem. Res. Inst. Living, Hartford  
 HEISEY, S. R.: Instr. Physiol., Harvard Med. Sch.  
 HELLEMS, Harper K.: Dir., CV Diseases, Seton Hall Coll. Med.  
 HENDERSON, Margaret J.: Asst. Prof. Physiol., Vanderbilt Univ.  
 HENLEY, Keith S.: Assoc. Prof. Int. Med., Univ. Mich.  
 HIBBS, Richard G.: Asst. Prof. Anat., Tulane Univ.  
 HOFFMAN, Roger A.: Biologist, US Army Chem. Res. & Devel. Labs.  
 INGBAR, Sidney H.: Asst. Prof. Med., Harvard Med. Sch.  
 INNES, Ian R.: Assoc. Prof. Pharmacol. & Therap., Univ. Manitoba  
 JAFFE, Ernst R.: Asst. Prof. Med., Albert Einstein Coll. Med.  
 JOHNSON, Robert M.: Asst. Prof. Physiol., Colorado State Univ.  
 KELLER, Daniel M.: Asst. Prof. Physiol., Univ. Tenn.  
 KING, Frederick A.: Asst. Res. Prof. Surg., Univ. Florida

- KOKETSU, Kyozo: Assoc. Prof. Physiol., Univ. Ill.  
 KOSTYO, Jack L.: Asst. Prof. Physiol., Duke Univ. Med. Ctr.  
 KRAMER, Philip: Asst. Prof. Med., Boston Univ.  
 KRONFELD, David S.: Asst. Prof. Physiol. & Pharmacol., Univ. Pa.  
 LA ROCHE, Gilles: Res. Biochemist, Donner Lab., Univ. Calif.  
 LATHAM, Willoughby: Assoc. Prof. Med., Univ. Pittsburgh  
 LEONG, George F.: Senior Invest., Radiol. Physiol., USN Radiol. Def. Lab.  
 LERNER, Leonard J.: Head Endocrine Biol., Squibb Inst. Med. Res.  
 LLAURADO, Josep G.: Sr. Endocrinologist, Chas. Pfizer Med. Res. Labs.  
 LORAN, Muriel R.: Assoc. Res. Pharmacol., Univ. Calif. San Francisco  
 LYONS, Harold A.: Prof. Med., State Univ. New York  
 Mac LEAN, Paul D.: Chief, Limbic Integ. & Behavior, NIH  
 MAFFLY, Roy H.: Sr. Res. Fell., Med. & CV Res. Inst., Univ. Calif.  
 MARONEY, Samuel P., Jr.: Asst. Prof. Biol., Univ. Va.  
 MARTIN, Carroll J.: Res. Assoc. Physiol., Univ. Wash.  
 MAYNARD, Donald M., Jr.: Asst. Prof. Zool., Univ. Mich.  
 McELROY, William T.: Asst. Prof. Physiol., Hahnemann Med. Coll.  
 McGRAW, Jean Y.: Asst. Prof. Physiol., Univ. Montreal  
 McKEEVER, William P.: Asst. Prof. Med., Northwestern Univ.  
 MEGIRIAN, David: Asst. Prof. Physiol., Univ. Ky.  
 MERSKEY, Clarence: Asst. Prof. Med., Albert Einstein Coll.  
 MICHAELSON, Solomon: Asst. Prof., Chief, Rad. Physiol., Univ. Rochester  
 MIGEON, Claude J.: Asst. Prof. Pediat., Johns Hopkins Univ.  
 MOON, Richard C.: Asst. Prof. Physiol., Univ. Tenn.  
 MORGANE, Peter J.: Fell. Physiol., Northwestern Univ.  
 MORRISON, Seoras D.: Physiol., Toxicol. Div., Haskell Lab.  
 NELLOR, John E.: Assoc. Prof. Physiol. & Pharmacol., Mich. State Univ.  
 NEWCOMER, Wilbur S.: Prof. Physiol., Oklahoma State Univ.  
 OLMSTEAD, Edwin G.: Asst. Prof. Med., Univ. N. D.  
 ORR, Richard H.: Exec. Dir., Inst. Advancement Med. Communication  
 OWENS, Guy: Chief, Neurosurg., Roswell Park Mem. Inst., Buffalo  
 PASIK, Pedro: Res. Assoc. Neurol., Mt. Sinai Hosp., New York  
 PASIK, Tauba: Res. Assoc. Neurol., Mt. Sinai Hosp., New York  
 PERMUTT, Solbert: Asst. Prof. Physiol., Univ. Colorado  
 POIRIER, Louis J.: Prof. Neuroanat., Univ. Montreal  
 POPPELL, James W.: Assoc. Member, Head, Cardiac Physiol., Sloan-Kettering Inst.  
 PREMACHANDRA, Bhartur N.: Res. Assoc., Jewish Hosp., St. Louis, Mo.  
 RAMPONE, Alfred J.: Asst. Prof. Physiol., Univ. Ore.  
 RAYFORD, Claudia R.: Physiologist, Cardio-Resp. Dis., Walter Reed Inst.  
 READ, Raymond C.: Asst. Prof. Surg., Univ. Minn.  
 REEVES, Thomas J.: Assoc. Prof. Physiol., Univ. Ala.  
 ROSENBAUM, Donald A.: Res. Physiol., Aero-Space Med. Lab., Dayton  
 ROSENFELD, Sheldon: Res. Assoc., Inst. Med. Res., Cedars Lebanon

- ROTHE, Carl F. : Asst. Prof. Physiol., Indiana Univ.  
RUBINI, Milton E. : Chief, Met. Serv., USA Trop. Res. Med. Lab.,  
San Juan  
SCHOOLEY, John C. : Physiol., Donner Lab., Univ. Calif.  
SENAY, Leo C., Jr. : Asst. Prof. Physiol., St. Louis Univ.  
SNELL, Fred M. : Prof. Biophys., Univ. Buffalo  
SOLOMON, David H. : Assoc. Prof. Med., UCLA  
STAUB, Norman C. : Asst. Prof. Physiol., Univ. Calif. Med. Ctr.,  
San Francisco  
STEELE, Robert: Biochemist, Biol. Dept., Brookhaven Natl. Lab.  
STEKIEL, William J. : Asst. Prof. Physiol., Marquette Univ.  
SULLIVAN, W. James: Group Leader, Exptl. Therap. Res., Lederle  
Labs.  
SZEKELY, Emery G. : Res. Assoc. Exptl. & Appl. Neurol., Temple  
Univ.  
TAUBER, Oscar E. : Prof. Zool. & Entomol., Iowa State Univ.  
TEDESCHI, Henry: Asst. Prof. Physiol., Univ. Ill.  
THOMAS, Lyell J., Jr. : Assoc. Prof. Biol., USC  
TIDBALL, Charles S. : USPHS Spec. Res. Fell., George Washington  
Univ.  
VAUGHAN, Burton E. : Head, Cell. Radiobiol. Program, USN Rad.  
Def. Lab.  
VISHWAKARMA, Pashupati P. : Lecturer, Pharmacol., Queen's  
Univ., Kingston  
WATERMAN, Talbot H. : Prof. Zool., Yale Univ.  
WILSON, Michael F. : Asst. Prof. Physiol., Univ. Ky.  
WINTERS, Robert W. : Asst. Prof. Physiol. & Assoc. Biochem.,  
Univ. Pa.  
WORTMAN, Bernard: Res. Asst. Prof., Washington Univ.  
YAMAMOTO, William S. : Asst. Prof. Physiol., Univ. Pa.  
ZORZOLI, Anita: Assoc. Physiol., Vassar Coll.

## ASSOCIATE MEMBERS

- AKERS, Thomas K. : Royal E. Cabell Fell., Loyola Univ., Chicago  
BERKSON, Harold: Res. Asst., Scripps Inst. Oceanography, Univ.  
Calif.  
BILLINGS, Charles E., Jr. : Instr. Prev. Med., Ohio State Univ.  
BURTON, George G. : Sr. Med. Student, Coll. Med. Evangelists  
CROUCH, Billy G. : Biol., USN Radiol. Def. Lab., San Francisco  
FISHMAN, Irving Y. : Assoc. Prof. Biol., Grinnell Coll.  
GINSKI, John M. : Asst. Prof. Clin. Physiol., Univ. Tenn.  
HANSEN, Carl L., Jr. : Chief, Binucleonics Sect., USAF, Washington,  
D. C.  
HUNDLEY, Louis R. : Assoc. Prof. Biol., Virginia Military Inst.  
KELLY, Arthur L. : Res. Asst., UCLA  
MCCOOK, Robert D. : Res. Assoc., Loyola Univ., Chicago  
NUNGESSER, William C. : Asst. Prof. Physiol., Univ. N. D.  
RAWSON, Robert O. : Adv. Grad. Student & Res. Assoc., Stritch  
Sch. Med.  
ROBINSON, Paul F. : Physiol., US Army Chem. Res. & Devel. Labs.  
THIES, Roger E. : Guest Invest., Rockefeller Inst., New York

# A REPORT OF THE COMMITTEE ON MEMBERSHIP

J. D. Hardy, Chairman

In 1960, the Council appointed a committee of six members to assist it in the matters pertaining to membership in the Society. The duties assigned to this committee were a) review of applications submitted to the Executive Secretary for full and associate membership, and b) other matters that the Council might refer to this committee for study and report. All recommendations of the committee are, of course, reviewed and approved by Council before action is taken, and the work of the committee was viewed as the necessary "spade" work which would relieve Council for the many additional responsibilities associated with the management of the Society's affairs. The committee at present consists of Lloyd Beidler, Florida State University; C. F. Code, Mayo Foundation; James D. Hardy, Pierce Foundation - Yale University; Walter S. Root, Columbia University; Knut Schmidt-Nielsen, Duke University; and Robert Tschirgi, University of California. The committee members are appointed by Council for different terms with two members being rotated each year.

At the 1961 Spring meeting, Council requested that the committee examine the membership status as regards number of members, resignations, rates of growth of various groups within the Society, etc. This study, which was carried out by Dr. Ray Daggs with some assistance from the committee, is the subject of this report.

In figure 1 bar graphs show the number of members in the Society by years since World War II. Total membership is indicated by the black columns against the upper scale and is seen to have increased by about 1,000 active members since 1945. This represents more than doubling the immediate post war membership. The average growth of the Society (within the usual physiological variation) was constant at about 4.7% per year from 1945 to 1957 but has shown an increase to 5.5% per year during the period 1957-60, and 7.6% for 1961.

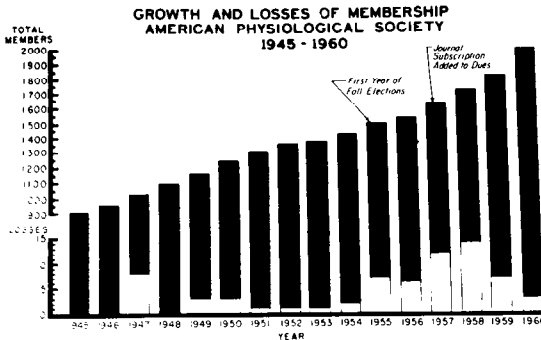
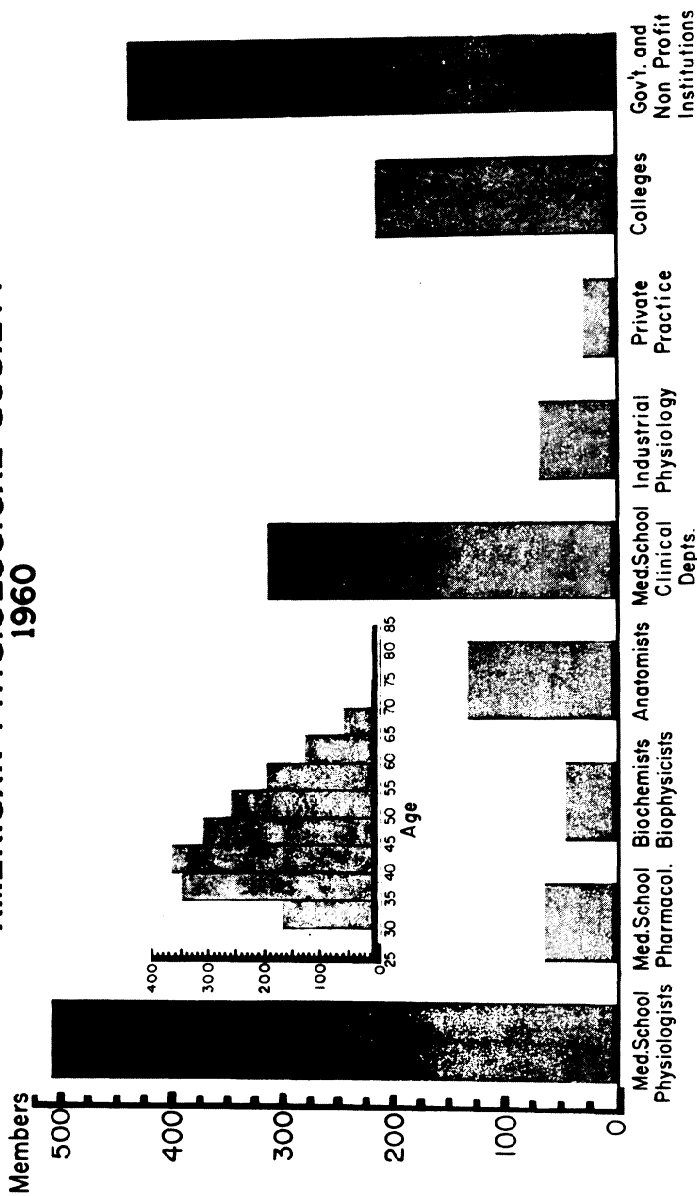


Fig. 1

# DISTRIBUTION OF MEMBERS OF AMERICAN PHYSIOLOGICAL SOCIETY 1960



Several factors seem to enter in the increasing growth rate of the Society among which can be identified the greater interest of the young clinical investigator in physiology.

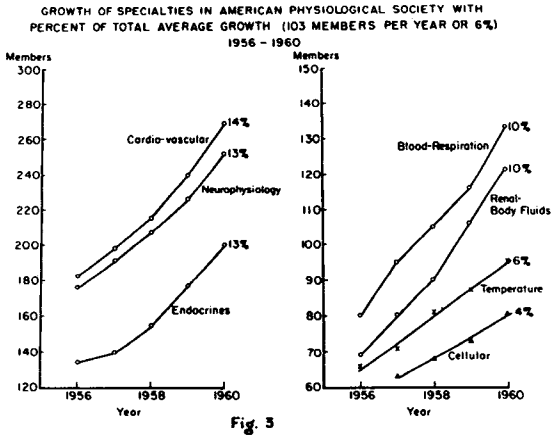
Losses from the Society by resignation are shown at the bottom of the chart by clear bars referred to the lower expanded scale. There were no losses from this source in 1945 and 1946, but 7 resignations in 1947 which may represent post war change of interest. Significant numbers of resignations seemed to have been associated with the first year in which members were elected at the Fall meeting and with the addition of the Journal subscription to the annual dues. In general, membership loss by resignation is not a significant factor in inhibiting Society growth.

