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ACTIONS TAKEN AT SPRING MEETING
April 9 - 14, 1965

ELECTIONS - Robert E. Forster was elected to the position of President-Elect. Robert W. Berliner was elected to a four-year term on Council. Harry D. Patton was elected to fill the two-year unexpired term of Kenneth S. Cole who resigned from Council. All candidates nominated by Council were elected to membership (See Newly Elected Members - this issue). All elections are effective July 1, 1965.

PORTER FELLOWSHIP - Mr. M. Crick of the Neurophysiology Laboratory of the Department of Pharmacology at Harvard Medical School was appointed Porter Fellow.

ASSESSMENT OF MEMBERS - At the Business Meeting the Society voted to assess members \$10 per year for the next three years to build up a fund to help support the 1968 International Physiological Congress in Washington, D. C. The \$10 assessment will be in addition to the \$15 regular dues. The Congress Fund will also accept gifts and donations over and above the \$10 assessment. This fund will be used as general support of the Congress and its expenditure will be under the jurisdiction of the U.S. National Committee for IUPS of which APS is the major member.

SPRING MEETING STATISTICS

	1964	1965
Total attendance	16,704	19,104
Total number of sessions	289	298
Intersociety sessions	42	53
Movies	11	8
Simultaneous sessions	31	35
Total number of papers	2,876	3,279

APS Abstracts

Total received and accepted	736	806
Transferred to other societies and intersociety sessions	221	134
Received from other societies (including intersociety on endocrines)	82	103
Number of sessions programmed by APS (including intersociety on endocrines)	75	83
APS simultaneous sessions	7	7

MEMBERSHIP STATUS

April 1, 1965

Active members	2408
Retired members	135
Honorary members	17
Associate members	180

SUSTAINING ASSOCIATES

Abbott Laboratories, Inc.	The Norwich Pharmacal Co.
Ayerst Laboratories	Phipps & Bird, Inc.
Beckman Instruments, Inc.	Riker Laboratories, Inc.
Burroughs Wellcome & Co.	A. H. Robins Co.
CIBA Pharmaceutical Products, Inc.	Sherman Laboratories
Gilford Instrument Laboratories	Smith Kline & French Laboratories
Gilson Medical Electronics	Squibb Institute for Medical Research
Grass Instrument Co.	The Upjohn Co.
Harvard Apparatus Co.	Warner-Lambert Research Institute
Hoffman-LaRoche, Inc.	Wyeth Laboratories
Lakeside Laboratories	
Eli Lilly & Co.	
Merck Sharp & Dohme Research Laboratories	

DEATHS SINCE FALL MEETING 1964

Shannon C. Allen	Arthur A. Hellbaum
C. R. Brassfield	R. G. Hoskins
Attilio Canzanelli	Harry B. Martin
John D. Evans	Ferdinando A. Morin
Alexander Forbes	Warren O. Nelson
John D. Green	Peter F. Salisbury
William F. Hamilton	Torald H. Sollman

50-YEAR MEMBERS

Samuel Amberg	Harold L. Higgins
Aaron Arkin	Paul E. Howe
George A. Baitzell	Dennis E. Jackson
Walter R. Bloor	Israel S. Kleiner
Harold C. Bradley	Benjamin Kramer
Thorne M. Carpenter	Edward B. Krumbhaar
Percy M. Dawson	Henry Laurens
Joseph Erlanger	Edward Lodholz
George Fahr	David Marine
Mabel P. Fitzgerald	E. K. Marshall, Jr.
Thomas S. Githens	Jesse F. McClendon
Charles M. Gruber	Hugh A. McGuigan
Addison Gulick	Franklin C. McLean
Charles C. Guthrie	Frederick R. Miller
Philip B. Hawk	Victor H. K. Moorhouse

Sergius Morgulis
 Eugene L. Opie
 Alfred N. Richards
 George B. Roth
 Andrew H. Ryan

Ernest L. Scott
 Charles D. Snyder
 Shiro, Tashiro
 George H. Whipple
 D. Wright Wilson

NEWLY ELECTED MEMBERS

The following, nominated by the Council, were elected to membership in the Society at the Spring meeting, 1965.

FULL MEMBERS

ALBERTS, W. Watson: Res. Assoc., Mt. Zion Hosp., San Francisco.
 ANDERSON, Gordon F.: Res. Instr., Wayne State Univ.
 ANTHONY, Adam: Prof. Zool., Pennsylvania State Univ.
 BACHMANN, Fedor W. L.: Asst. Prof. Med., Washington Univ.
 BARNES, Charles D.: Asst. Prof. Anat. & Physiol., Indiana Univ.
 BASSINGTHWAIGHTE, James B.: Career Develop. Awardee, NIH, Mayo Fndn.
 BIERMAN, Edwin L.: Assoc. Prof. Med., Univ. Washington.
 BISHOP, Beverly P.: Asst. Prof. Physiol., State Univ. N. Y. at Buffalo.
 BLACK, Donald L.: Assoc. Prof., Univ. Massachusetts.
 BLOMQUIST, Allen J.: Instr., Dept. Surg., Univ. Wisconsin.
 BOGNER, Phyllis H.: Asst. Prof. Pharmacol., Univ. Pittsburgh.
 BOUDREAU, James C.: Div. Psychol., Army Med. Res. Lab., Ft. Knox.
 BRADFORD, Reagan H.: Asst. Head, Cardiovasc. Sect., Oklahoma Med. Res. Inst.
 BRUSILOW, Saul W.: Assoc. Prof. Pediat., Johns Hopkins Univ.
 BRYAN, Charles A.: Head, Inst. Aviation Med., Toronto.
 CHIODI, Hugo P.: Asst. Prof. Physiol., Columbia Univ.
 COHN, George L.: Asst. Prof. Med., Yale Univ.
 COSMOS, Ethel: Asst. Member, Inst. for Muscle Disease, Inc.
 CUDKOWICZ, Leon: Assoc. Prof. Physiol. & Med., Dalhousie Univ.
 DEYKIN, Daniel: Assoc. Med., Harvard Med. Sch.
 DIAMOND, Jared M.: Jr. Fellow, Harvard Univ.
 DORMAN, Homer L.: Prof. Physiol., Baylor Univ. Coll. Dent.
 DZIUK, Harold E.: Asst. Prof. Physiol. & Pharmacol., Univ. Minnesota.
 ECKERT, Roger O.: Asst. Prof. Zool., Syracuse Univ.
 EISENMAN, Joseph S.: Assoc. in Physiol., Univ. Pennsylvania.
 EVANS, John R.: Assoc., Dept. Med., Univ. Toronto.
 FEIGL, Eric O.: Asst. Prof. Physiol., Univ. Pennsylvania
 FISCH, Charles: Prof. Med., Indiana Univ. Med. Ctr.
 FORTE, John G.: Assoc. Physiol., Univ. Pennsylvania.
 FOULKES, Ernest C.: Assoc. Prof. Physiol., Univ. Cincinnati.
 FRANKLIN, Dean L.: Res. Assoc., Scripps Clinic & Res. Fndn.
 GOETSCH, Dennis D.: Prof. Physiol. & Pharmacol., Oklahoma State Univ.
 GOTTLIEB, Sheldon F.: Asst. Prof. Physiol., Jefferson Med. Coll.
 GROSS, Ruth T.: Prof. Pediat., Albert Einstein Coll. Med.
 GROSSMAN, Sebastian P.: Assoc. Prof. Physiol., Psychol., Univ. Chicago.
 GUDBJARNASON, Sigmundur: Asst. Prof. Med., Wayne State Univ.

- HAHN, Jaok: Investigator, Masonic Med. Res. Lab.
 HAYWARD, James N.: Asst. Prof. Anat., UCLA.
 HENRIQUES, Basil L.: Assoc. Prof. Dent. Sci., Tufts Univ.
 HILF, Russell: Head, Cancer Endocrinol. Sect., Squibb Inst. Med. Res.
 HOLLENBERG, Charles H.: Asst. Prof., McGill Univ.
 HORN, Leif: Assoc. Prof. Physiol., New York Med. Coll.
 HORNBEIN, Thomas F.: Asst. Prof. Anesthesiol., Univ. Washington.
 IRVING, James T.: Prof. Physiol., Harvard Sch. Dent.
 JENDEN, Donald J.: Prof. Pharmacol., UCLA.
 JOBSIS, Frans F.: Asst. Prof. Biophys., Univ. Pennsylvania.
 JOHNSON, Alan J.: Assoc. Prof. Exptl. Med., New York Univ.
 JOHNSON, Harold D.: Assoc. Prof., Univ. Missouri.
 KAHLER, Richard L.: Sr. Investigator, Natl. Heart Inst., NIH.
 KENSHALO, Daniel R.: Prof. Psychol., Florida State Univ.
 LANGER, Glenn A.: Asst. Prof. Med., Columbia Univ.
 LAW, Orley: Assoc. Prof. Psychol., Claremont Grad. Sch. & Univ. Ctr.
 LENFANT, Claude J.M.: Asst. Dir. Inst. Resp. Physiol., Firland
 Sanitarium, Seattle.
 LEVITAN, Ruven: Asst. Prof. Med., Tufts Univ.
 LOTT, James R.: Prof. Biol., North Texas State Univ.
 LOWY, Karl: Prof. Ctr. for Brain Res., Univ. Rochester.
 MACKLEM, Peter T.: Res. Fell., Royal Victoria Hosp., Montreal.
 MAROTTA, Sabath F.: Asst. Prof. Physiol., Univ. Illinois Med. Ctr.
 MARTIN, Constance R.: Asst. Prof. Physiol., Hunter Coll.
 MASSOPUST, Leo C.: Dir. Lab. Neurophysiol., Cleveland Psych. Inst.
 MENDEZ, Carlos D.: Sr. Invest., Masonic Med. Res. Lab.
 MONROE, R. Grier: Assoc. Pediat., Harvard Univ.
 MORGAN, Howard E.: Assoc. Prof. Physiol., Vanderbilt Univ.
 NEIL, William A.: Asst. Prof. Med., Univ. Oregon.
 OLSEN, Charles R.: Res. Fellow, Univ. California, San Francisco.
 ORLOFF, Marshall J.: Prof. Surg., Harbor Gen. Hosp.
 OYAMA, Jiro: Chief, Res. Scientist, Ames Res. Ctr.
 PALDINO, Rita L.: Res. Assoc. Physiol., Univ. Southern California.
 PATTERSON, John W.: Prof. Physiol., Univ. Connecticut.
 PLUM, Fred: Prof. Neurol., Cornell Univ.
 RHODES, John M.: Asst. Res. Anatomist, UCLA Med. Ctr.
 SAWYER, Philip N.: Assoc. Prof. Surg., State Univ. N.Y., Down-
 state Med. Ctr.
 SCANU, Angelo M.: Asst. Prof. Med., Univ. Chicago.
 SCHAPIRO, Shawn: Chief, Neuroendocrinol. Lab., VA Hosp., San
 Fernando, Calif.
 SHIMIZU, C. Susan N.: Asst. Prof. Pediat., Childrens Hosp of Los
 Angeles.
 SIDEL, Victor W.: Instr., Biophys., Harvard Med. Sch.
 SIREK, Otakar V.: Assoc. Prof. Physiol., Univ. Toronto.
 SOBOL, Bruce J.: Dir., Cardiopulmonary Lab., Albert Einstein Coll.
 SOMLYO, Andrew: Res. Assoc., Res. Inst. of Presbyterian Hosp.,
 Philadelphia.
 STEINKE, Jurgun: Res. Assoc., Elliott P. Joslin Res. Lab.
 STEWART, Patrick B.: Asst. Prof. Med., McGill Univ.
 STUART, Douglas G.: Asst. Prof. Physiol., UCLA.
 TEMPLETON, James R.: Asst. Prof. Zool., Montana State Univ.
 THEYE, Richard A.: Staff, Sect. Anesthesiol., Mayo Clinic.

- TUCKER, Don: Res. Assoc., Florida State Univ.
VAN CITTERS, Robert L.: Asst. Prof. Physiol. & Biophys., Univ. Washington.
VILLAREAL, Herman: Head, Dept. Nephrol., Inst. Natl. Cardiol., Mexico.
WANG, Yen: Dir., Nuclear Med., Univ. Pittsburgh.
WHITE, Fred N.: Asst. Prof. Physiol., UCLA.
WILLIS, John S.: Asst. Prof. Physiol. & Biophys., Univ. Illinois.
WILLMAN, Vallee L.: Prof. Surg., St. Louis Univ.
WINEGRAD, Saul: Asst. Prof. Physiol., Univ. Pennsylvania.
WINGET, Charles M.: Res. Scientist, NASA, Ames Res. Ctr.
WURTMAN, Richard J.: Endocrine Unit, Mass. Gen. Hosp.
ZADUNAISKY, Jose A.: Assoc. Prof., Dir. Res., Univ. Louisville.
ZIMNY, Marilyn L.: Prof. Anat., Louisiana State Univ.

ASSOCIATE MEMBERS

- BISHOP, Vernon S.: Asst. Prof. Nucl. Engr., Texas A & M Univ.
COOKE, Julian P.: Res. Physiol., Sch. Aerospace Med.
HAMILTON, Mary A.: Assoc. Prof. Zool., Colorado Coll.
HOLBURN, Ruth R.: Asst. Mem. Cardeza Fndn., Jefferson Med. Coll.
LUTHERER, Lorenz O.: Res. Physiologist, U.S. Army Res. Inst.
MURPHY, Richard A.: Grad. Student, Physiol., Columbia Univ.
SNEIDER, Thomas W.: NSF Grad. Predoct. Fell., Marquette Univ.
STEFFEK, Anthony J.: Instr. Physiol., Marquette Univ.
STRAUSSER, Helen R.: Asst. Prof. Physiol., Rutgers Univ.
YOCHIM, Jerome M.: Asst. Prof. Physiol., Univ. Kansas.

1964 FISCAL REPORTS
SOCIETY OPERATING FUND

INCOME

Regular Membership Dues	\$34,400
Associate Membership Dues	878
Sustaining Associates	6,750
Interest on Savings Accounts	2,269
Reimbursement from Federation Spring Meeting	12,687
Reimbursement from Grants, etc. (overhead)	1,650
Fall Meeting, net	2,354
Course for Physicians, net	1,507
Allotment from Investment Interest	2,610
Sale of Laboratory Experiments, net	314
Physiology for Physicians Subscriptions	14,359
Miscellaneous Income	398
Total Income	\$80,176

EXPENSES

Salaries and Benefits	\$30,645
Legal and Consulting Fees and Personal Services	896
Travel	2,182
Addressing, Mailing and Shipping	4,611
Telephone	338
Printing	7,783
Supplies and Equipment	2,704
Duplicating	1,031
Rent	1,128
Depreciation of Furniture and Equipment	436
Repairs and Maintenance	117
Honoraria for Authors (Physiol. for Physicians)	999
Dues to Federation	13,953
Dues to AIBS	750
Dues to National Society for Medical Research	250
Insurance	205
Bowditch Lecture	500
Miscellaneous Expenses	127
Business Office Service Charge	5,447
Total Expenses	\$74,102
Excess of Income over Expenses	\$ 6,074
Amount in Savings as of Dec. 31, 1964	\$50,000

PUBLICATION OPERATING FUND

INCOME

Subscriptions	\$278,149
Sale of Reprints, net	56,894
Other Publication Sales	37,508

Advertising, net	18,543
Page and Article Charges	77,120
Royalty Income	111,281
Interest on Savings	900
Other Income	886
Total Income	<u>\$581,281</u>

EXPENSES

Salaries and Benefits	53,539
Section Editors Expenses	23,100
Redactional Expense	36,785
Professional and Other Personal Services	2,641
Printing and Engraving	232,093
Cost of Books Sold	103,071
Supplies and Duplication	4,043
Communications and Shipping	36,707
Travel	3,968
Promotional Expenses	7,374
Repairs and Maintenance	187
Depreciation of Furniture and Equipment	1,178
Rent	7,578
Miscellaneous Expenses	3,066
Business Office Service Charge	34,987
	<u>\$550,317</u>
Less Allocations to Publication Inventories	\$ 21,976
Total Expenses	<u>\$528,341</u>
Excess of Income over Expenses	\$ 52,940

PUBLICATION CONTINGENCY AND RESERVE FUND

Balance Dec. 31, 1963	\$605,472
Gain on Sale of Securities	88,707
Dividends and Interest Paid to APS	24,962
Balance Dec. 31, 1964	\$671,568

FUTURE MEETINGS

- 1965 - Fall Meeting, UCLA, August 24-28
Dr. Robert E. Smith, Local Committee
- 1965 - IUPS - Tokyo, Japan, September 1-9
Group flights leave Los Angeles August 29.
Dr. Genichi Kato, Chairman Organizing Comm., Dept. of
Physiology, Keio Univ. School of Medicine, Shinjuku-ku,
Tokyo, Japan.
- 1966 - Spring Meeting - Atlantic City, N.J., April 11-16.
- 1966 - Fall Meeting - Baylor Univ., Houston, Tex., August 29-
September 2.
- 1967 - Spring Meeting - Chicago, Ill., April 16-21.
- 1967 - Fall Meeting - Howard Univ., Washington, D. C., August 23-27.
This meeting immediately precedes the Pharmacology Society
meeting at Howard.
- 1968 - Spring Meeting - New York City, April 7-12.
- 1968 - Fall Meeting - cancelled because of IUPS meeting.
- 1968 - IUPS - Washington, D. C., August 25-30.

DUES NOTICES

Members will be receiving dues notices for the year July 1965 to July 1966. Dues are payable in advance. Along with the dues notices will be the assessment notices for the 1968 Congress. If at all possible, please submit separate checks. This will facilitate banking procedures. Checks for dues and assessment are to be sent to the APS Central Office. It is to be remembered that billings for APS journals subscriptions are separate from dues and run from January to January. Billings for subscriptions are sent out by the Federation Business Office.

FALL MEETING AT UCLA
University of California, Los Angeles
August 23 - 27, 1965
Robert E. Smith

Physiologists from the southern part of California are rallying around the Department of Physiology at UCLA in order to develop a program and agenda for the Fall meeting. It is their intent to present the special areas of strength in western physiology as well as to represent physiological information in currently salient areas.