In figure 2 are two bar graphs, the smaller inset representing the age distribution of active members and the larger graph indicating a rough breakdown of the employment of members. It is seen that membership in the Society is usually delayed until the fourth decade of life and the average age is near 47 years. The "mature" age of the membership is the result of the traditional policy of the Society to seek as members only those with demonstrated capacities as investigators in physiology. Associate membership, introduced some years ago to provide, in part, for participation of the younger investigator, is growing healthily (32 members elected in 1961) but is not included in the above charts.

It will be noticed that over one half of the Society's members at present are associated in some capacity with medical school teaching and about one fourth are in physiology departments of medical schools. Other large groups are physiologists in privately endowed Foundations and in the Federal Service (20%) and in university and college teaching (13%). The number associated with medical teaching would be considerably larger if those who are working in hospitals, government, etc., who do part time teaching in physiology departments, were included.

There are still other ways in which to look at the membership of the American Physiological Society. For example, in what fields of physiology are the members interested and how rapidly is the membership growing in respect to these fields. Figure 3 shows an analysis of some of the major investigative fields for the years 1956-60. The percentage of the Society's membership for each group is shown by the figures at the right for each discipline. The average growth rate of the various research fields, assuming roughly linear increase in those working in the areas, is :

Cardio-vascular Physiology	10% per year
Neurophysiology	10% " "
Endocrinology	10% " "
Respiration (Blood)	12% " "
Renal Physiology	14% " "
Temperature and Environmental Physiology	10% " "
Cellular Physiology	8% " "



The rates of growth for the various fields is roughly the same for 1961 as indicated by the latest figures. Under the traditional method of new membership nomination, the larger groups tend to increase in numbers of interested members more rapidly than the smaller, although the percentage growth rates are not greatly different. The future growth of the Society is the responsibility of the active members as it is they who nominate candidates for membership. The maintenance of membership standards is the responsibility of Council with the assistance of the Membership Committee.



PAST-PRESIDENT ADDRESSED SOCIETY

Past-President Comroe diverted from the usual rather formal pattern of past-president's addresses and entertained those present at the Fall meeting with a clever, humorous, satirical lecture on the status and woes of scientists, research and particularly physiologists. The lecture was almost entirely made up of annotated slides so was impractical for reproduction in THE PHYSIOLOGIST. Those who had the privilege of hearing the lecture certainly were entertained but got the message the speaker subtly conveyed by his illustrative slides.

## MOBILITY OF PHYSIOLOGISTS\*

1956-1958

The following tables show the movement of physiologists during the period from 1956 to late 1958. The data include 2,712 full-time physiologists who were on the National Register in 1956. The majority of these are members of the American Physiological Society.

Table 1 shows the transfers of physiologists to and from various categories of activity. There were 281 separate shifts of activity. This indicates that 10.5% of the full-time physiologists changed positions during this two-year period. Table 2 shows the gain and losses in each position category. Research and Teaching showed little change in totals whereas Administration showed considerable gain, mainly at the expense of Clinical Research.

Tables 3 and 4 show the same type of data by employer categories. Universities showed little change in total number whereas Industry and Non-Profit Institutions gained at the expense of Federal Government.

The reasons for the various shifts in activity and employment are not known but it is interesting to note the extent and type of mobility. The percent of physiologists who changed positions (10.5) is only slightly higher than the percentage of all full-time scientists in the fields of activity covered by the societies of the Federation (9.3%).

Tables 5 and 6 show the percentage distribution of the 2,712 physiologists in each category in 1956.

**TABLE 1. TRANSFER TO AND FROM VARIOUS ACTIVITIES**

	Research	Teaching	Research Administration	General Administration	Clinical Research	Clinical Practice	Consulting	Design and Development	Editing	Inspection	Total Loss
Research	-	48	25	1	0	21	1	0	0	0	96
Teaching	35	-	15	6	1	4	1	0	0	0	62
Research Administration	8	2	-	0	0	1	2	0	0	0	13
General Administration	5	0	1	-	0	2	0	0	0	0	8
Clinical Research	53	12	3	6	-	0	0	0	0	0	74
Clinical Practice	0	3	0	2	0	-	0	0	0	0	5
Consulting	5	0	0	2	6	4	-	0	0	0	11
Design and Development	4	1	1	0	0	2	1	-	0	0	9
Editing	0	0	2	0	0	0	0	0	-	0	2
Inspection	0	0	0	0	0	1	0	0	0	-	1
<b>Total Gain</b>	<b>110</b>	<b>66</b>	<b>47</b>	<b>17</b>	<b>1</b>	<b>35</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>281</b>

\*Material furnished by Mrs. Ruth Habel of the Federation Office of the National Register of Scientific Personnel.

TABLE 2. GAIN OR LOSS IN EACH ACTIVITY

	Transfer From	Transfer To	% Change	Total in 1956
Research	96	110	+ 0.3	1304
Teaching	62	66	+ 0.5	812
Research Administration	13	47	+22.0	154
General Administration	8	17	+10.2	88
Clinical Research	74	1	-55.7	131
Clinical Practice	5	35	+17.6	170
Consulting	11	5	-21.4	28
Other	12	0	-48.0	25
Total	281	281		2712

TABLE 3. TRANSFER TO AND FROM EMPLOYMENT CATEGORY

	University	Federal Government	State Government	Non-Profit Institution	Industry	Self-Employed	Total Loss
University	-	27	7	35	13	11	93
Federal Government	46	-	1	24	5	4	80
State Government	3	0	-	1	0	3	7
Non-Profit Institution	24	4	0	-	1	11	40
Industry	6	2	1	0	-	0	9
Self-Employed	10	0	0	2	2	-	14
Total Gain	89	33	9	62	21	29	243

TABLE 4. GAIN AND LOSS IN EACH EMPLOYMENT CATEGORY

	Transfer From	Transfer To	% Change	Total in 1956
University	93	89	-0.2	1707
Federal Government	80	33	-10.9	428
State Government	7	9	+3.7	53
Non-Profit Institution	40	62	+7.6	287
Industry	9	21	+9.6	125
Self-Employed	14	29	+13.4	112
Total	243	243		2712

TABLE 5. DISTRIBUTION BY ACTIVITY - 1956

(Read Across)

	University		Federal Government		State Government		Non-Profit Institution		Industry		Self-Employed		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Research	745	57	275	21	23	2	182	14	72	6	7	>1	1304	105
Teaching	783	96	6	1	6	1	14	2	1	>1	2	>1	812	106
Research Administration	32	21	62	40	5	3	24	16	31	20	0	0	154	100
General Administration	49	56	18	20	7	8	7	8	6	7	1	1	88	100
Clinical Research	48	37	38	29	10	8	27	20	8	6	0	0	131	100
Clinical Practice	35	21	14	8	2	1	27	16	0	0	92	54	170	100
Consulting	9	32	9	32	0	0	5	18	2	7	3	11	28	100
Other	6	24	6	24	0	0	1	4	5	20	7	28	25	100
Totals	1707		428		53		287		125		112		2712	

Example: 20% of those in Research Administration were employed by Industry.

TABLE 6. DISTRIBUTION BY EMPLOYMENT - 1956

(Read Down)

	University		Federal Government		State Government		Non-Profit Institution		Industry		Self-Employed		Total
	#	%	#	%	#	%	#	%	#	%	#	%	
Research	745	44	275	64	23	43	182	64	72	58	7	6	1304
Teaching	783	46	6	2	6	11	14	5	1	>1	2	2	812
Research Administration	32	2	62	14	5	10	24	8	31	25	0	0	154
General Administration	49	3	18	4	7	13	7	3	6	5	1	1	88
Clinical Research	48	3	38	9	10	19	27	9	8	6	0	0	131
Clinical Practice	35	2	14	3	2	4	27	9	0	0	92	82	170
Consulting	9	>1	9	2	0	0	5	2	2	2	3	3	28
Other	6	>1	6	2	0	0	1	>1	5	4	7	6	25
Total	1707	100	428	100	53	100	287	100	125	100	112	100	2712

Example: 64% of those in Federal Government employment were doing research.

**XXII INTERNATIONAL CONGRESS OF  
PHYSIOLOGICAL SCIENCES LEIDEN, THE NETHERLANDS,  
SEPTEMBER 10-17, 1962**

**Important Announcement**

The XXII International Congress of Physiological Sciences will be held under the auspices of IUPS, at Leiden, The Netherlands, September 10-17, 1962. As was the case with previous congresses, the program will include a number of symposia as well as lectures by invitation. In addition, each active Congress member is entitled to present one free communication. There will also be facilities for the presentation of films and for a limited number of demonstrations. Projectors for 2" x 2" (50mm x 50mm) slides will be available in all lecture theatres.

A large attendance is expected. According to a conservative estimate, the number of active members will be between 3,500 and 4,000. For the organizing committee to cope with this very large number, it has been necessary to lay down strict rules in regard to eligibility for membership, deadlines for the return of completed application forms, etc.

**Membership:**

Thanks to the cooperation of the secretaries of the physiological and pharmacological societies in member countries, the following system has been set up:

1. Members of the adhering and supporting societies will receive documentary material, application forms, etc. through the good offices of the secretaries of these societies. (Note: For APS members - R. G. Daggs, 9650 Wisconsin Ave., Washington 14, D. C.) They are requested to complete the application forms and to return them before the deadline indicated on the forms, to the secretariat of their society (R. G. Daggs for APS members) which will forward them to the congress secretariat.
2. Scientists residing in countries where such a society exists, but who are not members, are requested to apply to the secretariat of the society; applications made directly to the Congress secretariat cannot be considered. The Society secretaries will serve as agents for certification of eligibility for Congress membership.

**Registration Fee:**

The Executive Board of IUPS and the organizing committee are of the opinion that every attempt should be made to keep the registration fee as low as possible. This entails stripping the Congress of non-essential luxuries, and operating on a tight budget generally. Thus, the volume containing the abstracts of free communications will be produced in photo-offset, and there will be no simultaneous translation facilities.

It has thus been possible to set the registration fee for active members at 63 Dutch guilders or U.S. \$17.50. This low fee is applicable only in those cases where :

1. The completed application form has been received not later than January 1, 1962.
2. The registration fee is paid before February 1, 1962.

Active members are entitled to take part in the scientific meetings and the social events. The registration fee also covers the cost of the congress proceedings, comprising the abstracts of the free communications and the text of the lectures by invitation and of the symposia.

Associate members can be registered at a basic fee of 12.50 Dutch guilders or \$3.50. They are entitled to take part in the social events. In addition, they can compose their own program from a series of low-priced excursions.

#### Scientific Sessions; Free Communications, Demonstrations, Films:

The time available for a free communication is 15 minutes, including discussion. Prospective congress members who have indicated, on their application form, their intention to present a free communication will be provided with a special abstract reproduction form on which a 250-word abstract of their paper is to be typed. The abstracts should reach the agency from which the abstract reproduction form was received (R. G. Daggs, for APS members) not later than January 1, 1962. Prospective members who have indicated their intention to give a demonstration or to show a film will receive further instructions from the congress secretariat. Scientific sessions will be held in the lecture theatres of the Leiden University hospital complex.

#### Accommodation and Transport:

All arrangements concerning hotel accommodation, transportation, excursions, etc., have been entrusted to Holland Organizing Centre, The Hague.

The great majority of congress members will be lodged at the nearby seaside resorts of Scheveningen (9 miles) and Noordwijk (6 miles). The number of single rooms at the hotels is limited. Prospective congress members will be requested to indicate, on the application form, whether they want to share a twin-bedroom with a friend or colleague, and if so, with whom. Free transportation between the lodging centres and the University hospital will be provided. A simple fork lunch will be served at cost in a temporary cafeteria to be erected for the purpose on the hospital campus.

#### Miscellaneous:

It will be seen that the dates for the congress have been set so as to include a weekend. This has been done to allow for some unscheduled time in the second half of the congress week, which time can be used either for private scientific or social gatherings, or for relaxation, for excursions, etc.

Prospective congress members are strongly urged to comply with the rules for application for membership and to observe the deadlines.

Applications received after the closing date of January 1, but before July 15, 1962, will be considered, but no responsibility can be taken as to accommodation and transportation of late applicants; also, the registration fee will then be \$22.50 for active members, and \$5 for associate members. It will not be possible for late applicants to present free communication, hold a demonstration, or show a film.

Note:

Application forms, abstract forms, etc. can be obtained from Dr. Ray G. Daggs, Executive Secretary of the American Physiological Society, 9650 Wisconsin Ave., Washington 14, D. C.



### INTERNATIONAL SYMPOSIUM

A symposium is being organized on "Temperature Acclimation," to be held in the Netherlands Institute of Preventive Medicine at Leiden, on September 5th, 6th and 7th, preceding the XXII International Congress of Physiological Sciences (September 10-17, 1962). The purpose of the symposium will be to present and discuss, in a topical manner, controversial subject areas related to physiological responses to both heat and cold, with particular emphasis on the definition of the acclimatized state. The symposium is being sponsored by the National Academy of Sciences - National Research Council and the Federation of American Societies for Experimental Biology.

It is necessary to limit the number of participants and most of the places on the program have been filled by direct invitation; however, it may be possible to include some additional participants. Those who are interested are invited to write to Dr. Milton O. Lee, Federation of American Societies for Experimental Biology, 9650 Wisconsin Avenue, Washington 14, D. C.

## PRESIDENT'S MESSAGE

H. W. Davenport

### Somebody Must Do Something!

The trouble with our Spring meetings with the Federation is that there are too many 10-minute papers. On Tuesday, last April 10, there were 27 simultaneous 10-minute paper sessions. Four were intersociety, six physiology, eight biochemistry, and nine from the remaining societies. Enough meeting rooms to hold all these sessions can be found only in Atlantic City or Chicago, and even there the rooms are unsatisfactory ones scattered all along the Boardwalk or throughout the Loop. In a few years there will be no place that can hold us. The Federation must reserve hotel space years ahead, and to deal with the problem of ever-increasing numbers of sessions it is planning to lengthen the meetings. There will be six scientific session days in 1962 and 1963, seven in 1964 and 1965, and for 1967 a two-week period has been reserved. In such long meetings the physiologists and pharmacologists, societies with overlapping interests, may meet together at the beginning of the period while biochemists and nutritionists meet at the end. In between, the programs attracting members from all societies may be scheduled.