The Local Committee, working in close cooperation with the University of California Medical Extension, is attempting to develop an integrated program beginning on Tuesday, August 24, with the Refresher Course organized by Dr. John E. Nellor and dealing particularly with the use of avian and large domestic animals in physiology. Available on Friday afternoon, will be site visits to the Brain Research Institute, the Space Biology Laboratory, Cardiovascular Unit and the Pre-Clinical Sciences areas within the Medical School.

Among the regular sessions will be a special session, being organized by Dr. Bruce Dill, consisting of papers on Desert Physiology. The period of Friday morning will feature special symposia, of which particular mention should be made of the John D. Green Memorial Symposium, under the chairmanship of Dr. Charles Sawyer, on the subject of rhinencephalic systems.

The Bowditch Lecture of 1965 will be delivered by Dr. Ernst Knobil, Richard Beatty Mellon Professor and Chairman of Physiology, University of Pittsburgh Medical School. His presentation, entitled "The Pituitary Growth Hormone: an Adventure in Physiology" will mark the first Bowditch Lecture to be devoted to an area of endocrinology.

Social activities will include trips to Disneyland, to Marineland of the Pacific and to the Universal Studios. Ladies are especially invited to join various garden tours currently being scheduled to afford inspection of some of the many unusual features of landscape design and subtropical horticulture indigenous to the Los Angeles area.

University housing and board for registrants, including families with children aged 14 or older, will be available at the dormitories on campus. For those bringing children under 14 years of age, nearby motel accommodations will be made available on request. Day Camp activities for children will be provided if there is sufficient interest. Public beaches are a short drive or bus-ride from the campus.

Group flights to the XXIII International Congress of Physiological Sciences at Tokyo, will depart from Los Angeles, August 29, 1965.

Preliminary announcements of the Fall meeting will be mailed to the membership early in May, 1965. The Local Committee most cordially invites your attendance and participation.

APS REFRESHER COURSE

Avian and Large Domestic Animals in Physiological Research
Fall Meeting, UCLA, August 24, 1965

Introduction - Nellor

Electrical Anesthesia in Experimental Anesthesia
Cattle and Sheep - Short
Discussion

Temperature Regulation in Neurophysiology
Goats - Gale
Discussion
Coffee Break

Behavioral Experiments in Behavioral Physiology
with Pigeons and Goats - Wenzel
Discussion

Adrenal-Pituitary Axis and Aging in Endocrinology
Ruminants - Riegler
Discussion
Lunch and Demonstrations

High Altitude Studies in Pulmonary Physiology
Cattle and Sheep - Grover
Discussion

Arterial Receptors of Cardiovascular Physiology
Aves - Ringer
Discussion
Coffee Break

Vascular Changes in Cardiovascular Physiology
Experimental Hypertension in Swine - St. Clair
Discussion

Dynamics of the Fetal Lamb Circulation in Cardiovascular Physiology
Before and After Birth - Assali
Discussion

Participants

Assali, Nicholas S., M.D., Dept. of Obstetrics and Gynecology, School of Medicine, Univ. of California, Los Angeles.

Gale, Charles C., Ph.D., Primate Laboratory, Univ. of Washington, Seattle.

Grover, Robert F., M.D., Ph.D., Cardiovascular Pulmonary Laboratory, Dept. of Medicine, Colorado School of Medicine, Denver.

Nellor, John E., Ph.D., Endocrine Research Unit, Dept. of Physiology, Michigan State University, East Lansing.

Riegler, Gail D., Ph.D., Endocrine Research Unit, Dept. of Physiology, Michigan State University, East Lansing.

Ringer, Robert, Ph.D., Dept. of Poultry Science, Michigan State Univ. St. Clair, Richard, Ph.D., Dept. of Physiology, Colorado State Univ.,

Fort Collins.
Short, Charles E., D. V. M., UT-AEC Agric. Research Lab., 1299
Bethel Valley Road, Oak Ridge, Tenn.
Wenzel, Bernice M., Ph.D., Dept. of Physiology, School of Medicine,
Univ. of California Medical School, Los Angeles, Calif.



LABORATORY EXPERIMENTS IN GENERAL PHYSIOLOGY

In 1959 the Education Committee of the American Physiological Society, with funds from NSF, sponsored the selection, editing, testing, and distribution of a group of experiments in general physiology, which have had a very wide circulation at a nominal cost. With these experiments we tried to introduce some of the more recent research techniques and ideas into our current laboratory offerings.

We now want to make extensive revisions and additions to this list of experiments. We know that they have had a wide use in experimental laboratories so that we now are asking for comments, criticisms, and expressions of laboratory success or failure, comments or criticisms of the whole group of experiments or of any individual experiments that you have used or attempted to use in your own teaching laboratory. We want particularly to have your own version of the experiments that you finally found to be of use.

We want new experiments taken from your own research program or ideas for laboratory experiments so that we can adapt them for teaching purposes. In the revision, it is not intended to add "classical" laboratory material, but we do want to introduce new research material. If you have any experiments that you feel are new and are willing for us to test them, edit, and rewrite if we think desirable, please send us copies of these individual experiments, not your whole laboratory manual. You do not need to restrict the experiments to the categories we used in 1959. We are open to any new ideas for experiments.

In order to make a significant revision and addition to this set of experiments, we will have to have your help. Send all material to Samuel R. Tipton, Department of Zoology, University of Tennessee, Knoxville, Tennessee.

**COMPARATIVE STATISTICS OF APS
REGULAR MEMBERS
1960 and 1965**

The following comparisons were made in order to ascertain if the character of the Society and the research interests of its members had changed in the last five years. The data were obtained from the questionnaires sent to members around 1960 and again in 1964-1965. There were no major changes between 1960 and 1965 as shown in the tables, only slight trends.

TABLE 1.
GROWTH AND DISTRIBUTION BY DEGREES

	1960	1965
Total number of regular members	1767	2413
Growth in 5 years		36.6%
Average age	47.8 yrs.	48.9 yrs.
Those with Ph.D. degree	870-49.2%	1183-49.0%
" " MD degree	600-34.0%	855-35.4%
" " Ph.D. & MD degree	256-14.5%	315-13.1%
" " Other degrees	41-2.3%	60-2.5%
Those doing research 25+% of time	1493-84.5%	2093-86.7%
Those with Ph.D. doing research 25+% of time	750-86.2%	1041-88.0%
" " MD " " "	516-86.0%	752-88.0%
" " Ph.D. & MD " " "	194-75.8%	248-78.7%
" " Other degrees " " "	33-80.5%	52-86.7%

The distribution according to degrees remained about constant. There was a slight increase in the percentage of those engaged in research 25 or more per cent of their time.

TABLE 2.
PERCENT OF THOSE DOING RESEARCH 25+% OF TIME

Area of Research	Total		Ph.D.'s		MD's		Ph.D. & MD's		Other Degrees	
	1960	1965	1960	1965	1960	1965	1960	1965	1960	1965
Anatomy	1.1	0.6	1.5	0.7	0.6	0.3	1.5	0.8	0.0	1.9
Biochemistry	1.0	0.9	1.3	0.9	0.6	1.1	1.0	0.4	0.0	1.9
Blood	3.4	3.9	3.1	3.5	4.3	4.7	2.6	2.8	3.0	5.8
Cardiovascular	17.7	17.1	11.9	10.4	25.0	23.8	21.6	24.2	15.2	19.2
Cellular & Tissue	5.2	4.9	7.7	7.6	2.9	2.4	2.6	1.6	0.0	1.9
Comparative Physiology	2.1	2.2	3.5	4.1	0.0	0.0	1.5	0.8	3.0	3.8
Electrolytes	4.4	3.7	3.5	2.4	7.2	5.7	1.0	3.6	0.0	0.0
Endocrines	11.4	11.6	12.3	13.1	8.9	9.4	15.5	12.5	6.1	7.7
Energy & Temp. Regulation	1.1	1.7	1.3	2.6	1.0	0.9	0.0	0.4	6.1	1.9
Environmental	4.8	5.3	5.9	7.6	3.5	2.9	4.1	2.0	6.1	7.7
Gastrointestinal	4.0	3.8	3.1	2.5	3.5	3.6	8.8	10.1	3.0	3.8
General Physiology	0.4	0.6	0.7	0.9	0.0	0.4	0.5	0.0	0.0	0.0
Gerontology	0.5	0.5	0.5	0.9	0.4	0.0	1.0	0.8	0.0	0.0
Lipids & Steroids	1.0	1.1	1.3	1.1	1.0	1.6	0.0	0.4	0.0	0.0
Minerals, Bone & Teeth	0.5	0.9	0.4	0.7	0.4	0.8	1.5	2.5	0.0	0.0
Muscle & Exercise	4.0	4.0	5.5	5.5	2.3	2.3	2.6	2.5	3.0	5.8
Neurophysiology	16.7	15.6	18.4	17.4	14.7	13.2	12.9	14.5	33.3	19.2
Nutrition	1.2	0.9	0.9	0.7	1.5	0.9	1.5	1.6	0.0	0.0
Pharmacology	3.3	3.0	3.6	3.7	2.5	1.9	4.1	2.8	3.0	5.8
Radiation	3.4	2.2	4.0	2.6	2.1	1.2	3.1	2.8	12.1	7.7
Renal	3.6	4.3	1.6	1.8	6.2	7.7	4.6	4.8	0.0	1.9
Reproduction	1.1	1.5	1.9	2.5	0.0	0.4	1.0	0.8	0.0	0.0
Respiration	5.4	6.3	3.5	3.4	9.1	11.2	3.6	4.8	3.0	1.9
All other categories	2.7	3.3	2.8	3.7	2.3	3.7	3.1	2.4	3.0	1.9

By 1965 there was a trend toward increased interest in Environmental Physiology; Renal; Respiration; and Other Categories (more diversified interests).