Our Society must decide now to make a change in its Spring meeting program, or it will find itself in an intolerable position seven or eight years from now. In a year or two we will have lost the ability to make a sensible, evolutionary change. One solution, of course, is to stop meeting with the Federation. Members have never seriously debated this, and I doubt they would accept it. To many of us, participation in the Federation is our major line of communication with related scientific disciplines. The survey of attendance made at the last Federation meeting showed that there is a really significant amount of crossing-over between societies. Physiologists, some of them at least, do go to sessions of other societies, and members of other societies do come to our sessions. The intersociety sessions have been successful, and many members favor a completely integrated program. It is true that there are topics in physiology which do not appear to have much interest for other societies. Last April, I attended one large session on hemodynamics in which the only foreigner was a lone immunologist, and sessions on smooth muscle were almost as pure. On the other hand, we had a very lively session on liver which was good because all societies were about equally represented. It would be provincial to cut ourselves off from our sister societies because some part of physiology at the moment seems to be self-contained or to have its connections outside the Federation. If our members belonging to these temporarily encysted groups do not want to meet with the Federation, they can improve our Fall meetings by saving their strictly physiological papers for them.

Many members want more symposia and discussion programs in place of 10-minute papers. Symposia do not arise spontaneously; they

are generated by persons or groups with ideas and drive. We have had many good symposia, and the growing trend toward intersociety sessions has given us new ones. A notable example is the gastroenterology programs of the last two years, programs organized by pathologists, which have attracted large audiences from all societies. If we form sections of our Society, each of the sections could prepare one or more programs of invited or specially grouped papers at each meeting. This would put the responsibility for excellence directly on the group concerned. More participation in preparing the program and more widely diffused responsibility for its quality might even reduce the number and volume of complaints.

Members value their right to give a 10-minute paper, but it seems to me the time has come when they must choose between that right and eventual collapse of our Spring meetings. After all, the Fall meetings will remain open. At the Spring meetings there are many sound, important and well-presented papers (yours and mine) but we all know that many should be burked. Voluntary paper-control has not worked, and selection after submission of abstracts is both impracticable and unacceptable. Will the Society accept a drastic, general limitation of the right to give a 10-minute paper at the Spring meeting? Can we keep the number of physiology 10-minute papers under 250? If the biochemists would do likewise and if the other societies had a similar total among them, we would have only seven or eight simultaneous sessions of 10-minute papers in five days. Then we would have the room, time and energy to profit from the other advantages of being federated. Can we agree that a member may give a 10-minute paper only every third year? To abolish the frantic beating of the backwoods which occurs every December will we rule that no member may introduce a 10-minute paper of which he is not an author? If we enacted such rules we would all be forced to reconsider the function of the 10-minute paper, and in addition to reducing their number we might improve their quality.

## SUMMARY OF ACTIONS TAKEN AT THE FALL MEETING

The new committees, (Publications Committee and Finance Committee) authorized by the change in Bylaws adopted at the April 1961 meeting, have worked together and made several recommendations to Council. Most of the recommendations were accepted and approved by Council.

### I. Dues and Subscriptions

Compulsory subscription as a part of dues for regular members is to be dropped July 1, 1962. This means that a regular member need not subscribe to one of the Society's journals but, if he so chooses, he can subscribe at the same rates offered under the previous plan, that is, 50% reduction for American Journal of Physiology and Journal of Applied Physiology and 20% reduction for Physiological Reviews. These are reductions from the non-member subscription prices. Members will be billed separately for subscriptions (if they care to subscribe) and for dues. The Federation Circulation Office will handle subscriptions as they have in the past but the APS Central Office will bill for and collect membership dues.

The dues for regular members, beginning July 1, 1962, have been raised from \$10 to \$15. Federation dues for the Society as well as AIBS dues come out of membership dues. Associate membership dues remain at \$5. Associate members are not calculated as members of the Federation or AIBS. Retired members pay no dues but they, as well as associate members, may subscribe to APS journals at member rates. All regular members receive Federation Proceedings, which is being increased from four to six issues a year, without charge. All members will continue to receive THE PHYSIOLOGIST without charge.

### II. Financial Structure

The Society will have three separate funds. This is in keeping with the new bylaws that guarantee and protect publication funds.

a) Publication Contingency and Reserve Fund. This is the invested fund referred to in the bylaws as the capital fund of the former Board of Publication Trustees. The capital of this fund can be used only for publication matters. The interest on the investments, however, can be used for any Society activity including publications. This interest will be kept separate and its use will be determined by Council annually on recommendation of the Finance Committee.

b) Publications Operating Fund. This fund involves receipts, expenses, short term investments relating to annual receipts, disbursements and continuing operation of APS publications. In essence it is the yearly operating fund for publications just as the name implies.

c) Society Operating Fund. All other funds, restricted or unrestricted, uninvested or invested, short or long-term, are contained as sub-accounts in the Society Operating Fund.

### III. Publications

Council authorized the Publications Committee to negotiate the purchase of the Journal of Neurophysiology now owned jointly by Yale University and the C C Thomas Publishing Company.

Council also authorized Dr. Comroe to start the publication of a bulletin on physiological topics for practicing physicians. This is to be a monthly leaflet similar to Modern Concepts of Cardiovascular Disease.

Page charges for the AMERICAN JOURNAL OF PHYSIOLOGY and the JOURNAL OF APPLIED PHYSIOLOGY were authorized. The amount of the charge has been set at \$20 per page. In addition an article charge of \$20, for indexing and supplying national and international journals with abstracts, will be charged. The former author charges for tables, figures, etc. has been eliminated. There will be no free reprints to authors. Page charges will be assessed only if the authors' supporting funds can accept them. Editorial decision on the acceptability of any paper for publication will not be influenced or concerned with the ability of authors' supporting funds to pay page charge assessments.

The Publications Committee is establishing a group of section editors, that is, scientific editors who will be responsible for obtaining editorial comments and for accepting or rejecting papers in their particular subdivision of physiology.

### IV. Relation of APS to the Federation.

Most of the time at the Society Business Meeting was devoted to a discussion of this topic. Members had previously been supplied with copies of the report of analysis of attendance at the 1961 Federation meeting as well as a reprint of the article on finances, etc. that appeared in the February 1961 issue of THE PHYSIOLOGIST.

Practically all members present felt that the Federation

meetings were very valuable in respect to intermingling with other disciplines, exhibits, etc. and were strongly against leaving the Federation.

All members, however, recognized the problem of the size of the Federation scientific program and felt that something must be done to reduce the number of 10-minute papers. Following are the major suggested cures that were discussed with some indication of the sentiments of those in attendance.

1. Have own APS Spring meeting.

There was no enthusiasm for this and the idea was quickly discarded.

2. Regional meetings - geographical or topical.

It was felt by some that additional meetings would relieve the pressure. Some proposed having several national Fall meetings (as opposed to sectional or regional), each concentrating on a specific subject area. The Federation meetings could then be reserved for symposia and invited lectures, but no 10-minute papers. Most members present were opposed to these suggestions.

3. Staggering meeting by societies over a two-week period.

This would have to be instituted at least five years in advance since the Federation must make time commitments for reservations that far in advance. Most felt that we could not wait that long before doing something to limit the size of the scientific program and further that this scheme of spreading out would cut down the desired crossover between the societies. It also would not reduce the number of simultaneous sessions of any one society.

4. Elimination of the 10-minute papers.

Two thirds of those present were against this.

5. Restrict the 10-minute papers to a specific topic each year.

There was no sentiment for this type of restriction.

6. Selection of 10-minute papers by censorship at a central office or on a local basis.

Most were opposed to any type of censorship or selection.

7. Totally integrated Federation program.

Programs should not be by societies but by

topic wherever possible. In effect there would be all intersociety sessions except in a very few highly specialized areas. Others suggested all intersociety symposia. The majority preferred to keep the society 10-minute papers in some restricted form.

8. Limit the number of non-member papers.

There were several suggestions under this category.

a) Charge non-members a much higher registration fee.

b) Do not publish abstracts.

c) Do not permit a member to sponsor a non-member paper unless the member is from the same department as the non-member author.

d) Do not permit any sponsorship unless the member is actually one of the authors of the paper. The Fall meeting would remain open as it is now. A large majority of those present were in favor of this idea.

9. Limit the frequency of presentation of 10-minute papers.

The idea here was to limit sponsorship of any one member to every other year, again leaving the Fall meeting open as it is now. This idea met with a great deal of favor and many felt that this restriction should be coupled with the provision that a member must be one of the authors.

The Council, with the Society's concurrence empowered President Davenport to consult with the Biochemists and try to arrive at some bi-society set of rules that would tend to reduce the number of 10-minute papers. If these two largest societies could reduce the number of their 10-minute papers it would greatly reduce the size of the scientific program. Dr. Davenport was to convey to the Biochemists the feelings of APS members as discussed above but was not restricted in his being able to concur in some joint solution that could be used at least as a trial.

## REQUEST BY THE FINANCE COMMITTEE

E. M. Landis, Chairman

The Finance Committee, established by vote of the members of the American Physiological Society at their Business Meeting on April 11 and 13, 1961 consists, for 1961-62, of Drs. Hallowell Davis, Arthur Martin and Eugene Landis, Chairman. This Committee has held three meetings; two during the summer at Beaumont House (July 13 and 14; August 14) and one at Bloomington, Indiana (Sept. 3, 1961) just prior to the meeting of Council. These three meetings were devoted in large part to conferences with the Publications Committee; with Dr. Daggs, Secretary-Treasurer of the Society; with Dr. Lee, Managing Editor of APS publications; with Mr. Rice, the Business Manager of the Federation, with the auditors, etc. As a result of these conferences a series of recommendations were made to Council on September 4, 1961, action on which is reported elsewhere.

The purpose of this note is to let all members of the Society know that the Finance Committee, with Council's approval, has decided that one of its important, continuing functions should be to request, from all members of the Society and its committees, suggestions, questions and particularly criticisms concerning the Society's finances. To answer any queries or criticisms the Finance Committee will gather relevant facts, will consult with those concerned, will confer with financial or legal experts if indicated, will weigh the pros and cons, and then make recommendations to Council so that Council may consider these recommendations and report their action to the Society membership at business meetings.

This note is simply an invitation to each member of the Society or of any committee to send suggestions, questions or criticisms dealing with financial matters to the Chairman of the Finance Committee. We urge that letters be sent early enough, before each of our semi-annual meetings, to permit time for the gathering of information and figures that the Finance Committee must obtain before a sound recommendation can be made to the Council of the Society.

## ACTIVITIES OF EDUCATION COMMITTEE

The Education Committee of APS held its regular semi-annual meeting at the time of the Fall meetings in Bloomington. A summary of activities follows.

1. Workshops in Teaching Physiology

Funds are available through an NSF grant to hold a workshop at Purdue University in August of 1962. The 1961 workshop at the University of Massachusetts was highly successful. The workshops seem to be filling a definite need among college teachers of physiology and will be continued on a changing regional basis each year as long as funds are made available.

2. Career Brochure

The brochure titled "A Career in Physiology" has had enthusiastic reception. Approximately 50,000 copies have been distributed to colleges, secondary schools, career guidance groups and others. Since the remaining supply is dwindling a limited reprinting in the near future has been approved in order to meet the day to day demands. The Education Committee is starting work on a completely revised edition. Comments, criticisms and suggestions regarding the present edition should be sent to Dr. Louise H. Marshall, National Institutes of Health, Bethesda 14, Md.

3. Teaching Session

Each year the Committee is responsible for planning and conducting a teaching session at the Federation meetings. For the 1962 meetings the general theme of the session will be the use of television and programmed instruction in teaching physiology. Dr. R. D. Tschirgi is organizing the session.

4. Refresher Course

Just preceding each Fall meeting the Education Committee plans and sponsors an all-day session on some phase of teaching with emphasis on laboratory techniques. For the 1962 Fall meeting, Dr. Bennett Cohen, Chairman of the APS Committee on the Use and Care of Animals has agreed to organize a session on the selection, use and handling of animals for physiological experiments. This will include care and preparation techniques. Demonstrations are planned.

5. Laboratory Experiments

The mimeographed set of selected laboratory experiments in general physiology which is available at cost (\$1.30) from the APS office has been widely used. Since the supply is practically exhausted (over 950 sets

distributed) a revision is in process and should be available in several months. Suggestions and comments regarding this set of selected experiments should be sent to Dr. R. R. Ronkin, Dept. of Biological Sciences, University of Delaware, Newark, Delaware.

The Committee has just completed a second series of selected laboratory experiments designed primarily for college courses in elementary human physiology. Mimeographed sets of these experiments are now available at cost (\$1.50) from the APS office. These experiments like those in general physiology have been screened and carefully tested by a sub-committee headed by Dr. Charlotte Haywood of Mount Holyoke College. An outline of the contents is given below.

### Laboratory Experiments in Elementary Human Physiology

#### Table of Contents

#### GENERAL PRINCIPLES

- A. Fluid Exchanges in the Frog under Varying Osmotic Pressures
- B. The Effect of Varying Osmotic Pressure upon the Integrity and Contractility of Muscle

#### CIRCULATION AND RESPIRATION

- A. Some Reactions of the Microcirculation
- B. Ballistocardiograph
- C. Recording the Pulse through Movements of the Foot
- D. Adjustments in Circulation and Respiration to Posture and Exercise
- E. Rebreathed Carbon Dioxide as a Respiratory Stimulant

#### METABOLISM

- A. Methods for Determining Oxygen Consumption in Small Mammals
- B. Tissue Oxidation
- C. Body Weight Changes with Various Activities and Increased Environmental Temperatures

#### MUSCLE

- A. Hand Fatigue
- B. Glycerinated Muscle Fiber Preparation; Contraction with ATP

#### BODY TEMPERATURE

- A. The Measurement of Human Skin Temperature with a Thermistor
- B. Mapping of Sweat Glands

- C. Physiological Responses to Environmental Temperature
- D. Variations in Human Body Temperature. Brief Statistical Analysis

#### KIDNEY AND FLUID BALANCE

- A. Microscopic Observations of the Kidneys of Necturus
- B. Unilateral Nephrectomy in the Rat, and its Effect on the Remaining Kidney
- C. Osmotic Regulation by the Human Kidney
- D. Vitamin C Tolerance Test
- E. Chromatographic Demonstration of Riboflavin in the Urine

#### ENDOCRINES

- A. Insulin Shock in Fish
- B. Insulin-induced Convulsions in Mice
- C. Alloxan Diabetes
- D. Pregnancy Tests
- E. Ovarian Hormones
- F. Testicular Hormones
- G. Relationship of the Adrenal Glands to Stress
- H. The Thyroid and the Metabolic Rate

#### NERVOUS SYSTEM

- A. The Electrical Activity of Skeletal and Cardiac Muscle
- B. The Establishment of a Conditioned Response
- C. Excitation, see Laboratory Experiments in General Physiology, 1959

#### MISCELLANEOUS

- A. Living Sperm Cells
- B. Somatic Responses to Total Body X-Irradiation
- C. Glass Fiber Balance for Student Use
- D. Classic Experiments for Classes in Elementary Human Physiology
- E. Practical Aids

#### 6. Visiting Scientist Program

See the article by Dr. Mayerson in this issue for accomplishments to date. Dr. A. W. Martin is continuing the program in the northwest. There is some indication that the program may be enlarged to cover other areas of the United States.