By 1965 there was a trend toward decreased interest in Neurophysiology; and Radiation.

The order of categories of major interest remained the same: - Cardiovascular; Neurophysiology; and Endocrines.

REPORT ON COUNCILMAN'S TOUR - 1965

J. D. HARDY

This year your Councilman selected as his tour a visit to a number of the military laboratories in the United States in which physiologists are working and in which the laboratory problems are to a large extent physiological.

The laboratories visited were: -

- U.S. Army Research Institute of Environmental Medicine,
Natick, Mass.
- U. S. Naval Air Development Center, Johnsville, Pa.
- Naval Air Engineering Center, Aerospace Crew Equipment
Laboratory, Philadelphia, Pa.
- Naval Medical Research Institute, Bethesda, Md.
- Naval Medical Field Research Laboratory, Camp Lejeune, N. C.
- Aerospace Medical Research Laboratories, Wright-Patterson
Air Force Base, Dayton, Ohio.
- USAF School of Aerospace Medicine, Brooks Air Force Base,
San Antonio, Texas.

A large variety of research problems are under investigation in these laboratories including basic research in neurophysiology, respiratory physiology, biophysics of membranes, biomechanics, cardiovascular research, neuro-endocrine research, temperature regulation and heat and cold adaptation, environmental physiology including the effects of noise, temperature, atmospheric pressure, acceleration, long term effects of unusual gas mixtures and radiation biology. Although the missions of these laboratories are generally specific in terms of the support which the laboratory can give to the Armed Forces, it has been realized by a wide variety of policy makers that in order to effectively maintain this support, basic research must be done in the life sciences. In many respects the research being carried on in these military laboratories is of high quality and the physiologist's approach to his research is essentially similar to that encountered in university laboratories. Much of the output of these laboratories does not appear in the publications of the American Physiological Society and can be found only in the formal laboratory reports which are published in limited numbers. During the informal discussions with the physiologists who are actually doing the research, it appeared that the policy among the various laboratories in regard to reports is variable. In some laboratories, publications in the journals of the American Physiological Society are encouraged primarily and the reprints are bound into the laboratory cover and submitted to the parent bureau as a formal report. Some of the physiologists feel that the necessary restrictions which apply to publications in the Society journals prevent full presentation of data and description of methods and thus they prefer to have their experiments described in extenso in the laboratory reports. Other physiologists feel that publications in the Society journals is essential to the development of their scientific careers but that publication in a laboratory report is also useful because it allows presentation of tabular data and descriptions of methodology.

All of the physiologists read the Society journals regularly and like them very much; many stated that through these journals they maintain contact with scientific progress in physiology. Physiology for Physicians was much praised by senior medical officers in command of laboratories.

In each laboratory there was a spontaneous expression of appreciation of the Society's interest in having someone from the Council pay them a visit. In all but two laboratories this was the first visit of a Councilman and the younger physiologists were particularly articulate in expressing their appreciation. Good physiological research is being accomplished by men in uniform but in general these physiologists are not members of the American Physiological Society, and seldom attend the Spring or Fall meetings. The reasons for this were varied but it was clear that these physiologists had other outlets. For example, the Biophysical Society and the Aerospace Medical Association, the Acoustical Society of America, etc. provided some with satisfactory outlets for both publication and scientific meetings where original work could be presented. There was some expression of loneliness on the part of a few physiologists and several Society members volunteered the opinion that they feel somewhat on the periphery and isolated when they attended Society meetings. Many of them indicated that they would like to participate more fully in Society responsibilities serving either as chairmen of sessions or as associate editors for the journals. A number of them expressed concern about the difficulty in having their way paid to meetings. The General policy in military laboratories is that a scientist may go to only one meeting a year and only then if he or she is presenting a paper. This rule is even more restrictive than it appears when it is realized that many laboratories are expected to support a particular society on a more or less official basis. In general, the expression of feeling was that the Spring meeting was the meeting they would most desire to attend and they expressed themselves firmly in favor of the ten-minute papers. Some complaints were voiced about the limitations now being placed on the ten-minute papers at the Spring meeting by the American Physiological Society.

In general, the feeling was expressed that the American Physiological Society was a "prestige" Society and that it was important to belong to the Society. A complaint was sometimes heard about the difficulty of attaining membership in the Society and the fact that the membership rule was somewhat restrictive since they could not include everyone who is doing research in physiology. However, there was a general, expression of approval of the Society and its functions and your Councilman had the feeling that the Society had the strong support of the physiologists working in military laboratories. There were no suggestions as to how the Society might expand its functions to better serve the interests of the military laboratories.



THE FACTS OF LIFE

LOUISE H. MARSHALL

Physiologists will agree that the goal of an organism is species survival. Just how well is our professional organism surviving in the jungle of special disciplines? This short survey will present a few facts obtained from current publications often unknown or unavailable to the persons most interested in them.

One means of gauging how well physiology progresses is from the numbers of students earning degrees in physiology. The Office of Education, DHEW, sends annual questionnaires to educational institutions and receives 100% return. These data are more useful to physiologists than are those compiled by NSF because they separate men and women, animal and plant physiology, and exclude pathology, pharmacology, and nutrition. Their weakness, common to all tabulations, is that they do not include physiologists earning degrees as zoologists or biologists. Table 1 shows trends for the last three years, taken from references 1 through 3 respectively. During this time the number of M. A.'s in animal physiology remained almost stationary, the men increasing 15%, the women decreasing 25%. The animal physiology Ph.D.'s increased 75% for the men, 9% for the women. Plant physiologists decreased in all categories during this period. Comparing these trends with the

Table 1. Supply of New Physiologists

	M. A.						Ph. D.					
	1962		1963		1964		1962		1963		1964	
	M	W	M	W	M	W	M	W	M	W	M	W
Animal	89	24	89	27	102	18	60	11	68	12	104	12
Plant	10	1	8	1	16	1	20	1	15	1	9	1
Totals	124		125		137		92		96		126	

number of earned degrees in the biological sciences (2, Table 3), that for masters degrees was below the totals and that for doctorates was above. At both levels the proportion of women was consistently decreasing. Although the recent trend for the totals was upward, the masters did not approach the peak of 153 reached in 1951, and the doctorates were over 100 in 1964 for the first time (4).

The market for physiologists has no factual statistics, but supply and demand can be estimated from Table 2, showing numbers of positions and candidates listed by two placement services at comparable periods of the last two years. AIBS showed a healthy positions-to-candidates ratio of more than 2:1 in animal physiology for both years. The ratio for plant physiologists was the reverse. FASEB had positions about stationary for the two years, but an increase of more than 50% in candidates. The two placement services reach different types

of registrants. If we assume that AIBS registers primarily teachers and colleges, and that research-minded M.D.'s would be more apt to register with FASEB, then trends in demand are apparent - the severe lack of qualified teachers and the influx of M.D.'s into research.

Table 2. Demand for Physiologists

From AIBS Placement Service

	January 1964		January 1965	
	Positions	Candidates	Positions	Candidates
Animal	23	11	27	11
Plant	10	23	10	25

From FASEB Placement Service

	March 1964	Feb. 1964	March 1965	Feb. 1965
	Positions	Candidates	Positions	Candidates
Animal	93	53 (45 M, 8 W)	90	81 (69 M, 12 W)

It is apparent that the demand for animal physiologists continues, although more are being trained. Hopefully, the impact of the APS Education Committee's career booklet, "Consider Physiology" should be visible six to eight years after it first appeared. By then there may be more "splinter" groups doing physiological work under another name. To counter this tendency, new subspecialties may be developed such as environmental physiology. Future additions to the career materials should take these new directions into serious consideration, to encourage young physiologists into areas which will be fruitful to them and to our science.

Of particular interest is the failure of women to participate in the expanding training of physiologists. Traditionally attracted to the life sciences - about one-fourth of the Westinghouse Science Talent Search entrants are girls, but their projects constitute about three-fourths of the biological finalists - yet they have not followed through with graduate work in this area. Nor have they done so in any of the biosciences; the proportion of women receiving degrees at all levels in the biosciences showed the same declining trend, and was particularly noticeable between the masters and the doctorate levels (5). A comparable situation exists in politics, and one of our more decorative lawmakers (6) suggests that it is because women dislike the competitive give and take. The dislike of competition can discourage women more than men, but also the hard facts of employment opportunity are a hindrance (5). Physiology as a profession can stimulate its viability through attention to some of the facts brought out by surveys.