#### 7. Course for Physicians

The Committee is working on plans for a course for physicians similar to the one conducted by Dr. Comroe in 1960. Announcement will be made later.

#### 8. Other Activities

The Committee is beginning work on several other projects such as evaluation of physiology teaching films; recommendations concerning graduate training in physiology; premedical course requirements; etc.

This is a very active Committee and it welcomes comments and suggestions from members. The Chairman of the Committee is Dr. John R. Brobeck, Dept. of Physiology, University of Pennsylvania School of Medicine.



#### PORTER FELLOWSHIP

Applications for the William T. Porter Fellowship are invited from predoctoral students in training and research in any branch of physiology.

The Fellowship will be awarded for a one or two-year period. Preferential consideration will be given to those applicants who are in the final period of their training.

The applicant may plan to continue his studies in his present location or in another laboratory. The applicant may plan to spend up to 40% of his time acquiring teaching experience. United States citizenship is not required.

The annual stipend is \$3600. The William T. Porter Fellow may accept only such additional compensation (tuition, fees, modest stipend) as agreed upon by his sponsor.

Applications must be made on or before January 10 of each year for the following academic year beginning July 1 or September 1. Announcement of the award will be made by April 1 of each year. Application forms may be obtained from the American Physiological Society, 9650 Wisconsin Avenue, Washington 14, D. C.

The Fellowship is made possible through the contributions of the Harvard Apparatus Company.

## VISITING SCIENTIST PROGRAM

H. S. MAYERSON

On June 12, 1959, the National Science Foundation approved an application of the Education Committee of the American Physiological Society to experiment with a program of visiting lecturers to colleges in Louisiana, Mississippi and Texas for a period of two years. The present report presents the results of this program.

The general objectives of the program as set forth in the application were:

1. a) To strengthen and stimulate the undergraduate biology program in colleges;
- b) To provide staff and students in these colleges an opportunity for additional contacts with productive and creative scientists;
- c) To aid in the motivation of able college students toward careers in science and the teaching of science; and
- d) To experiment with a new type of program involving intensive visiting within limited geographical areas.
2. The colleges and small universities to be visited will be distributed as widely as possible within the geographic areas described in the proposal.
3. Contributions to the program, in the form of subsistence for the visitor and a portion of the traveling expenses, will be sought from the institutions visited, but no institution will be denied visits if it cannot afford the contribution.
4. Visiting scientists will be chosen from among first-rate creative scientists.
5. Visiting lecturers will be reimbursed for traveling expenses and may receive an honorarium for on-campus visits.

With the receipt of notice of approval of the program, attempts were made to contact members of the faculties of the various colleges. Unfortunately, most of these individuals had already left on summer vacations and few contacts were made. The colleges were again contacted in September. Announcements were sent to 7 colleges in Louisiana (exclusive of New Orleans), 7 colleges in Mississippi and 4 colleges in Texas. A list of available speakers and their areas of interest was presented, the colleges were appraised of the objectives of the program and urged to participate. Approximately half of the colleges replied during the next month and expressed interest in the program. A third letter was sent to those colleges who failed to reply but, with one exception, we did not hear from them either at this time or later in January when another attempt was made to interest them.

Because of the experimental nature of the program, it seemed advisable to limit the roster of visiting scientists to members of the department of physiology of Tulane University for the first year. During the second year we added scientists from the department of physiology of Louisiana State University School of Medicine. Thus five scientists were involved during the first year (Drs. L. M. N. Bach, J. K. Hampton, Jr., S. J. LeBrie, D. F. Sears, and M. Mizell) and five additional scientists were added to the group for the second year (Drs. A. S. Harris, L. Churney, G. Davis, and R. A. Russell. I also participated during the second year.)

Since many of the colleges had already completed their plans for the first semester and because of delays in communication, the program got off to a slow start and only 4 visits were made during the first semester of the 1959-1960 academic year. During this period, however, schedules were completed for visits during the second semester during which period 9 colleges were visited at least once. Thus during the first year, a total of 16 visits were made to 11 colleges, 7 in Louisiana, 3 in Texas and 1 in Mississippi. In addition, 10 visits were made to the departments of biology of colleges located in New Orleans (Tulane, Newcomb, Loyola). During the second year (1960-1961) 20 visits were made to 11 colleges in Louisiana and Mississippi. No visits were made to Texas. Five of the colleges visited had not been visited the previous year. Five visits were made locally.

The pattern of operation varied with the particular school. Generally, the visiting scientist arrived on location by late morning and lunched with a small group of faculty and students. The early afternoon provided an opportunity for visiting laboratories and talking to students. The scientist then presented a seminar for graduate students, frequently dined with some of them and gave a formal lecture in the evening for all interested students and/or for the general public. In approximately half the instances, the lecturer remained through the following morning, attended and participated in laboratory sessions, etc. The exact material presented within each area was varied to suit the requirements of the activities at each college. A supply of the brochure "A Career in Physiology" was made available to each college for distribution during and after the visits.

The program for several of the colleges deserved particular comment. After the first visit to Mississippi Southern College in Hattiesburg, Dr. J. F. Walker, chairman of the department of biology, indicated an interest in organizing a seminar course for his small group of biology majors and asked whether we would be willing to send one scientist each month to implement his program. This developed into a very effective program and provided a continuing contact during the 2 years which was mutually advantageous. Several students evinced interest in taking graduate work and one has been accepted for graduate work next year. A second stimulating experience was that of Dr. Bach who visited Hardin-Simmons University in Abilene, Texas. Dr. Craik, head of the department of zoology, sent the following list of ways in which we could help them.

1. To be here for a Friday afternoon laboratory period and either a Thursday or a Saturday morning lecture period, preferably the second or third week in March.
2. Lecture to the physiology group on some phase of neurophysiology; impulse conduction, the physiology of the synapse, membrane potential, and electrical phenomena of nerves, etc.
3. Observe a lecture in physiology in the nursing group and make comments on subject matter, methods of presentation, etc.
4. Observe a laboratory session and make suggestions as to improvements of nerve-muscle preparations, recording techniques, use of muscle levers, and general laboratory procedure.
5. That he go over with Dr. Moore the subject matter of the human physiology course, suggesting changes that might be made to better suit it to meet its objectives.
6. To discuss physiology textbooks suitable for the course as well as reference works that we might add to the library.
7. To go over the sequence of laboratory exercises with the thought in mind of adding experiments which would give us a greater variety of physiology experiments.
8. To examine our laboratory equipment and make suggestions as to what we might get in the way of equipment to prepare us to do a greater variety of experiments.
9. To examine the laboratory curriculum in Biol. 113N-123N with the idea of perhaps proposing the introduction of some simple physiology experiments.
10. Perhaps to do a mammalian physiology demonstration for the human physiology group.
11. To give a lecture in his research field to either a faculty group, a student group, or a combined group.

Dr. Bach packed a car full of equipment and proceeded to Abilene. He listened to a lecture to nursing students and interviewed some of the students. He met with members of all scientific departments (including mathematics and psychology) during the first morning. After lunch he demonstrated bulbar reticular facilitation and inhibition in the cat to a class of medical technologists and biology majors. His report of the demonstration is as follows:

"After lunch, I prepared a cat for a demonstration of bulbar reticular facilitation and inhibition, utilizing the stereotaxic instrument. This demonstration went off beautifully. The class (medical technologists and biology majors) had a laboratory exercise scheduled for the afternoon in an adjoining laboratory but, with the encouragement of

Dr. Moore and the head of the department, clustered around while I explained the administration of nembotal and the onset of anesthesia. (They provided a cat and I brought along all of the necessary equipment.) I explained the theory of the stereotaxic instrument, showed the atlas of brain sections and explained some slides which we projected in the room. Each student was invited to examine the tone and nature of the patellar reflex before, during and after bulbar inhibition and hypothalamic facilitation. During the hypothalamic stimulation, each student observed such autonomic effects as pupilodilatation and cardioacceleration, both of which effects were fortunately pronounced. They also observed inspiratory and expiratory effects produced by bulbar stimulation. Their questions indicated that most of the students were intelligently impressed with the demonstration, understood the purpose of the experiment and were prepared to ask about it. Despite the fact that they were totally unfamiliar with the functional characteristics of the central nervous system, I managed to give them a quick and, in a few cases at least, effective run through of motor and sensory functions. I opened the chest of the cat at the end and each student felt the heart, observed the ventricles and atria, the changing color of blood in the pulmonary veins, the vena cava and in the aorta. Section of the phrenic overlying the heart eliminated further action of one side of the diaphragm during terminal gasping.

"I then participated in what was left of the formal laboratory work which consisted of study of the effect of temperature on the frog muscle. The equipment for this purpose appeared more than adequate. Dr. Moore, who had previously attended the Baylor 'physiograph' training program, had managed to scrounge a number of smoked paper kymographs from Baylor and the laboratory was also favored with a mixture of inductoria and AC operated Harvard stimulators. None of the students were getting responses from their muscles and nobody appeared to know why. I soon found that the muscle leads were being shorted by the solution in which the muscle was bathed and upon correcting this situation, things moved faster. I quizzed the students a bit as I moved from table to table and found that some of them, at least, realized that bathing the muscle in a large solution would wash out metabolites, that temperature effects were related to rates of chemical reactions, etc."

Dr. Bach's additional activities included a conference on content of the course in physiology for biology majors, a public evening lecture on sleep and wakefulness which was attended by students and faculty from the other two colleges, Abilene Christian College and McMurray College, and another lecture on the second morning on synaptic physiology.

A memorandum from Dr. Hampton regarding one of his visits is typical of the reactions of the scientists involved.

Memorandum

From: John K. Hampton, Jr.

To: Dr. H. S. Mayerson

Date: May 19, 1960

Subject: Visit to East Texas State College, Commerce, Texas, May

6, 1960.

This particular trip has been still more satisfactory to me than any of the previous similar trips. My hosts were most cordial and the publicity preceding my visit had been tasteful and adequate.

The program which was outlined for me was:

9:30 - 10:30 AM - Forum Arts Program "The Atomic Era - The Impact of the New Dimension in Living."

1:00 - 3:00 PM - Radiation Biology class. "The Effects of Low Level Radiation upon Erythropoiesis."

3:00 - 4:00 PM - ROTC "Operation Afta - A Realistic Mass Casualty Field Drill."

All three of these programs were well attended and well received by the students. Especially satisfactory was the Forum Arts Program held in their new auditorium with several hundred students and a large segment of the faculty present. The faculty personnel I met were universally active, enthusiastic people with splendid rapport with their students. This seems to be exactly the kind of student body from which we would expect well prepared graduate students and this warrants every effort to continue our contact with them.

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The terminal activity of our program for this year was participation in the nationwide "Science and Life Week Program" on invitation from the AIBS. Dr. Hampton spent May 9th and 10th at Pensacola Junior College in Florida where, in addition to meeting students and faculty, he lectured on radiation biology.

The cost of the program was less than had been anticipated, for several reasons. When the program was considered, it was anticipated that a committee would be set up composed of faculty members of the various colleges and that this committee would administer the program. Since formation of such a committee would have delayed the beginning of the program, it was decided to proceed without it. Also, the Louisiana Heart Association committee on undergraduate research met in New Orleans in October 1959. This committee is composed of representatives of 10 Louisiana colleges. The director appeared before this committee and discussed the program and the need of a committee to administer it. The members of the L. H. A. committee felt that it would be unnecessary to have another committee for our program and that it probably would operate better with central control. Actually, once the program got under way, there seemed to be no difficulty in organizing the program and in obtaining the cooperation of participating colleges. It may be pertinent to add that all colleges on our original list have had at least one visit during the two-year period. Another factor tending to reduce costs was the desire and ability of all schools to pay for meals and other expenses of the visiting scientist while he was on their campus. As previously indi-

cated this was not made a condition for a visit.

It is the unanimous opinion of all concerned with the program that it has more than fulfilled its objectives. Our scientists have enjoyed their excursions and have profited from them. It has given them fresh points of view as to what is going on in small colleges. They have been stimulated by their contacts with these college students and have been impressed by the facilities available in some institutions. Most important, they have come away from each visit with a feeling of accomplishment and satisfaction.

The real benefits to the host institution are difficult to evaluate. Typical responses showed that our hosts were appreciative and grateful for a variety of reasons. The fact that there was keen competition among the colleges for visits during the second year is forceful evidence that we were performing a useful function. A president of one of the host institutions expressed his gratitude to me with the terse comment: "Thanks for the shot in the arm." The benefits to students involved are intangible and impossible to estimate at the present time.

We are in agreement that the formal program should now be terminated as planned. We expect our contacts with the colleges involved in the program to continue. There will unquestionably be requests for visits from some of the colleges. These could probably be met with funds remaining in the program budget and with funds from other sources. The NSF, AEC and other agencies have now established many visiting scientist programs and the colleges are availing themselves of these lecturers. It should be emphasized, however, that our program differed from the usual lecturer program in our objectives and accomplishments. Ours was an intensive program with continuing contacts and giving lectures was incidental to giving service and advice to our host institutions. Our successful experience leads us to recommend that a similar program be continued in other parts of the country. The objectives outlined for the program are sound and can be achieved with benefit to all concerned. This activity should remain as a fundamental part of the activities of the Education Committee of the American Physiological Society.

# THE EXPANSION OF MEDICAL EDUCATION AND EVOLUTION OF PHYSIOLOGY IN AMERICA\*

C. I. REED

After the Revolution and the stabilization of constitutional government, there was a pubertic outburst of interest in medical education which, as already shown,\* carried the efforts of enthusiastic pioneers into remote New Hampshire and to frontier Kentucky. In all of these early schools, medical curricula were attached to existing, regularly constituted institutions of higher education. With the new century, some of the early enthusiasm degenerated into post-pubertic lethargy in that there began to be evident a further slump from the standards which Morgan had tried to establish. Much to the surprise and chagrin of early educators, the medical schools were regarded as finishing schools to which men who had already practiced for years could come for what is now regarded as post-graduate refreshing. Still further, many bonafide students did not see any necessity for taking the degree when they could be recognized as graduates and could practice medicine without restriction while saving the diploma fee.

In 1807, James Cocke and John B. Davidge, both of whom had been conducting private tutorial classes in physiology, joined forces in securing a state charter for a University of Maryland. Whatever their original motive, they did not promote anything but the medical school, so that it was the only portion of the university in operation for some years; thus for the first time, a medical curriculum took form independent of an academic curriculum. The founders' statement of the aims and functions of the new school was promising but illusory because the ideal was not attained for nearly a century. Many able men were associated with the school but the first physiologist of special character was Joseph Roby, professor of anatomy and physiology (1843-60), better known today as a comparative anatomist. Thereafter, until the tenure of John C. Hemmeter (1903-15), physiology was submerged under the "practical" program. While not officially a proprietary school, the operation must have borne some of the earmarks of that status.

Nathan Smith, a very able physician (Harvard, 1790) who had done graduate study in Europe was the entire faculty of Dartmouth Medical School for several years, also serving Yale, Bowdoin (Medical College of Maine), and the University of Vermont. He was the first of the "circuit riders", the peripatetic professors who traveled from school to school, the term depending on the time of the year when one could arrive at a particular location. His son, Nathan Ryno Smith, succeeded him at Vermont (1821-30) and effected the organization of a separate medical faculty. This was the first of three medical schools in this sparsely populated and geographically isolated state, and the only one to survive to the present.

Brown University operated a medical department briefly and another cross road school appeared at Fairfield, New York, and still another at Auburn; this last was apparently located there because of the ready availability of cadavers from the penitentiary. Vermont Medical College, or the Clinical School of Medicine, and the Castleton Medical Academy ran parallel courses and both were discontinued after 1861. The only important feature of the first was that John Call Dalton taught there (1851-56) and introduced the microscope to physiologists during that time. He was probably the first American to hold the title of professor of physiology and histology. Corydon La Ford was the last professor of physiology at Castleton but he later figured prominently in the progress of physiology in the University of Michigan. The mushroom growth of medical schools through the third decade of the century reveals a condition in which physiology could not thrive if it even survived. Groups of physicians, sometimes actuated by local pride, often by jealousy of some other community or clique, many of them able practitioners, but usually with no special knowledge of physiology and generally devoid of pedagogical or administrative experience, found it good business to start a medical school wherever an old barn, an abandoned schoolhouse or even a dwelling could be secured. Thus arose the proprietary school in its simplest form. New faculties sometimes split before they could start to function and another new faculty was formed. Physiology made little difference in the progress of these schools. Within the scope of information then existing, some of these faculties did a good job of teaching medical practice slightly above the first aid level and the students then learned by their own later experience, often at the cost of patients' future health. Many a neophyte had his first obstetrical indoctrination from the local midwife.

The serious feature of the situation was that no one was encouraged to undertake original research and those who did so paid the cost out of pocket. And there was the further discouraging fact that publication media were lacking, many men publishing new observations as letters to lay newspapers. Christian Reil began editing "Archiv für Physiologie" in 1795 but there was no comparable English medium except the "Transactions of the Royal Society" until 1812 when the ancestor of the "New England Journal of Medicine" was published and a decade later the "American Journal of Medical Sciences" made its appearance.

It has been claimed that the number of medical schools in the United States and Canada has exceeded 400. The author has been unable to confirm this figure. Two proprietary schools, previously unknown to him have been found since coming to the present residence, both located in High Point, North Carolina. Dr. Madison Lindsay operated one (1820-30) from which Dr. S. G. Coffin was graduated and in 1840 the latter set up another school only a short distance away; this, he operated until 1855 when Dr. J. L. Robbins bought him out and continued the school until 1861.

Many members of the medical profession were convinced that they should control all activities relating to education, licensure and practice. Consequently, when President Ezra Stiles of Yale, as early as 1777, proposed a medical curriculum in that college, the Connecticut

Medical Society opposed the plan vigorously until 1810 when Articles of Union were ratified by the legislature and the Medical Institution of Yale College began instruction two years later, with Jonathan Knight as professor of anatomy and physiology. It was not until Graham Lusk's regime, beginning in 1891, that any physiologist showed distinction or originality. Scientific progress was promoted more vigorously by Benjamin Silliman (1777-1864) than by anyone on the medical staff with the possible exception of Nathan Smith, although the latter never published any original work. Silliman had been made professor of chemistry and natural history, after which he attended medical lectures in Philadelphia, giving particular attention to those of Wistar. He also attended lectures in Edinburgh and could have qualified for a medical degree; he had no interest in practice, however. He was motivated entirely by interest in the scientific aspects of health care. In the new faculty of medicine he was named professor of chemistry, mineralogy, and geology (sic). The last two items indicate the degree of interest in mineral drugs.

Aside from Rush's own writings and those of his students, Caldwell, Young, Spencer, and Ewell, there were few publications of scientific merit. Ephraim McDowell did not report on the ovariectomy he first performed in 1809 until eight years later. Nathan Smith had, independently, accomplished the same result but withheld publication after learning of McDowell's report. Also in 1809, James H. Miller of Baltimore ligated the sympathetic trunks in both dogs and rabbits without evident impairment of function, although postoperative observation must have been limited. This was about six years before the report by Brachet who is ordinarily credited with priority for this procedure. Miller's work was not reported in any journal but in an obscure clinical textbook on nervous diseases wherein it was uncovered by Nathan S. Davis and described in a critical review of medical education published in mid-century.

William Charles Wells began practice in America some years after graduation from Leyden in 1780 but soon began to publish original work on binocular vision, muscle contraction and blood color. An essay on the formation of dew published in 1814 was cited by the Royal Society as one of the first scientific contributions to knowledge of physics by a medical graduate. Also, Darwin conceded priority to Wells for enunciation of the theory of natural selection. Perhaps his loyalist sympathies were responsible for the lack of recognition accorded him in America. A similar case is that of John Jeffries, a Harvard and Aberdeen graduate who became Surgeon General of the British forces in America during the Revolution. Exiled to England after the war, he returned in good standing in 1795. Meantime, in 1784, he undertook a balloon ascent to 6,560 feet, carrying all of the most important scientific equipment then available, including air sampling bottles. A year later, he crossed the Channel in a similar venture. His data were given to the Royal Society for study by a committee headed by Cavendish and were subsequently published.

John Maclean was graduated from Glasgow and came to America in 1795. Upon advice from Rush, he began practice in Princeton but soon

became professor of chemistry; for the next two decades he published extensively, his favorite theme being support of Lavoisier's views on metabolism. In 1823, Benjamin Horner Coates published a monograph on the absorbing power of veins and lymphatics, which really extended and confirmed Magendie's work in this same field. It appears, then, that the scientific spirit was augmenting appreciably in America.

A retrograde incident in medical education occurred in 1814 when, after several years of dissention, the medical department of Columbia College separated from the parent and was reorganized under charter as the College of Physicians and Surgeons of New York, rejoining the University in 1860. Able clinicians filled the chair of physiology but none was of note until the coming of John Call Dalton (1825-89), (M. D., Harvard, 1847) who was appointed professor of physiology and histology in 1855, serving until he became president of the university in 1884.

Further gemmation of medical education occurred about 1820 when Daniel Drake (1785-1852) (M. D., Pennsylvania, 1816), with two associates, undertook the organization of the Medical College of Ohio in Cincinnati. For reasons not now important, he was forced out after two years and, except for brief tenures at Transylvania and Louisville, he spent the next 30 years, first fighting for restoration, and when that failed, for the destruction of the College, provoking endless feuds and schisms, including the establishment of two additional schools, neither of which survived long. This is one of the most discouraging chapters in American medical education. Drake was an able, ingenious and progressive physician, with good comprehension of what demands the future would impose on the profession but he was unable to keep the peace long enough to accomplish lasting results. He never held a position as physiologist but was probably the most scientific of all of his local contemporaries in the application of physiological principles to the progress of health care. Of the officially appointed physiologists in the various schools in Cincinnati, few need be considered here although many attained to great accomplishment in other disciplines, such as S. D. Gross, Edward Rives, Jedediah Cobb, Frederick Forschheimer, and Joseph Eichberg.

At least three homeopathic schools existed in the city at different times, also an eclectic medical school and a physio-medical school. After generations of quarreling and separating and reorganizing, separating again and starting over, the remnants of nine different schools of sorts finally fused into the college of medicine of the University of Cincinnati in 1910, nearly sixty years after Drake's demise. The coming of Martin Fischer at that time opened a new era for physiology in the Ohio valley.

For a decade, the University of Maryland represented the most southerly extension of medical education but in 1819, Samuel Henry Dickson, who was graduated from Pennsylvania, set up the Medical College of South Carolina (1821) with himself as professor of physiology (The Institutes). Until the coming of John Van De Erve a century later, physiology played no very important part in this school; in fact, there were periods when no appointments were made.

The medical department of Brown University did not survive long (1811-30) but Usher Parsons conducted there a course in physiology that made such an impression as to induce continuation as an academic discipline down to the present, more recently under the guidance, successively, of M. X. Sullivan, Philip H. Mitchell and J. Walter Wilson. This was a significant innovation as it is probably the first introduction into academic classes of a high grade course in human physiology, aside from the cautious insertion of personal hygiene into the curricula of female seminaries which began about 1825.

Among the more respectable medical schools founded during this period, but later discontinued for a variety of reasons, were Fairfield Academy (1812-40); Auburn Medical School (1817-34); Castleton Academy, or Vermont Medical College (1818-61); Berkshire Medical Institute, affiliated loosely with Williams College (1823-69); Bowdoin (1820-1921); Washington Medical College of Baltimore (1827-61); College of Physicians of the Valley of Virginia, or, Winchester Medical College (1825-29; 1847-62); Geneva Medical School, New York (1834-72); New Orleans School of Medicine (1856-61); Pennsylvania College of Medicine in 1859; and La Porte University Medical Department (1844-48) which was renamed Indiana Medical College (1848-52) then disappeared by merger with Central Indiana Medical College, the forebear of the University of Indiana Medical School. Dr. William W. Mayo, the patriarch of the Mayo clan of Rochester, Minnesota was graduated from La Porte, Evansville Medical College (1845-52; 1871-84). The most notable of this group was Rush Medical College (1843-1941). In all of the schools discontinued there were able men who taught physiology briefly, often in conjunction with, and secondary to, clinical subjects. Often, too, a circuit rider appeared briefly in the faculty list, to appear elsewhere in some other capacity. Samuel David Gross became an internationally honored surgeon but his occasional digressions into physiology were quite undistinguished and without impression on the discipline itself; unquestionably, however, his influence enhanced the prestige of physiology among his clinical colleagues. It is clearly evident that he continued to think physiologically throughout his professional career. Reuben D. Mussey, Daniel Oliver, E. R. Peaslee, Daniel Brainard, and Nathan S. Davis all followed a similar course - teaching physiology briefly, then a clinical career of distinction. John Kearsley Mitchell, father of S. Weir Mitchell, did make contributions of original research on cardiac physiology which were unique for the day. Austin Flint, Sr., besides producing a distinguished physiologist in his son, Austin, Jr., also was distinguished as a clinical man. The son taught physiology in New Orleans School of Medicine, and Vermont Medical College, where he first came into contact with John Call Dalton.

Discussions of formal medical education appeared slowly. Rush had published a treatise appealing for better general education as preparation for the study of medicine. And at the opening of the Medical College of Ohio, Daniel Drake had urged that medical education be extended more rapidly in the western country in order to keep pace with local population needs. He also argued vigorously for more comprehensive general education. However, the first really penetrating study was published in 1828 by James Thacher (1754-1844), a preceptor

trained man of considerable ability and ingenuity. This was entitled "American Medical Biographies" but in addition to personal sketches, he included brief histories of all medical schools, plus a rather searching critique of the current status of scientific medicine which would have done credit to Flexner eighty years later. This was the first survey of its kind yet published.

The first physiological laboratory for student instruction was established in 1825 by Purkinje in Breslau but it was to be emulated in America only after another 60 years.

The establishment of a medical curriculum in the new University of Virginia (1825), one of Jefferson's special projects, brought Robley Dunglison (1795-1869) from England as professor of anatomy, physiology, surgery, materia medica, pharmacy, and history of medicine! His aversion to bloodshed caused him to request substitution of medicine for surgery in the titles. Also it prevented him from undertaking experiments on animals. He was the first physiologist imported for service in an American school and the first full-time professor on salary. After seven years he published his text on human physiology, the first all-American product. Three years as professor of therapeutics in Maryland were terminated by transfer in 1837 to Jefferson Medical College which had been organized out of a schism in the University of Pennsylvania medical faculty in 1825. There he remained until 1868.

His clinical writings were not based on personal experience for he practiced little after coming to America. But he possessed to an extraordinary degree the ability to write factually and clearly. S. D. Gross, his official biographer, stated that what Haller did for medicine in Europe, Dunglison did for American medicine; brought knowledge in condensed form to the ordinary physician everywhere. His textbook on human physiology went through eight editions, easily replacing the translation of Haller's Institutes and Caldwell's edition of Blumenbach's text, becoming the standard American authority for many years.

At the instance of Thomas Sewall, William Beaumont sent to Dunglison a sample of gastric juice in which the latter found hydrochloric acid in agreement with the report of Silliman.

Dunglison must be considered the foster father of American physiology, not because of scientific contributions but because he interpreted so lucidly. His students were to play an extraordinary part in the next phase of progress but space does not permit even listing them.

The career of Thomas Sewall (1787-1845) (M. D., Harvard, 1812) was intimately interwoven with that of Dunglison. He began to practice in Washington and early became aware of the chaotic state of health care in the District. He participated in the organization of the District Medical Society in 1817 and when the Baptist denomination established Columbian College in 1821, he and James Staughton began giving independent lectures a year later in anticipation of the formation of a medical faculty. This materialized in 1825, with Sewall as professor of anatomy and physiology until 1839 when he transferred to pathology.

He published "The Errors of Phrenology Exposed" and a monograph on "Pathology of Drunkenness." This was the first publication on the subject in any language and was based on his own original investigations. It was translated into German and widely circulated abroad. As in so many other schools, physiology slumped after his tenure until the appointment of Shepard Ivory Franz (1906-21).