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SPECIAL GROUP FLIGHT TO TOKYO

For members of APS only

Flight will depart from Los Angeles August 28 or 30, returning September 19, 1965. This flight will accomodate members (and families) of APS who are otherwise ineligible, i. e. by reason of late registration for the Tokyo Congress, for previously announced group flights. Fare for adults will be \$555 with other conditions in respect to dependents as previously announced. Those interested should contact.

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GRADUATE TRAINING IN PHYSIOLOGY*

Introduction

CHARLES G. WILBER

It is about a decade since this Society has sponsored a teaching session on the specific topic of graduate education. The scheduling of such a program this year is most appropriate. There is an increasing public interest in and concern for teaching in higher education. Self-appointed experts, with striking lack of qualifications, are proclaiming a mass "flight from teaching" by university teachers.

There are pitiful articles by disgruntled faculty members about the so-called evils of "publish or perish." One is moved to suggest that such outbursts illustrate the old saying, "A poor workman blames his tools." Students mill around on some campuses complaining of inadequate teaching. This unrest is in the air; it cannot be ignored. In my view, much of it is misdirected and the result of emotional outbursts with little factual basis.

Nevertheless, professional societies such as ours must be certain that our own house is in order - that as leaders in our profession, we are duly providing for well trained future leaders in physiology.

The present panel of active physiologists, all competent teachers and productive research workers, represent a number of facets of physiology as it exists in latter 20th Century America.

Your Chairman and one of the participants both have served as deans of graduate schools. They have some appreciation of the complexities of any graduate program. One participant is from a distinguished medical school department of physiology; three are from graduate departments not in medical schools.

A large percentage of practicing physiologists are trained in non-medical school graduate departments. A significant number of the Society's membership, officers, committees, and Council were trained in non-medical school departments of physiology. This situation will continue. It, therefore, seems only reasonable to understand how these departments operate. What is their philosophy of graduate education? How do they go about training the young people who will eventually help to run this Society? Hopefully we will get some insight into the matter from this panel.

The individual members of the panel have had complete freedom to develop their topics as they saw fit. No restriction was placed on them except one of time.

*From the Spring Meeting 1965 Teaching Session.

BALANCE BETWEEN DEPTH AND BROAD COVERAGE IN GRADUATE TRAINING IN PHYSIOLOGY*

LEONARD SHARE

The question of the proper balance between depth and broad coverage in graduate training in physiology is a difficult and controversial one. It touches upon the very core of the philosophy behind the training of Ph.D.'s in physiology. The answers to this question are varied, probably at least as numerous as there are physiology graduate training programs. They run the spectrum from those which try to provide a broad survey of physiology, in the belief that attempts at depth in areas other than the student's research specialty are wasteful, to those somewhat monolithic approaches based on the belief that only intensive training in a few closely related areas can equip the student for the keen competition of modern science. This is indeed a difficult problem to approach. To my knowledge there are no experiments and no data to serve as guidelines in the rational development of a graduate training program in physiology. One has to rely upon experience and, I am afraid, some preconceived notions. Thus, the ideas which I shall present are based largely upon our approach in the Department of Physiology at Western Reserve University. I would like to develop the thesis that broad coverage should not be a major concern in graduate education in physiology. Equally important as the transfer of factual information is the development of a critical way of thinking, of an analytical approach to scientific problems.

A vital question to be answered before attempting to design a graduate training program is "What kind of product do you intend to produce?" Our answer is unequivocal. It is our intention to turn out well trained, highly competent research physiologists. It is our hope that our graduates' primary orientation in their professional lives will be research, that they will be prepared to carry on productive, vigorous programs in some aspect of modern physiological research. On the other hand, we recognize that most of our graduates will obtain employment in departments of physiology in medical schools, so that an important aspect of their careers will be the teaching of physiology to graduate and medical students. We do not wish to diminish the importance of this function, but we recognize that rightly or wrongly, the successful physiologist today is the one with a successful research program. I do not believe that by this approach we are really being negligent in our obligation to train teachers of physiology. The accomplished researcher can, and usually does, do an excellent job of teaching in areas far removed from his own research interests. This of course requires a great deal of advanced preparation on his part. On the other hand, I think it is questionable whether anyone, regardless of the breadth of his graduate education in physiology, can present a series of lectures to a class of medical students in some area removed from his research interests without considerable preliminary review. Thus, it is our expectation that our graduates will not only be highly competent researchers, but also good

*From the Spring Meeting 1965 Teaching Session.

teachers, capable of teaching in any area of physiology.

Having decided upon the type of physiologist we wish to produce, our next question concerns the type of training necessary to meet this objective. Regardless of the approach to graduate training in physiology, I think that there is little question but that the student should be given a broad survey course in physiology very early in his graduate career. This accomplishes several things in addition to the obvious role of such a course. First of all, it provides a basis for previously undecided students to select a specific area for their future research. Secondly, it provides a background, so that in the future, the student may draw upon other areas of physiology as they may relate to his own, specialized research. Thirdly, and perhaps most important, it is an attempt to bring the student, at the early stage in his development, to thinking of the living organism as a whole, so that he will have a proper perspective for his future specialized research efforts. The conclusion of this survey course marks the conclusion of our concern for breadth of coverage. From this point on, our graduate program has two main objectives. The first of these is to provide the student with great depth of training, theoretical and practical, in his research specialty. The other objective can best be described as an attempt to develop in the student certain habits of thought, a way of thinking. We want the student to be able to evaluate critically experimental data, others as well as his own. We want the student to be able to evaluate critically the experimental basis for generalizing concepts in a given field. We want the student to be able to put together experimental observations in a constructive fashion so that meaningful questions can be asked for future research.

Certainly these are primary objectives in most graduate training programs. However, I think that our approach is somewhat different. As I have indicated previously, our concern for breadth of coverage ends when the student has completed his survey course in physiology. From that point on, we feel that our goals can be best achieved by giving the student a number of opportunities for the detailed analysis of specific, limited subjects in depth. I think that our approach to this question of the balance between breadth and depth can be most easily explained by briefly describing certain aspects of our own graduate training program.

Our graduate students begin, as is the case in most programs, by taking the survey course in physiology. It is part of the regular first year medical school program, which the graduate students take along with the medical students. It is referred to officially as Integrated Biological Science, and includes a survey of biochemistry and anatomy. In this course we aim for an extremely broad coverage of all aspects of modern physiology. At the conclusion of this first year, the student begins his research work, which is to culminate in his dissertation. This aspect of the program is fairly standard, and I shall not comment further upon it except to point out that we expect each student to minor in some subject which is of importance to the theoretical development of his research area. Here we are flexible, and our students minor in such broadly ranging subjects as biochemistry, physical chemistry, mathematics and engineering.

In addition to these requirements, the student is required to take a series of six to seven graduate courses offered by the department. This represents a key aspect of our program. It is in the approach here that we probably differ most from many other institutions. At first sight these courses may appear to be rather conventional. The list of their titles in the catalog of the Graduate School would seem to represent an attempt to cover most of the major areas of physiology. However, their primary purpose is not to provide broad, complete coverage in these particular areas. Thus, for example, the course in Endocrinology which was given this past semester was devoted solely to the adrenal cortex. Several years ago, the course listed as Physiology of the Central Nervous System was devoted entirely to the study of the role of the central nervous system in the control of the secretions of the pituitary. What then do we hope to achieve with these courses? We look upon them as model exercises in depth. It is largely through them that we hope to achieve for our students the way of thinking that I mentioned previously. Most of the staff members of the department attend these seminar courses and take an active part in the discussion. In most cases the research interests of the staff member giving the course are directly related to its subject matter. The students are asked to read the key papers in the subject being covered, and they take turns in orally presenting these papers to the rest of the class. The student must do more than merely summarize the contents of the paper. He is expected to give a critical evaluation of the validity of the methods, the data and the conclusions drawn from the data. He may be asked to write a brief review paper on some aspect of the material being covered. He may even have to take an examination at the end of the course, although this is not considered to be a major aspect of the teaching program. Active student participation is emphasized. In some courses the bulk of the oral presentation is provided by the students, the instructor confining himself to brief correlating and summarizing comments.

You may feel that it is wasteful for a student to delve in such depth into a particular, limited subject when his research interests lie elsewhere; that the time would be more fruitfully spent on a general survey of a broad area of physiology in order to obtain more complete coverage of physiology as a whole. On the other hand, our students have had a broad survey course in physiology before taking these advanced graduate courses. Thus, one may seriously question the additional gains of taking more detailed, broad survey courses in the major subdivisions of physiology. Indeed, much would be lost in such an attempt. In order to achieve "coverage" the student participation would have to be largely replaced by lectures from the faculty. There would be insufficient time to examine the experimental bases for the current concepts and hypotheses in the field. The student would thus be subjected to additional lecture courses, additional passive exercises in learning. The only active effort required from the student would be in the examination at the end of the course, when the student is asked to throw back at the instructor with a small shovel a small fraction of what the instructor had previously heaped upon the student's head with a large shovel.