The acme of physiological progress in this period was the work of William Beaumont (1785-1853). The main features of his career have been written about so much that it remains only to bring out a few items of secondary significance but of some personal interest. Beaumont never attended a medical school and never taught in one although he did, briefly, hold a paper appointment in a faculty that never functioned until later. He was, in a sense, a scientific opportunist but he did what most predecessors failed to do, recognize the opportunity and act on it even though illy prepared technically. A modern critic has lamented, "How much better it would have been had he been prepared scientifically to do the things he left undone." This is silly sophistry. How many productive scientists have been technically prepared in advance for their major activities? Unfortunately, his book, after a brief flurry of interest, was relegated to musty library shelves to be rescued fifty years later by Pavlov. Only then did he receive due recognition from his countrymen. His granddaughter, Sophia Beaumont, librarian in Green Bay, Wisconsin until 1935, told the author that at the dedication of the memorial at Mackinac in 1903, two irresponsible young girls standing near her fell to discussing the significance of the event. Queried one, "Just what did this Beaumont do to rate all this fuss?" To which her companion replied, "Why, honey, don't you know? He discovered indigestion!"

It was our original intent to extend the story of the period of expansion to the Civil War. Study of events as this account has unfolded during four months of preparation, however, suggests that that catastrophic event does not represent a natural break in scientific evolution of physiology. Slowly, there has emerged a realization that the decade 1830-40, represents the initiation of a mutation, not very effective at first but ultimately irresistible. Of course, it is foolish to expect to separate historical periods by days or years as most historical influences have relatively prolonged latency. Another installment will initiate the period of maturation.

## A FOUR-YEAR CURRICULUM IN PHYSIOLOGY

W. C. RANDALL, C. N. PEISS, V. V.  
GLAVIANO, AND A. A. ROVICK

Stritch School of Medicine  
Loyola University  
Chicago, Illinois

In this day of exclusively research-oriented graduate training programs, we are continually reminded that gifted students must not "waste" time in teaching. Choice fellowships stipulate that no more than 10% of the students' time may be spent in teaching (which, when calculated on a calendar year, is quite a realistic figure) and it is frequently implied that more attractive postdoctoral appointments await the full-time researcher. Much effort is currently directed toward reorganization of the MD program but the principle evidence of concern for graduate physiology appears as the plaintive cry that few candidates apply.

During the past several months well over 100 physiologists have visited our laboratories and almost without exception have commented favorably about our graduate training program. Many requests have been made for a description of a "typical" graduate curriculum, with special emphasis upon our graduate colloquy and our course in Methods and Techniques. These requests, together with the superb plea expressed by President Pitts (1) for a return to training for a "rounded academic career," prompted us to submit this description for the consideration of our colleagues.

A brief examination of Table 1 affords a quick resume of a "typical" program. It will also serve to show the progress of a college graduate, through four calendar years of work to his emergence as a mature, well-rounded and proficient physiologist. We hope it will dispel the idea that graduate training inevitably consists of a "pair of hands" performing a senior investigator's experiments with a Ph. D. as the ultimate reward.

TABLE 1

	Fall Quarter	Winter Quarter	Spring Quarter	Summer Quarter
Year 1	1. Methods & Techniques 2. Introduction to Research 3. Special Problems	1. Medical Physiology 2. Medical Biochemistry 3. Introduction to Research	1. Medical Physiology 2. Medical Biochemistry 3. Neuroanatomy 4. Introduction to Research	1. Experimental Physiology 2. Research
Year 2	1. Physiology of heart and Circulation 2. Graduate Colloquy 3. Research	1. Autonomic NS 2. Pharmacol. or Chemistry 3. Graduate Colloquy 4. Research Assist in Lab.	1. Autonomic NS 2. Pharmacol. or Chemistry 3. Research Assist in Lab.	1. Graduate Colloquy 2. Research
Year 3	1. Physiology of Temp. Reg. 2. Graduate Colloquy 3. Research	1. Central NS Physiol. 2. Graduate Colloquy 3. Research Assist in Lab., Conf.	1. Central NS Pharmacol. 2. Graduate Colloquy Assist in Lab., Conf.	1. Graduate Colloquy 2. Research
Year 4	1. Graduate Colloquy 2. Research	1. Graduate Colloquy 2. Teaching Physiology 3. Research	1. Graduate Colloquy 2. Teaching Physiology 3. Research	

## I. Instruction in Methodology

During the first quarter, each new graduate student is required to register for two courses: Methods and Techniques, and Introduction to Research. In the event of deficiencies in background, he may find it necessary to take additional work in mathematics, chemistry, or anatomy, or he may be assigned a "special problem" which will give him added experience in electrical circuitry, or mechanical design and construction. These courses are planned to give the student experience in conception and design of research instrumentation as well as to give the staff insight into the student's mechanical and conceptual sense. In the Methods and Techniques course, the student is given three pieces of bar stock each about 1" x 1" x 5" of aluminum, brass and plastic. From these he must construct a micrometer which is accurate to 0.003 inch. During the preparation of this instrument, he learns the important operations of the lathe, milling machine, drill press, band saw, grinder, and the use of conventional shop measuring instruments. He also is required to prepare a lettered, scale drawing of his project, together with a photographic negative, a print suitable for publication, and a positive slide suitable for presentation at a national meeting. The student is introduced to the essentials of electrical metering instruments, elementary tube and transistor circuits, and is given a project involving the assembly or construction of a simple electronic amplifier.

The new student is also "introduced to research" by joining the research program of one of the full-time faculty. He assists in the preparation, performance, and postoperative procedures of the experiments, in this way gaining intimate knowledge of the kind of research the staff member is doing as well as his specific application of the scientific method. The following quarter he moves to the research program of another faculty member and works closely in his investigations. In this way, the student becomes acquainted with the actual performance of research, and decides which program is most interesting to him. The staff member of his choice later becomes his advisor.

## II. Didactic Courses

During the winter quarter and spring quarter of the first year, the student encounters a rigorous intellectual requirement when he registers in the regular medical courses in physiology, biochemistry and neuroanatomy. In these courses he is in direct competition with the medical students, and he must perform in the upper 10-12% of the class in physiology and must earn a strong B grade in biochemistry and neuroanatomy. If he fails to perform at this level, he is not permitted to continue his graduate studies in physiology.

During the first year, the student is expected to attend all graduate colloquies, journal clubs and staff functions although he does not receive academic credit. He does, however, become acquainted with techniques of preparation and presentation of scientific topics, current literature reviews, and analysis of experiments. After he has fulfill-

ed these prerequisites for advanced study he registers and participates in all of the departmental colloquies and graduate courses throughout the remainder of his training.

Each staff member offers a graduate course based on his own special interest about once in four quarters. These courses are supplemented by a series of four in neuroanatomy and neuropharmacology. Journal clubs regularly consist of student and staff discussions of individual research progress together with pertinent papers from the current and classical physiological literature.

### III. The Graduate Colloquy

This is the "heart" of the didactic graduate program. Since it is thought to be somewhat unique, a brief description will be given. Its objectives are varied and it is actively attended by all staff members as well as students. It serves the following functions:

1. To inform in depth, the entire department of recent developments in areas not encountered in the regular research interests of the department.
2. To give the student experience and guidance in evaluation of original publications.
3. To give the student experience and training in presentation of papers before a critical audience.
4. To give the entire staff a close view of the professional potential and progressive development of all the graduate students in the department.

Each member of the professional staff makes a written evaluation of each student's presentation, including his insight, analysis, and background and he offers constructive criticisms on mannerisms, delivery, and poise. These criticisms are then relayed to the student by the faculty member in charge of the colloquy. This responsibility rotates each quarter to another member of the staff. The entire quarter is spent in examination of a single major area. Each student has a minimum of six weeks in which to prepare his paper which consists of a 45-minute, illustrated presentation. This is followed by 45 minutes of critical discussion by the entire group. The last two to four sessions in the series are generally presented by nationally recognized authorities on the topic. Many such scientists are available in the Chicago area, but funds are budgeted to bring authorities from other sections of the country when necessary. When this scientist speaks, the staff and students are familiar with his work, and profit doubly from meeting a foremost worker in the field and from personal discussion of his contributions. Discussion at these sessions is lively and informed. Without exception, visitors have commented favorably upon this type of seminar. The following topics will serve to illustrate the areas which have been considered within the past few quarters: insulin, liver, microstructure of skeletal muscle, structure and function

of the kidney nephron, pituitary-adrenal axis, neuro-humoral control of the endocrine systems, the pressure pulse, regulation of respiration. A list of titles considered in the regulation of respiration will serve to illustrate the coverage:

- 2 sessions - Neuroanatomic basis of central control of respiration
- 1 session - The cellular basis for inherent rhythmicity of cells in the respiratory center
- 2 sessions - Molecular CO<sub>2</sub> vs pH as the chemical stimulant to respiration
- 2 sessions - Actions of drugs on respiration
- 1 session - Chemical control of respiration, Dr. J. Perkins, University of Chicago
- 1 session - Pulmonary ventilation, Dr. John Gray, Northwestern University

During a typical four-year period of study, the student thus encounters from ten to twelve areas of physiology quite different from those presented in conventional graduate courses. Since the total number of students is small (8-12), each student participates actively in every session and rapidly develops a critical and analytical viewpoint in evaluating research procedures, instrumentation, data, and conclusions. He also rapidly gains professional poise which stands him in excellent stead when he first appears before a national meeting. It is not mere coincidence, of course, that he is continuously being groomed for this appearance.

#### IV. Student Teaching

Each student is assigned teaching responsibilities in the medical student laboratory during his second year. He is expected to audit the didactic lecture again, also, and invariably reports the "second time around" is of inestimable value in solidifying knowledge of basic physiology. During the third year, the student is given increasing responsibility in organization of laboratories and conferences, and usually is assigned one or two lectures which are recorded for his subsequent listening and study. In the fourth year, the student is assigned a specific group of lectures, all of which are attended by a senior staff member who carefully advises him in lecture objectives and techniques.

#### V. Research

The Ph. D. is emphasized as a research degree, and independent research is established as an objective which cannot be attained until adequate preparation has been acquired. Hence, the student is "introduced to research" his first year, and works closely with his advisor through most of his second year. He generally progresses to an independent status and a doctoral dissertation during his third year. In his fourth year, he spends the vast majority of his time and effort on his dissertation, but concurrently collaborates with his advisor, other staff members, or student colleagues in working out ancillary problems which broaden his research experience.

Thus, throughout the four years of graduate training, there is carefully planned emphasis and direction. The first year is spent in learning fundamental didactic physiology and in intimately guided introduction to research. During the second year, there is repetition of fundamentals, advanced didactic course work, and an initial personal research experience. The third year is spent primarily in research with a broadening seminar experience and the fourth year is spent almost entirely in independent research and in acquiring classroom teaching experience. In this program, teaching and research are essentially inseparable. There is, in reality, little gap between a careful examination of the frontiers of physiologic knowledge as it is described in the research literature and as it is observed in the active professor's laboratory.

Only time and product performance will adequately test the validity of this graduate program of training. We can, however, cite the following in support of our enthusiasm. During the past five years, six Ph. D. degrees have been awarded by the department, and all of these young men are currently in academic physiology departments where they are considered exceptionally successful and promising. At the time of graduation, they have published an average of two abstracts and two full-length publications in our Society journals, or journals of comparable stature.

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1. Pitts, R. F. Past-President's Address. *Physiologist* 3: 20-29, 1960.

Editor's Note: The following are extracts from a letter from Dr. Randall to the Editor.

" I am well aware of the fact, of course, that many good schools have been training Ph. D. physiologists for a lot longer than we have. But I also suspect that many schools are granting Ph. D. degrees without putting in the necessary effort, and some are turning our poorly-trained graduates. Nearly all complain about the caliber of applicants they receive, and few have accepted personal responsibility for contacting undergraduate departments. In our experience, most undergraduates are completely uninformed of physiology as a career, and some inform us that their teachers have told them to 'apply first to medical school and if you can't get in there, you can always go to graduate school.' I am also aware of the fact that many important universities are experimenting with 'new and progressive teaching programs' at the graduate level, but I strongly suspect that devoted teachers can still do the job well by the old formula of personal interest in the student and sincere and honest effort to train him. You will recognize the fact that I do not buy the argument that one trains a researcher best by simply letting him do research.

I have the feeling that some may react strongly to our reemphasis of the didactic, technical, and research elements in a graduate program. Even so, I believe a serious exchange of views might be useful. It might cause more departments to look twice at their own programs and once again make physiology sufficiently exciting to attract

the exceptional youngster. The fact that the best material is now going into nucleonics, physics and space engineering should stimulate physiology rather than stifle it. We should be getting more and better applicants for career training rather than less.

"The better student is going into physics because it is currently presented to him more dynamically and with greater appeal. We must, therefore, look to our laurels and make our programs equally exciting and attractive. We can not do it with graduate teachers who are unwilling to teach with effort and enthusiasm. We can not do it with the concept that a Ph. D. degree can be awarded to a narrowly trained individual who spends two or three years learning a single highly specialized technique.

"I believe we all need to be jolted out of a complacent self-satisfaction or an overwhelming preoccupation with our limited research interests long enough to ask ourselves why we are not attracting our share of good students. I believe, with you, that part of the answer lies in the fact that we are not giving the enthusiastic and challenging presentation of a John Murlin, or an Ajax Carlson."



#### SPRING MEETING SCHEDULE

Because of the hotel's Easter season commitments the time for the 1962 Spring meeting at Atlantic City had to be changed from the regular Monday through Friday schedule. The meeting is scheduled to run from Saturday, April 14 through Thursday, April 19. Those special groups that normally arrange for evening dinner meetings should bear the change in days in mind when arranging schedules through the Federation Convention Office.

APS Business meetings will be held on Sunday (April 15) and Tuesday (April 17) afternoons. In all probability the APS Headquarters hotel will be the Ambassador.

# THE AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES

WALLACE O. FENN

APS Representative on Governing Board

The AIBS continues to expand its activities in the interests of biology and of biological societies and is rapidly increasing its influence and effectiveness in the scientific life of the nation. It provides a convenient office in Washington where much can be done for biology, partly on request from member societies and partly on the individual initiative of the officers, the Director, or the Governing Board. The Governing Board now holds two meetings per year at which reports of activities and problems of general policy are widely discussed. Under the presidency of Dr. James Dickson, many new activities were initiated, much of this being due to the president who spent a great deal of time attending conferences of AIBS committees and traveling widely in the interests of AIBS. Now AIBS has elected Dr. Tracy Sonneborn as president, a most distinguished biologist, who is undertaking his new duties with much enthusiasm. Dr. George Beadle has consented to serve as honorary advisor to the Governing Board. New staff appointments of special significance are:

Dr. John R. Olive as deputy director so that the scope of activities covered can be greatly expanded.

Mr. F. W. Harwood in charge of publications.

Mr. Harold F. Osborne, a science writer in charge of the Biology News Bureau.

Dr. Arnold B. Grobman in charge of the Biological Sciences Curriculum Study.