I reject this as a major approach to the advanced training of graduate students. The gains in breadth of coverage do not compensate for the

losses. This approach represents a lost opportunity to make the educational process an active rather than a passive one. I think that it is more important that the student understands how a concept is arrived at than that he attempts to commit to memory a vast amount of broadly-ranging factual information. On the other hand, I readily admit that there are certain advanced subjects, essential for the student's training, which can be effectively presented only as lecture courses. Thus, last year we gave our students a course in compartmental analysis. It was, incidentally, listed as our course in Cell Physiology. This was a lecture course in which student participation was limited to applying the didactic material to the solving of representative problems.

There is another part of our program which I think is pertinent to this discussion. In the period between the completion of the survey course in physiology and graduation, we require our students to write three review papers on subjects of current physiological interest. Two of these papers may be, and usually are, in the area of the student's research interest. The third must be in an unrelated area. In each of these papers the student must provide a detailed, critical analysis of the subject in question. The purpose of these papers is two-fold. They provide the student with practice and experience in writing, and they represent additional exercises for the study of a given subject in depth.

To avoid being misunderstood, I would like to emphasize that we do expect our students to be well trained physiologists. After the first year's survey course, the student has a variety of opportunities for reinforcing his knowledge of the various areas of physiology. One obvious source for such opportunity is in our graduate courses. Although, as I have indicated, no attempt is made for broad coverage in most of these courses, they do provide the student with considerable information about the field under study. Our students are required to assist in the physiology laboratory exercises given to the medical and dental students. In order to be effective laboratory instructors, they must be familiar with the theoretical aspects of the experiments. Our advanced students are offered the opportunity of giving several lectures in our dental physiology course. These lectures are not necessarily in the same area as the graduate student's research activity. Another opportunity which our students have for broadening their education derives from the fact that we have a large staff with a wide variety of research interests. Thus, our students pick up a considerable variety of physiological information from the weekly departmental research seminars, which they are required to attend. Finally, our students are required to pass a general examination in physiology six months to a year before graduation. In preparation for this examination the students spend a considerable amount of time reviewing physiology as a whole.

Thus, I believe it is possible, in fact desirable, to achieve a balance between breadth and depth in graduate education in physiology. I think it is possible to produce graduates who are on the one hand competent physiologists and on the other hand well trained research specialists. I think that the key to this is to avoid any concern for breadth of coverage upon completion of the survey course. Upon completion of this phase of the student's training, it is more important to concentrate upon the

development of appropriate habits of thinking by offering the student numerous opportunities for detailed, critical studies in depth of a variety of subjects. Incidental to this and other aspects of their graduate study, the good students will have ample opportunity to broaden their knowledge of physiology.

THIRD INTERNATIONAL CONGRESS OF NEPHROLOGY

The Third International Congress of Nephrology will be held in the new Washington Hilton Hotel, Washington, D. C., U. S. A., September 25-30, 1966. Dr. Robert W. Berliner of the National Institutes of Health is President of the Congress, and Dr. George E. Schreiner, Professor of Medicine at Georgetown University, is Secretary General.

The Congress is under the general sponsorship of the International Society of Nephrology, and is being sponsored in the United States by the Renal Section of the Council on Circulation of the American Heart Association, together with a number of cooperating societies including, currently, the American Federation for Clinical Research, the American Medical Association, the American Society for Artificial Internal Organs, the American Urological Association, the Scientific Advisory Board of the National Kidney Foundation, and the Washington Heart Association, Inc.

Tentative plans for the program include general sessions devoted to renal physiology, pyelonephritis, uremia, hemodialysis, and homo-transplantation. The program will also include sessions on the following topics: renal pathology including biopsy and special microscopy; renal physiology including micropuncture, electrolyte transport, acid base balance, diuretics, renal blood flow, hormones and the kidney, membrane transport; experimental nephritis and pyelonephritis; toxemia of pregnancy; renal tubular defects; nephrotic syndrome; toxic nephropathies; renal hypertension; congenital and hereditary renal disease; epidemiologic studies of renal disease; radiographic and isotopic techniques; peritoneal dialysis and other treatment techniques. Time will be available for the presentation of brief free communications.

Details of the scientific program and social programs, and forms for the submission of abstracts, registration, and hotel reservations will be distributed early in 1966.

Address inquiries to: Secretariat, Third International Congress of Nephrology, 9650 Wisconsin Avenue, Washington, D. C. 20014.

SOME CRITERIA FOR EVALUATION OF THE DEVELOPMENT AND PERFORMANCE FOR GRADUATE STUDENTS IN PHYSIOLOGY*

DONALD S. FARNER

A definition of standards of performance for graduate students in any science requires first a definition and characterization of the science itself. With this in mind one immediately finds himself in difficulty for, philosophically considered, physiology is really not a science in its own right. Properly it is to be regarded as an aspect of the science of biology with a characteristic point of view in our attempts to understand and rationalize living systems. It is the aspect of biology that is concerned with the internal dynamics of living things (1).

For a number of reasons, mostly pragmatic and not to be detailed here, physiology repeatedly, and indeed almost continuously for a century, has nevertheless assumed the role of a distinct science, a role in which it has been extremely successful. In this role as a separate natural science, physiology has developed an almost baffling poly-dimensional structure with an intricate web of relationships among its subunits. It has developed almost equally extensive and complex relationships within other divisions of biology and also with the physical sciences through its ties with biochemistry, physical chemistry, biophysics, electronics, communication science, and other academic disciplines.

It is most fortunate indeed that it is generally accepted that there should not be undergraduate curricula in physiology. This assures a diversity of disciplinary origins of physiologists and a continuing intellectual hybrid vigor in physiology. This multidisciplinary origin of physiologists and their students has resulted in a philosophically, academically, and operationally diverse array of university programs in physiology. I assert that this is good, and indeed necessary, for the intellectual viability of physiology. However, it does impose serious problems with respect to general criteria for the evaluation of development and performance of graduate students.

I shall not discuss the criteria related to formal courses, and performance therein, in mathematics, physics, and chemistry since two recent surveys demonstrate the existence of a reasonable consensus concerning them (2, 3). Likewise, I shall not comment on course requirements in biology and physiology; these, in general, are characterized by a healthful heterogeneity and are beginning to feel the impact of the conceptual revolution in the biological sciences. I would only express my concern over the not infrequent tendency for graduate programs to become excessively course oriented thereby de-emphasizing the critical function of independent development through the traditionally important master-apprentice relationship between professor and student.

*From the Spring Meeting 1965 Teaching Session.

I shall direct my attention primarily to a battery of somewhat subjective criteria which may be rather generally applicable throughout the great diversity of graduate programs in physiology. Evaluations of some of these emerge from the preliminary or qualifying examinations; some emerge in the defense of the thesis. But evaluation of most can be effected only by the major professor in consultation with his knowledgeable colleagues to the extent that he feels that such is fruitful. I am, in fact, asserting that the standards of performance of graduate students, despite formal examinations and graduate-school rule books, are to a very great extent those of their major professors. This strongly emphasizes the responsibility of the University in granting license to direct graduate study. It also firmly emphasizes the great ethical responsibility of the major professor to his science, to his university, and, above all, to the graduate student as an individual.

Among the most important criteria is that of the degree of development of intellectual curiosity for without such it is unlikely that any graduate student can become a scholar. It is neither difficult to nourish nor to evaluate although we as graduate professors do frequently fail at both. As a former graduate dean I staunchly assert that our graduate-student bodies sorely need more intellectual curiosity, more skepticism, and indeed more iconoclasm!

Of almost equal importance is the criterion of conceptual framework. Into what sort of conceptual frameworks has the student inserted his graduate education; his research; his seminar reports? Do these frameworks have adequate temporal dimensions? I have seen from young investigators far too many research proposals in which the conceptual framework is weak, or all too frequently inapparent. This is certainly in part a reflection of our failure to apply adequately a criterion of conceptual framework in the evaluation of performance and development of our graduate students.

It is essential, of course, that there be a criterion of research craftsmanship, albeit complex and variable. To be assessed are a host of skills and operations including techniques, use of instruments, care and ethical use of experimental animals, management of experiments, recording and processing of data, and skill and care in logistics. Beyond these must be assessments of such as the ability to detect sources of error and unsuspected or uncontrolled variables; the willingness and ability to modify or abandon techniques or instruments when it becomes apparent that they no longer produce data of useful quality; and an adequate resistance to specific instrument orientation or fixation. With respect to the last, I do view with no little alarm the increase in stereotyped instrument-specific or technique-specific research. Admittedly this is largely a product of the complex technology characteristic of contemporary physiology. Nevertheless it does represent a serious hazard in the education of graduate students.

Closely related to the criterion of research craftsmanship is the highly significant criterion of decision-making in research. Among the many possible experiments that the graduate student might perform, does he have good judgement as to which involve the most significant

questions and which are likely to lead him to decisive answers? Does he construct the simplest hypothesis and then design experiments to disprove it? Is he willing and able to weigh time and expense against possible significance of results? Does he know when he has reached the point where further collection of data will add little or nothing to the answer?