Dr. Charles W. Shilling in charge of the Biological Sciences Communications Project.

Dr. Frank Fremont Smith, formerly with the Macy Foundation was appointed director of the Interdisciplinary Conference Program.

Dr. Fred A. Hitchcock formerly professor of physiology, Ohio State University, in charge of the Visiting Lecturer Program.

All of these men are now working full time for AIBS.

Publications. The AIBS Bulletin and the Quarterly Review of Biology are both strictly AIBS publications. The Bulletin goes to all members of full-member societies. The last number contained an editorial and quotations from biologists on the Cooper bill. An AIBS news letter

"In Brief, in Biology" is also published and distributed widely, including affiliate societies. In addition, eight volumes of symposia have been published and three other special volumes including the style manual for biological journals, 5,000 copies of which have already been sold. Translations in full of seven Russian journals are being published regularly and nine Russian monographs have been translated and published. Further expansion of this program is planned. Arrangements have also been made for the translation of some Chinese journals but difficulty is experienced at present in obtaining copies for translation. Redactory services are also being provided for six biological journals.

Biology News Bureau. AIBS now has an experienced news writer, Mr. Harold F. Osborne, working full time in this Bureau. He attends meetings of biological societies to assist in publicity arrangements and provides press releases. A series of 20 Voice of America Forum lectures on the biological sciences is now being publicized, for example, with weekly press releases and broadcast on a domestic radio station. These projects, making no mention of AIBS, are intended to bring important and interesting developments in biology to public attention, regardless of their origin. Press releases on other subjects are regularly being prepared and sent to science writers for newspapers throughout the country.

A Biological Science Exhibit was prepared for the Indian Science Congress, University of Roorkee, India. This was attended by Dr. Ralph W. Gerard as the AIBS representative. It was shown also at two other points in India, in Pakistan and at points in southeast Asia and Hong-Kong. The Bureau cosponsored with the Council for the Advancement of Science Writing a very successful conference on science writing held at Princeton in March 1961. This bureau serves all member societies and meets an important need which biologists have felt keenly for a long time.

Meetings, Conferences and Committees. AIBS continues to hold one general meeting each year. The 1960 meeting was at Stillwater, Oklahoma where 20 biological societies gathered with 2,168 paid registrants. The 1961 meeting was at Purdue University. Other meetings organized during the year included the First International Congress on Research in Burma in September 1960, the Conference on Anti-Microbial Agents in October 1960 and the Conference on the Role of the Physical Sciences in the Biological Sciences in December 1960. Dr. Frank Fremont-Smith is setting up a new series of meetings called the Interdisciplinary Conference Series. The first of these was held in April 1961 on marine microbiology. Later conferences will be on energy system relationships and brain and behaviour.

AIBS operates three advisory committees for the AEC and one for ONR.

Biological Sciences Curriculum Study. The project is run by a committee under the chairmanship of Dr. Bentley Glass. The project director is Dr. Arnold Grobman with headquarters at the University

of Colorado, Boulder, Colorado. This is the counterpart for biology of the Physics Study operated by Educational Services, Inc., the Chemistry Study by the University of California, and the Mathematics Study. A writing conference held in Boulder during the summer of 1960 and attended by 100 biologists was extraordinarily successful. Three separate text books for high school biology courses were written from three different points of view. Each one includes a text for students, a text for the teacher, and a laboratory manual. The resulting 32 publications occupy all together 15 inches of shelf space and are designed to serve as source books for planning new biology courses. The courses are being tried out this year in 105 schools throughout the country and should do much to improve the teaching of biology to elementary pupils.

Film Series. This series of teaching films in biology is now nearing completion with the support of the Ford Foundation and the Atomic Energy Commission. There will be some 120 films in all which constitute a complete elementary course in biology if desired. There are eight coordinating teachers for the ten units, and seventy eminent biologists appear as guest lecturers. The films can be used by the biology teacher in any way desired. They are designed to supplement, not to replace the teacher. They may be obtained from the McGraw-Hill Book Company, Inc. together with the appropriate texts, teachers guides, etc.

Biological Sciences Communication Project. In October 1961, Dr. Charles W. Shilling was appointed director of the Communication project located in the AIBS headquarters building, Washington, D. C., and supported by a grant from the National Science Foundation. The project will study all phases of the communication problems as they relate to the biological sciences and scientists, with particular reference to the tremendously expanding literature in biology, the staggering abstracting and indexing job which this entails, and all the other problems of storage and retrieval of this information. Plans are under way to establish a center which will endeavor to list the serials of the world published in the field of biological sciences, together with the pertinent bibliographical information concerning each serial. The second phase of this effort will be the development of an acquisition policy to insure that all of these titles are made available for use somewhere in this country. Other studies under consideration include an evaluation of the present Slavic and Oriental language translation programs; a study to determine the manner in which information is obtained by biologists and the manner in which they prefer to utilize this material; organization of a seminar with representatives in the fields of research, writing, publishing, documentation and information handling, etc. to isolate those problems which are of paramount interest and concern as they relate to the communication problem of the biologist.

Other Activities. Mention here may be made of the Placement Service of AIBS which is growing in usefulness, the Foreign Visiting Biologists Program which brought over twelve foreign biologists and arranged itineraries for them, the Science and Life Week Program which arranged Science Week Programs for six small colleges with four or five speakers being sent to each place for the week. The biology section of the Register of Technical and Scientific Personnel is also maintained by AIBS. These files contain an enormous amount of statistical data from which

such information as salaries and employment can be gleaned. In this way it is hoped that AIBS can keep track of important trends of significance to biologists.

Visiting Lecturer Program. The AIBS has maintained a program of this sort which is not unlike that maintained by the APS. The AIBS list of speakers has not included many physiologists in the past. I have consulted with Dr. Cox about possible collaborators in this matter, and he writes as follows: "I have talked frequently during the past five years with people in the Federation and the American Physiological Society about how we could cooperate in running the visiting lecturers program which we administer. I would be only too happy to see more physiologists participate and I am sure that Fred Hitchcock, who has come with us temporarily as administrator of our education programs, would also be happy with such an arrangement."

Conclusion. AIBS, in the opinion of your representative has not yet reached its full potentiality for service to biology. It needs the continued support of those who are already members and it needs also the membership of a few more important and influential societies. The over-all budget of AIBS including all its contracts is large, amounting to something like a half-million dollars per year, but its uncommitted budget from member dues is small and severely limiting. It is for this reason that the dues are required of members and are of special significance to the success of AIBS.



#### BIOPHYSICAL SOCIETY

The annual meeting will be held February 14-16 at the Sheraton-Park Hotel, Washington, D. C. Abstracts for individual papers are due December 1, 1961. The program will include three symposia - The Excited State and Photobiology; Biological Replication; and Statics and Dynamics in Biological Systems.

For further information write - Dr. Dean Cowie, Carnegie Institution of Washington, 5241 Broad Branch Road, NW, Washington 15, D. C.

## THE AAAS DENVER MEETING, 1961

Physiologists and other biologists interested in space science are reminded that this subject will be extensively covered in several symposia currently scheduled among the sessions of the AAAS meeting, December 26-31, 1961, in Denver, Colorado. Particular attention of biologists is drawn to a symposium on Extraterrestrial Biochemistry and Biology sponsored by Section C - Chemistry with cosponsors - and a session on Physiological Factors in Manned Lunar Flight appearing as part of a one-day program on Manned Lunar Flight, cosponsored by the American Physiological Society and the American Astronautical Society. The schedule for the session on physiological factors will feature papers in two important phases of this area in addition to a prepared panel discussion: "Space Physiologists": their role, availability and training". This panel will endeavor to point up the need for implementation of biological space problems with biologists adequately trained in both the general and specific aspects of this specialized area. The program proposed for the session is as follows:

### Schedule

Date: December 29, 1961

2:00 PM

Coordinator for American Physiological Society, Robert E. Smith

Session: Physiological Factors in Manned Lunar Flight

Chairman: Prof. Loren D. Carlson, Ph.D., Dept. of Physiol.,  
Medical School., University of Kentucky

Neurophysiological Aspects of Space Flight (25 min.)

Dr. W. D. Winters, M.D., Ph.D., Space Biology  
Laboratory, UCLA Medical Center

Hemodynamic Evaluation at Null Gravity (25 min.)

Prof. Nello Pace, Ph.D., Environmental Physiology  
Lab., Dept. of Physiol., University of California, Berkeley

Space Physiologists: Their Role, Availability and Training

Panel: Dr. Loren D. Carlson, Moderator (40 min.)  
Mr. William Purdy, Director, Engineering Div.,  
The Martin Company, Denver, Colorado

Dr. J. H. U. Brown, Ph.D., Executive Secretary,  
Physiology Training Committee, National Institutes  
of Health

Dr. Robert E. Smith, Ph.D., Dept. of Physiol.,  
UCLA Medical Center

**General Panel Discussion**

# CLAUDE BERNARD AND THE CELL

JOSEPH SCHILLER

The work of Claude Bernard is a permanent source of information for the historian interested in the development of physiological thought and one of meditation for the physiologist who proceeds along new paths in research. His discoveries are classical and need no retelling; his methodology is consciously or unconsciously applied in modern experimentation. There are still aspects of his work which are practically unknown except to the few and it is the purpose of this article to show Claude Bernard's scientific attitude and its relationship to the development of modern cell physiology.

Bernard's philosophical mind, objective to the point of rejecting all philosophical systems because of their rigidity, enabled him to rise to generalizations and conceive concepts which, in turn, became new tools for further investigation. The most revolutionary of his concepts was that of "the constancy of the internal environment" which, after one century, still provides the foundations for physiological investigation. In this respect Claude Bernard is misunderstood insofar as his famous dictum is incompletely quoted: "The fixity of the internal environment is the condition for a free independent life" merely enunciates that fragment of his thought which emphasizes the prerequisite of constancy. In fact, he continues: "the mechanism which allows it is the one which assures in the internal environment the maintenance of all conditions necessary to the life of the elements"(1). Thus completed the famous Bernardian dictum encloses three constituents: conditions that maintain life; the internal environment; and the elements.

"Conditions for life maintenance" need no elaboration, they are water, solutes, oxygen, and nutrient.

The "internal environment" needs clarification. It is true that Bernard stated, "modern experimental medicine is the science of the internal environment" (2) but he did not imply that it deserved the exclusive interest of the physiologist. In his way of thinking it was a necessary step towards the exploration in depth of the organism: "this environment although deeply seated is still external to the elementary organized particle which is the only part really alive"(3). Topographically the relation of "the internal environment" to the "organized particle" is not without analogy to that of the digestive tube to the rest of the body. Its role is to provide food and shelter to "the elements" which live in this surrounding as in "a hot house" (4).

This brings to the forefront the third constituent of his dictum "the elements," by which he means the morphologic structures of varied complexity: organs, tissues and cells. It is tacitly assumed that as a physiologist Bernard's interest was confined to organ function. This is unwarranted and one is struck by the frequent recurrence of the words "tissues" and "cells" through the over 20 volumes that constitute his published work. Sentences like "it is imperative to exper-

iment on the elements" (5) resound time and again.

There were a number of factors that prompted Claude Bernard to evaluate the role of morphology in physiological investigation. Some are obvious, like anatomy being a prerequisite for the localization of phenomena by vivisection. Bernard tells the story of the conflicting results obtained by Magendie and by Brodie in the study of the respective effects of bile and pancreatic secretion on fat digestion (6). The discrepancy resulted from the species of animal used in the experiment: one investigator used the cat, in which the pancreatic and bile ducts, being closely associated, were ligated together, whereas the other investigator used the dog, in which the two ducts are easily dissociated. A correct appraisal of comparative anatomy in physiological investigation would have avoided the controversy but this need was not yet clearly established. As illustrative as this anecdote is, it is less significant than the historical perspective of the scientific climate in Bernard's formative years.

Historically, physiology developed in the shadow of anatomy and remained subordinate to it. Its full emancipation from anatomy did not occur until the middle of the 19th century when it became an experimental science. Harvey's experiments, although conceived physiologically, were performed by anatomical means on the living animal. It was still natural science although enunciated in the new language derived from Galilean mechanics. It was the kind of physiology that Haller was to label "anatomia animata"; based on observation and reasoned by deduction. This trend still prevailed in the 19th century. For example, an authority like Geoffroy Saint-Hilaire demanded that physiology remain subservient to anatomy. Cuvier not only made deductions of function from structure, as did Darwin according to Bernard, but went further and denied the possibility of obtaining valid information from a study of the living body. It is obvious that such irrational thinking left the door open to vitalistic explanations of which Bichat was the most influential exponent. Bichat differed from other vitalists in that he endowed each of the numerous tissues that he had described with its own particular vital properties (unstable) without entirely rejecting physical properties (stable). According to Bichat, vital properties escape the control of natural law; nevertheless he drew attention to the possibility of explaining organ and tissue function in their own intrinsic properties. The latter thesis Bernard accepted as materialistic, but rejected all metaphysical considerations. This was Bernard's morphological heritage and it was to constitute "the tripod" of experimental science; the other two supports were Lavoisier's method of applying procedures used in inorganic material to the study of organic material and Magendie's establishment of facts from vivisection. As a result, Bernard reversed the situation and assigned to physiology primacy over morphology because: 1) it is a more complex science, 2) there are parts in the body that cannot be dissected, such as the fluids of the internal environment, 3) techniques other than anatomical have to be resorted to for the investigation of living phenomena, 4) anatomy alone does not explain the function of organs; adrenals, spleen or pancreas being specific examples. To the old "anatomia animata"

he opposed the new "functional anatomy". Bernard's codification of physiology as a self-reliant science was not done without hurt.

Such was the impact of morphology on the thinking of 19th century scientists that some of the most celebrated physiologists, Johannes Müller and Tiedemann among others, had abandoned physiology for description anatomy. Bernard was impressed with this change in scientific activity and questioned himself concerning the legitimacy of physiology as an independent science. (This was not without influencing Claude Bernard's attitude towards statistics at a time when experimental physiology was at its formative stage.) He gained the certainty that he was following the right path, and instead of falling into the opposite extreme and denying all significance to morphology, arrived at the conclusion that function and structure are inseparable. "Without the morphological component no thinking is physiological, no complete explanation of functional properties is possible." Consideration for morphology is justified because "anatomy is to physiology what crystallography is to chemistry"(8).