Of increasingly greater concern is the multifaceted criterion of capability in communication. Science involves many forms of communication and in a spectrum of time from the remote past to the distant future. There is the immediate problem of effective oral communication. How effectively does the graduate student communicate in seminar; in informal conferences and conversations; in presentation of oral papers? Of even greater importance, how well does he communicate with biologists in other disciplines; with mathematicians; with electronic engineers? Another, more complex type of communication is instruction. I deplore the sharp increase in the fraction of graduate students who complete their "education" without experience in classroom or laboratory teaching. We must accept the thesis that teaching in some form and at sometime is a part of our ethical responsibility as individual scientists and scholars. It follows that a careful evaluation of the performance of graduate students as teachers is of paramount importance. A further aspect of competence in communication is that of competence in the use of the rapidly growing literature of physiology and competence in the use of tools of literature search. I emphasize that this must extend also to the use of the non-English literature despite a regrettable tendency on the part of some of my colleagues towards relaxation in standards therein (2). I would remind you that, despite frequent statements to the contrary, somewhat less than 40 per cent of the world's biomedical literature currently appears in English (4); for chemistry, the corresponding datum is now somewhat under 50 per cent (5). An acceptable standard in the use of non-English literature can not be attained through the foreign-language reading examinations alone. We as professors must insist on a continuing acceptable standard and must evaluate our students accordingly. Also we must do everything possible to further the development of foreign-language programs in the primary and secondary schools and to strengthen undergraduate requirements. With the vast resources and opportunities available for education in this country it is ridiculous that students enter graduate school without reasonable ability in at least two useful foreign languages. If this country is to maintain its leadership in science, its scientists must improve substantially their comprehension and appreciation of the non-English literature. At this point I would like to insert, with an eye to the future, a suggestion concerning the problem of the explosive increase in research literature. It must be clearly recognized that an increasing fraction of the effort of research scientists must, of necessity, be invested in the production of critical and synthetic reviews. I urge that we attempt to identify graduate students with interests and ability in these functions and that we encourage and facilitate the development of these abilities.

I turn now to two more specifically biological criteria - criteria which at times fail to receive adequate emphasis. The first of these is a criterion of comprehension of evolutionary biology. To what extent

is the student cognizant of the subtle adaptive aspects of the functions that he studies? To what extent does he recognize that they are remodelled versions of those of ancestral species? Does he have a mature philosophy of organic evolution and its implications in physiology? The second of these is a criterion of appreciation of the organismal concept. Does the graduate student really appreciate the necessity of projection of the function under investigation into the integrated function of the whole organism? If he appreciates this, can he do it effectively? This is obviously related to the criterion of conceptual framework discussed above.

Time does not permit discussion of evaluations of the student's appreciation of the contemporary revolution in biological science; his ability to form quantitative relationships; his concepts of the ethics of the scientist; his views concerning the obligations of a scientist; and the maturity of his conception of the role of science in contemporary society.

Evaluations of development and performance in accordance with the criteria that I have discussed must, of course, be in addition to evaluation of performance in the traditional requirements in terms of formal courses, examinations, and defense of thesis. They re-emphasize the fundamental importance of the master-apprentice relationship between professor and student and the subjectively subtle aspects of the development of a scholar. Fortunately, for most of us, it is indeed true that it is difficult to ruin a good student. However, I do assert that continuous attention to a set of criteria such as outlined above, can make good graduate students even better.

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THE TERMINAL MASTER'S DEGREE IN PHYSIOLOGY*

X. J. MUSACCHIA

Introduction

The masters degree in the higher education of students of physiology can probably serve as the major vehicle to three objectives: 1) in the preparation and ground work for a doctoral program, 2) as a terminal degree for those interested in college, or other teaching careers, and 3) as a terminal degree for those primarily interested in research (academic or industrial) positions.

In the classification of educational programs leading to the masters degree in physical and natural sciences there are three general subdivisions.

1. The master of science with some research experience (sometimes referred to as a M.S. (R) degree). In such a program the student takes a minimum of from 24 to 30 hours of course credits. They can be in a variety of subjects or in selected course areas usually depending upon the dictates of a department. In addition to courses the student usually works on a research problem and is supervised rather closely by mentor or research director. Very often, these investigations are phases of larger problems already underway in a particular laboratory. Sometimes they are pilot projects with a high probability yield of results. In addition, many of these works are often published under the joint authorship of mentor and student; a type of mutual benefit which can hardly be disputed.

2. There are also programs leading to master of science teaching degrees, often labeled M.S. (T). In this case the individual takes some 30 or more credits of course work in a given department (e.g. biology, zoology, physiology, etc.) and in this program the individual does not engage in a research project, although a library thesis is often a requirement. Thus the students' exposure to post-graduate training is essentially one of extensive course work and, at that, the courses are usually didactic in nature. The strongest arguments, from both staff and administrators, which have been offered in justification for these programs and in terms of keeping such programs out of the departments of education may be abbreviated in the often repeated view that "If teachers are to be prepared in a specific scientific area - it can be better accomplished in the department of specialization, where they can share experiences with professional students engaged M.S. (R) and Ph.D. programs." The quotes are mine.

3. The last type of master of science program which can be included in this classification is the M.S. in Education (M.S. Ed.). In this program the student obtains a masters degree in a department or school of education and enrolls in a number of courses in a science department (e.g.

*From the Spring Meeting 1965 Teaching Session.

physiology, zoology, etc.). The science courses are acceptable as a minor or a field concentration in a specific discipline and ancillary to the major in education. In such a program a student may take about 10 or 12 hours of physiology or zoology courses and 20 or more hours of "education" courses, and upon finishing the required total number of courses (usually about 30) he is identified as a Master of Science in Education. Unfortunately after a period of time the qualifying word Education, which was incorporated in the original paper work designating the student as M. S. Ed., is often conveniently overlooked.

These then are essentially the three major types of masters programs in the natural or physical sciences and which can be identified in various college and university catalogues.

I wish it understood on the onset that what I am about to say is strictly personal opinion. I think we would all accept that personal opinions may be weighted with emotion, and, being aware of this feature, special efforts were taken to evaluate and discuss this subject with additional objectivity. Personal opinions, none the less, are often based on accurate reflections of our educational and professional experiences and on those of respected colleagues. Personal opinions are valuable in that they offer many areas for contradiction and criticism, and thus serve in the initiation of controversy and discussion. Personal opinions are valuable in the sense that the speaker alone can be held accountable and therefore what he has to say need not be approved or sanctioned by the institution he represents. Having thus admitted that anything said from this podium may be more or less acceptable (or even unacceptable) and having thus admitted that I will be fair game for any one in the audience I would like to discuss my views on the subject of a terminal masters degree in physiology.

Meaning and Interpretation of the Masters Degree

The objectives of a masters program in any sense must be accepted as the preparation of an individual in a professional and academic field, and, admittedly, this is a limited professional training at the graduate level. It is difficult to define the role of graduate education any more succinctly than that found in the Encyclopedia Britannica (1), where we find the statement: "The principal purposes of graduate education are: to prepare college and university teachers; to prepare specialists in the various professions; and to prepare students to carry on research." Definition and orientation are always helpful. In a historical perspective the term "Master" (derived from the Latin *magister*) defines a person of authority, and in universities the two principal applications are: the master of science, M. S. or master of arts, M. A., again both derived from the Latin (e. g. *magister artium*). Whereas in years gone by the degree had more universal status and its holder basked in the light of some authority, today the quality of its significance is somewhat dubious. In fact in a number of university departments it has little academic stature, while in other departments of the same university it might be well recognized as a significant and terminal degree. In regards to physiology, it is a safe assumption that the masters degree has little acceptance. There are few, if any, members of the Society who hold

this degree as a terminal manifestation of their educational experiences. Perhaps among some of the associate membership there are a few terminal masters degrees. In short then, it certainly is reasonable to say that there are extremely few terminal masters degrees in physiology.

In this country, there are about 600 institutions which award the masters degree. More than one-fourth are granted by liberal arts or teachers colleges, and the rest by university class institutions. About half of the programs are in education, the rest in various fields such as arts, humanities, science, and engineering. It is also true that in comparison with those in the humanities and education who hold the doctorate, in science there are fewer individuals who have, in addition to the Ph. D., a masters' degree. It is also apparent that in those departments where the graduate faculty devotes considerable attention to doctorate programs, the masters degree has been deemphasized. The most lucid statement in this regard appears in Berelson's Graduate Education in the United States (2): "The higher degree tends to crowd out the lower one; if nothing else, there are simply too many theses to supervise, and the doctoral load takes precedence." I know this view holds in my department and certainly it is true of numerous other departments of which I am aware. Since there is an obvious problem in many physiology, zoology or biology departments, and I don't accept that the problem is necessarily universal, it does not seem out of place to suggest that where there is the desire or the departmental apparatus to train masters students, such programs be encouraged.

The Training Grounds

There are many universities and colleges which have departments of a lesser stature than those of the major top 20 or 30 schools. In many of these departments there are active researchers, good teachers and individuals interested in developing high quality but limited graduate programs. Usually the same individuals are fighting to keep a decent research program underway and are simultaneously faced with disproportionate teaching loads. The same staff member who might continue to serve the academic community with his teaching talent and research potential is usually and often induced to move to the large institutional department. Whereas he could have participated in the training and education of masters level graduate students, he now finds himself one of the many contributors to large and monumental departmental team projects. Would it not have been better, in many instances, to have given the same man the opportunity to continue in the smaller school, where he could have contributed substantially and often in more productive work in terms of selection and training of competent graduate students at the masters level? Eventually these same masters students could and would find their place in one of many areas currently opening up in our broadening physiology. I have visited a number of schools with small departments of physiology, each with a staff of limited numbers, departments of zoology, or biology which do and could participate further in training masters level students. The major shortcoming is one of funds, available mainly for advanced doctoral programs. There are many sources of funds (USPH, NSF, NASA) for predoctoral training and predoctoral programs in physiology as well as other sciences.