While accepting morphology as an integrant part of physiology, Bernard gives chemistry precedence over it because its results can be quantified. However, an exact quantitative result is not the whole process and Bernard stresses the specificity of the morphological framework within which chemical reactions proceed in the body. The chemist can synthesize in the laboratory the same compounds that the living body produces. What separates the two is the nature of the instruments used towards the same end - the ways of the natural tools cannot be reproduced in the laboratory, they are specific to the organism. "The tools are the organs and the histological elements" (9) and the know-how of the morphological tools is the very object of physiological investigation - "histology is the basis of all physiological explanations." This most subtle observation is fundamental for the understanding of Claude Bernard's scientific attitude. (Had it been noticed and rightly evaluated, many of the discussions around Bernard's "vitalism" would have proven irrelevant.) It shows the dependence of physiology upon morphology and chemistry while justifying physiology as an independent object of study. On the practical side it reflected on the organization of Bernard's laboratory inasmuch as he needed two assistants, a chemist and an histologist.

Organs alone will not explain the working of the body; they are complex structures made of different tissues, each of them with its own properties. Bernard carefully distinguished between functions which are the manifestations of organs, and properties which are the manifestations of tissues. The function of an organ is the sum total of the different tissues that compose it. It is the resultant not the antecedent of phenomena - "the phenomena manifested by living organisms are merely the effects of tissue properties which are their causes"(11).

The necessary interdependence between chemistry and morphology goes deeper. "Even where a single tissue is involved, functional differences between structurally similar parts may be manifested,

showing that their identity is more apparent than real. An auricle and its ventricle are structurally identical but beat at different rates and die at different times under the effect of the same noxious agent. Physiology provides the analytical tools that evidence such diversity. For example, all nerves have the same morphology; however, under this uniformity are hidden elements which differ functionally, such as sensitive and motor. Curare dissociates one function from another and there are other poisons which also act as specific analytical tools" (12). It is significant from a methodological point of view that Bernard extensively investigated toxic substances (he is one of the precursors of modern pharmacology) not for their own sake, but as physiological tools like the microscope but more sensitive. Functional differences are explainable by "differences in the molecular arrangement"(7) because it would be unscientific to think that the same causes produce different effects. The analytical method led Claude Bernard to the conclusion that tissues, although less complex than organs, are still too complicated to represent those "elements" which are "irreducible to simpler forms". Those elements he finds in the "cell-theory" which was making headway in his time(10).

A number of other factors concurred to direct Bernard's interest towards the cell. There are properties which are common to all living organisms whether plant or animal, high or low on the evolutionary scale, and which cannot be assigned to any organ or tissue in particular. Such universality presupposes the existence of an identical underlying structure. For example, irritability is a widespread property and it can be formulated that "all that is alive is irritable"(13). Secretion is another example of striking universality among the living. Most impressed was Bernard with nutrition because it is common to all "histological elements" and proceeds continuously. It is the means whereby morphological elements create organic matter by selecting from the external environment the materials to be converted into characteristic structures. This "synthese assimilatrice" (today's anabolism) has a definite morphological connotation. Its counterpart is "combustion" (today's catabolism) its connotation being chemical. One conditions the other and it is on this account that morphology and chemistry are inseparable (14).

Bernard's own experimental work justified an inquiry into the physiological significance of the cell: the generality of the effect of anesthetics; that of oxygen lack; glycogenesis which he studied in the hepatic cell, placenta, amnion, fetal muscles, intestinal epithelium, insect larvae, embryos of plants and animals.

Causal determinism of which he was the promoter in biology must necessarily have its roots in the most elementary structures. Those structures are also the last refuge of the metaphysical interpretations of life and must be expelled because "determinism cannot exist except in the elementary properties" (15). Consequently "the endeavor of the physician is to reach determinism by aiming at the element thus limiting the problem to one property instead of a complexity of properties." This approach is possible because the cells, although sub-ordinated

to the whole, are autonomous and can be investigated as independent units. The idea, derived from the study of infusoria, that the body is an aggregate of independent cells was not uncommon in his time.

General properties have a common origin and Bernard found it in the original cell, that is, the developing ovum. All other cells derive from it and subsequent differences are the result of a process of specialization entailing the promotion of one property over the others. Accordingly he attached great importance to embryology and the study of the developing organism is the province of the physiologist because he can act experimentally on this primordial cell. It is experimental embryology in the germ and an historical study of Claude Bernard's idea on this problem would reveal many modern concepts. The cell is mentioned in Bernard's early writings (1857) but its modern significance did not become clear to him until around 1870. The evolution of his ideas on the subject reflects a curious admixture of the prevailing ideas of his time and of his own concept of the structure of organic matter. In the middle of the 19th century the cells were conceived as one of the fundamental tissues participating in the fabric of body organs, together with the muscular and nervous tissues and without any relation of filiation among them. Long after the "cell theory" received its formulation from Schwann (1839) confusion still persisted concerning the origin of cells and the significance of their constituents. Bernard hesitated between Vinchow's "omnis cellula e cellula" and Schwann's "cytoblastem", from which cells originate by crystallization, the latter view exerting a greater attraction for him than the former. The "cytoblastem" was functionally the equivalent of the protoplasm of Von Mohl (1853) who also considered it as the generator of new cells. Bernard gave to protoplasm a physiological meaning derived from his representation of the relationship between chemical processes and the genesis of structures. (The modern definition of protoplasm was not formulated before the classical work of Max Schultze in 1861 and its diffusion among scientists took some time.) The protoplasm is definable by its physico-chemical properties, before it acquires any structure (16). It is "living matter," it is not yet "a living body" because it lacks form. Chemical processes precede morphology; there is a "morphological synthesis" which parallels "chemical synthesis" and is secondary to it (17). There is an initial independence between matter and its mold and this distinction is important because the latter will manifest the properties inherent to the former. At a time when nothing was known about the laws of heredity, Bernard considered that protoplasm persisted unchanged through the successive generations while form did change. Many of his preoccupations echo modern discussions on the origin of life and it is difficult to escape the feeling that it was his strong attachment to determinism that prevented him from speculating on a problem which he considered as pertaining to the metaphysical "primary cause" and which consequently escaped experimental proof.

The nucleus is treated with great clarity; it is the center of the vital phenomena, nutrition, and morphogenesis. Nutrition is the elemental property; it proceeds continuously, and reproduction is nothing more than its continuation resulting in the creation of morphological structures

patterned in accordance with the evolutionary potentialities of the cell. The morphogenetic properties of the nucleus are revealed by the phenomena of degeneration and regeneration common to numerous animal species and to this unique cell, the developing ovum. The ovum is at the crossroad of chemical synthesis, morphogenesis, heredity and evolution.

Considering the primacy of the cell, what was the place that Bernard assigned to organs and organ systems in the economy of the body? The answer unfolds the process of organ development like a kaleidoscope: "organs and systems have no existence in themselves; they exist for the cells, for the innumerable elements which make the organic fabric. While the developing scaffolding becomes progressively complicated, vessels, nerves, respiratory organs appear, so as to create around each element the necessary environmental conditions and provide them, within needs, with the indispensable materials, water, nourishment, air, and warmth" (18). He continues: "thus, the law of organism, structure, and that of organic betterment, merge with the laws of cell life. It is in order to regulate cell life with greater accuracy that organs add to organs, and apparatus to systems. Their task is to assemble the qualitative and quantitative conditions necessary for cell life."

If the basic properties of living matter are exhibited in their relative simplicity by the cell as opposed to the complexity of functions displayed by multicellular organisms, why did Bernard not experiment on the infusoria to which he often alludes? Truly, the technical facilities for experimenting on one-cell organisms were not adequate in his time but this is not the reason put forward by him. His argument, still based on experimental grounds, is amazingly valid: for the study of functional mechanisms, vertebrates, if not mammals, are simpler than lower animals because "in higher animals each function has emerged from the pool of undifferentiated functions characteristic of lower groups and can be studied in isolation" (19).

Knowing the "elements" is not an end in itself; "the effect of the part will be felt by the whole organism" (20). After analysis, a work of synthesis is necessary; synthesis is not a method but merely the control of analysis which remains the only method applicable in physiology. By selectively developing one property more than others, cells become adapted to new performances. New adaptations imply new requirements in the physico-chemical conditions of the environment. The arising needs which vary with each new type of cell are satisfied by the internal environment which varies from one area of the body to another, constituting as many fields of action for the physiologist. At the same time the internal environment assures the solidarity of the various elements and their subordination to the whole. The physiologist has the command of the internal environment and through its medium he can act on the cells, induce changes, discover laws and even create new species (21). "One must go to the elements and experiment on them" (5) because "the cells are the physiological implements which manifest the properties", and "life is nothing more than a mechanism resulting from their arrangement" (22). The idea that the cell represents the mergence of morphology and chemistry, with its offspring physiology,

is far from being simple philosophical speculation. It is present in most of Bernard's books and notes, some as much as 20 years apart, be it concerned with method or with experimental demonstration. It is a working program resulting from the analysis of physiological phenomena progressing from complex to simple, and from particular to general. "In brief, life resides in every cell, in every organic element which functions for its own sake. It is not centralized in any organ or system of organs. All systems exist in view of cell life" (23).

The physiologist who investigates cell functions is as much the spiritual heir of Claude Bernard as the one whose original object of study is the internal environment. In fact, the latter has prepared the support on which the former builds the scientific edifice, the plans of which were established by the genius of Claude Bernard.

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# LABORATORY EXPERIMENTS IN ELEMENTARY HUMAN PHYSIOLOGY

Detailed directions for selected and tested laboratory experiments in elementary human physiology are available in mimeographed form from the American Physiological Society, 9650 Wisconsin Avenue, Washington 14, D. C. for \$1.50 per set.

Following are the titles with brief descriptions.

## General Principles

- A. Fluid Exchanges in the Frog under Varying Osmotic Conditions.  
The student is introduced to experimental design, to quantitative measurements and physical principles of diffusion and osmosis.
- B. Effect of Varying Osmotic Pressure upon Integrity and Contractility of Muscle.  
A demonstration of the effects of hyper- and hypotonic solutions on frog muscle.

## Circulation and Respiration

- A. Some Reactions of the Microcirculation.  
Observation of blood flow in frog's tongue and other organs and some reactions of human skin vessels.
- B. Ballistocardiograph.  
Simple, inexpensive method to illustrate thrusts and recoil of body due to heart beat.
- C. Recording the Pulse through Movements of the Foot.  
Simple procedure for recording popliteal artery pulse.
- D. Adjustments in Circulation and Respiration to Posture and Exercise.  
Blood pressures, pulse rates and respiratory rates are recorded with postural change and exercise.
- E. Rebreathed Carbon Dioxide as a Respiratory Stimulant.  
Simple apparatus is used to prove the stimulating effect of carbon dioxide.

## Metabolism

- A. Methods for Determining Oxygen Consumption in Small Mammals.  
General directions for measuring energy metabolism.
- B. Tissue Oxidation  
Oxidation in muscle using methylene blue as hydrogen acceptor.
- C. Body Weight Changes with Various Activities and Increased Environmental Temperatures.  
Accurate weighings illustrate variations in energy expenditure.

## Muscle

- A. Hand Fatigue  
Simple ergograph combined with a pneumograph graphically represent muscle fatigue and effects on respiration.
- B. Glycerinated Muscle Fiber Preparation; Contraction with ATP.  
Simple preparation demonstrates trigger action of ATP.

### Body Temperature

- A. Measurement of Human Skin Temperatures with a Thermistor.  
Temperatures determined on different body areas and under different conditions of activity.
- B. Mapping of Sweat Glands.  
Iodine-starch method is used to study distribution.
- C. Physiological Responses to Environmental Temperature.  
Directions for constructing simple heat cabinet for raising body temperature and for obtaining physiological measurements.
- D. Variations in Human Body Temperature. Brief Statistical Analysis.  
Outline for studies of temperature variations and statistical treatment of data.

### Kidney and Fluid Balance

- A. Microscopic Observations of the Kidneys of Necturus.  
Observation of living glomeruli in Necturus. Circulation in the gills can be made on same animal.
- B. Unilateral Nephrectomy in the Rat and its Effect on Remaining Kidney.  
Directions for surgical removal of kidney. Postoperative observations on NaCl and H<sub>2</sub>O balance. Principle of compensation illustrated.
- C. Osmotic Regulation by the Human Kidney.  
Water and chloride regulation.
- D. Vitamin C Tolerance Test.  
Titration technique to illustrate excretion of excess ascorbic acid.
- E. Chromatographic Demonstration of Riboflavin in Urine.  
Illustrates fluorescent urine and introduces paper chromatography.

### Endocrines

- A. Insulin Shock in Fish.  
Shock induced by immersion in insulin solution; recovery by immersion in glucose solution.
- B. Insulin-induced Convulsions in Mice.  
Cure of insulin convulsions by glucose or adrenalin.
- C. Alloxan Diabetes.  
Produced in rats and corrected by insulin.
- D. Pregnancy Tests.  
Directions for Ascheim-Zondek Test; Frog Test; and Ovarian Hyperemia Test.
- E. Ovarian Hormones.  
Ovariectomy and ovarian grafting in the rat illustrates effects of ovarian hormones on genital development.
- F. Testicular Hormones.  
Effects of castration and hormone replacement with testosterone in the rat.
- G. Relationship of Adrenal Glands to Stress.  
Illustrates poor response of adrenalectomized rats to stress, e.g. excess KCl.
- H. Thyroid and Metabolic Rate.  
Metabolic effects of thyroidectomy in the rat corrected by chemical means.

Nervous System

- A. Electrical Activity of Skeletal and Cardiac Muscle.  
Conversion of electrical activity to sound. Identification of electrical discharges during willed and involuntary activity.
- B. Establishment of Conditioned Response.  
Conditioned pupillary response by use of light and sound.

Miscellaneous

- A. Living Sperm Cells.  
Observation of living sperm cells from the rat.
- B. Somatic Responses to Total Body X-Irradiation.  
Rats x-rayed (by local hospital) observed for body changes in blood cells.
- C. Glass Fiber Balance for Student Use.  
Detailed directions for making inexpensive balance for weighing small organs, chemicals, etc.
- D. Classic Experiments in Elementary Human Physiology.  
References are given.
- E. Practical Aids.  
Lists of useful laboratory aids, etc.



## RADIATION CONGRESS

The Second International Congress of Radiation Research will be held in Harrogate, England, August 6-11, 1962. The Congress will be concerned with research into the physical, chemical and biological effects of ionizing radiation. The Radiation Research Society, in cooperation with the National Academy of Sciences-National Research Council, is exploring possibilities for providing partial travel support to qualified participants. Applications must be submitted prior to February 1, 1962. Forms for this purpose are available from the Committee on Travel Grants, Room 319, 2101 Constitution Avenue, NW., Washington 25, D. C. Further information about the Congress may be obtained from the Secretary-General, Dr. Alma Howard, Mount Vernon Hospital, Northwood, Middlesex, England.

## ADDITIONAL RUSSIAN TRANSLATIONS

List prepared by  
WILLIAMINA HIMWICH

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