There are little or no funds available for the masters type program herein referred to. I merely suggest that if the idea has any merit - if there is a need for a masters program in the physiological sciences - then financial support would have to be forthcoming. These funds would almost of necessity have to come from private foundations, university foundations, government granting agencies or even the American Physiological Society.

Thus if there is any merit to the idea of a terminal masters degree in physiology, I would suggest that the American Physiological Society explore the feasibility of such programs. Perhaps after making a survey of the departments already engaged in post-graduate programs, and departments willing to engage in post-graduate "masters programs", I can visualize the role of the Society in terms of providing information which the USPH and/or NSF could use in setting up a program to support graduate training at the masters level. I suggest that we can help ourselves advance the role and growth of physiology, and suggest that there are four factors essential.

1. We, the physiologists, must train those interested in, or only capable of a terminal masters degree. In short, despite the fact that the masters program in many departments are anathema, I suggest that in order to work towards a guarantee of increased numbers of graduate students, we must yield a little and consider the modest burden of training a few additional students at the masters level. These terminal masters will participate in the feedback essential to locating potential graduate students.

2. Those of us who have some influence at the administration level might advise these serious minded councils that despite the reverence for the doctoral degree, and the usual measure of competence associated with this title, good teachers with "only" a masters degree might well be rewarded in academic kind - i. e. increases in salary and rank.

3. We might also work to upgrade the status of the masters degree and masters program by removal of the stigma of its being a consolation prize degree. Rather, it can be viewed as an end in itself.

4. There is no reason why some training grant funds, fellowship opportunities from NSF or USPH cannot also be used in support of programs intended for masters degree candidates.

I realize also that staff limitations (i. e. numbers) often prevent the serious consideration of a masters program in medical school departments. It is also evident that many physiologists are being trained in departments of biology and zoology, viz., the rapid growth of comparative physiology in the same universities where there are medical school departments of physiology. I suggest that where a single department may not be sufficiently large enough to train terminal masters candidates, it may be perfectly possible to utilize the facilities of two or more departments. These same individuals, with an upgraded and well programmed terminal masters degree - will often find themselves returning to college level teaching. Having experienced the fruits of various de-

partmental orientations, will they not make for better teaching and participate in the selection of graduate students for our university departments.

Where Will They Go?

There can be no doubt that there is an absolute and growing need for college teachers. This is well recognized by a variety of national agencies and associations, for example, the U. S. Department of Health Education and Welfare, the National Science Foundation, and the Association of American Colleges. The preparation of these teachers can be implemented in great part from masters degree programs i. e., through improvement and upgrading of current programs and initiating new imaginative programs. Rather than presenting accumulations of statistical data I should like to illustrate the problem by referring to a situation which is rather close to home, and is in fact a reflection of a national trend. In the metropolitan St. Louis scene four years ago we had two major universities, St. Louis University and Washington University; three girls colleges, Webster College, Fonthonne College and Maryville College; two major seminaries (one Lutheran and one Roman Catholic) and one municipal teachers college, Harris Teachers College. Only the last one mentioned is tax-supported. Each of these schools has planned for expansion in accordance with their academic commitments and objectives. Within the last four or more years we have witnessed the birth of three junior colleges which are municipally owned and operated. The extension of the University of Missouri with a two year college program and ultimately (in a year or two) four year college program, and in the immediate vicinity of metropolitan St. Louis the University of Southern Illinois is currently developing a major campus with plans for a four year college program. The growth of these schools is naturally due to the needs for more tax supported municipal or state operated educational institutions. The numbers of students which they plan to accommodate more than doubles all of the students currently enrolled in all the private colleges. Many of the target dates for peak enrollments are in the early or mid seventies. In so far as I am aware there never has been any mention of the decline in numbers of students and in fact I dare say very few of us have ever heard of a tax supported institution shrinking in terms of physical needs or services to be rendered. I would raise one immediate question concerning these schools and the dozens like them across the country. The question is not particularly the method for obtaining students but the question concerning the source and recruitment of faculty. The general problem of faculty recruitment must indeed be a frightful spectre for administration of colleges and universities. So formidable is the problem, that last January while attending the national meeting of the American Association of Colleges the question came sharply into focus at both private and public meetings. Parenthetically the meeting to which I refer is one primarily for deans, presidents and other college administrators. As a guest and representative of the American Association of University Professors I sometimes felt as though I were eavesdropping. Since, apparently, it is difficult to distinguish between a member of the faculty and a member of the administration I was readily accepted in these inner circles where the problems of our higher educational institutions were discussed with

considerable candor and vigor. One of the major highlights of these public and private meetings was the fact that there will not be sufficient Ph.D.'s to staff colleges and universities. The future looks grim and it is quite likely that many of the staffing problems will not be solved, even with money. Yet, why can't we attempt a solution to our facet of this multisided dilemma of education? Why can't we find at least some solution to the problems which face physiology? Some of our problems can be identified and, those which can be accepted as being significant, can be solved with terminal masters degree programs.

Contribution to Physiology "Service" and College Courses

It appears quite certain that the influx of students into colleges and universities will necessitate the development of new programs, new course sequences in the biological sciences, and enlargement of current curriculum offerings. The least common denominator to each of these will be to find teaching staff. It seems to me that partial solutions to these problems can be used to the betterment of physiological sciences in general.

In a number of universities there are now departments of physiology and they perform various academic services. The staff members of a department of physiology are often responsible for graduate, undergraduate, medical and service courses. Incidentally I do not suggest by any stretch of the imagination that individuals with a terminal masters degree participate in the education of graduate students; however there is certainly room for some rather competent and highly trained individuals to participate in undergraduate programs and quite definitely in service and health education courses. For example, most of you are aware, that in many schools the nurses are taught anatomy and physiology and other courses by staff members from "the" department of physiology. Whereas these courses may serve a sound function in initiating the neophyte staff member into the mysteries and arts of teaching, I am of the opinion that after one or two semesters many of these men and women are no longer making the best use of their training and talent. To keep research oriented staff occupied in teaching nurses elementary physiology, and physical education students the physiology of muscular exercise is truly uneconomical and academically unsound. In the last two or three years I have talked with at least a dozen men or women so involved, and frankly the talents of these people were being wasted. Whereas there is little complaint about teaching medical students or graduate students, there is complaint and critique of using highly skilled personnel in teaching in the clearly identified "Service course" (i. e. teaching of nurses, medical technicians, physical therapists and in some instances students in health education). In short, I maintain that terminal masters programs in physiology could provide properly trained individuals to staff these positions and teach these courses. I am not minimizing the importance of these areas, I only suggest that it does not take the doctorate to do the most effective teaching for these people.

There can be little doubt that the new programs which will evolve at the college level will require trained educators. In fact, in practi-

cally every biology or zoology department with three or four staff members, there is always one introduced as their physiologist. As a member of the Visiting Scientist Program of the American Physiological Society I have encountered a number of these individuals. Their attitude and motivations indicate that they want to "belong" and be identified with physiology. Their enthusiasm is readily garnished when they realize that they can participate in the growth of physiology by sending their better undergraduates and qualified students into graduate school departments of physiology. What characterizes these individuals further is that teaching becomes paramount and in itself a satisfactory end.

A Marriage to Other Disciplines

Another aspect of a terminal masters degree is the possibility of utilizing it as a base for extension and development of other areas. We are all aware of the growing new areas such as, space biology, space medicine, bio-engineering, bionics, marine biology, bio-climatology, and others. In each of these there is ample room, if not a direct need for individuals grounded in physiological subjects. Training and education in zoo-physiology, comparative physiology, human physiology and general physiology through the masters level would certainly arm an individual with unique tools to proceed into specialization in any of the disciplines mentioned. Currently a man finds himself in areas such as space biology or bio-climatology, just to mention two, because his interest happen to lean in that direction and not particularly because of specialized training in the discipline. How much better to formulate a program of training in the defined area and to recruit personnel from existing degree programs at the masters or bachelors level.

There is ample evidence that in order to develop competence in many of these areas, there are programs with curricula and training leading to a masters level degree. In several institutions there are programs leading to degrees in bio-medical engineering (B. M. E.), and "students" are recruited from a broad spectrum of highly trained individuals many of whom already hold the M.D. or Ph.D. Would it not be more profitable to have people with a terminal masters degree in physiology proceed to a doctoral program in the field of specialization.

What Has Been Done, And What Can Be Done

The interest and activities in educational programs concerned with the development of physiologists and the advancement of our discipline are well documented and summarized by Professor Adolph in 1963 (3).

It is obvious that the Society has given considerable attention to the improvement of college teaching of physiology. It has provided Workshops for Teachers of College Physiology, Summer Traineeships, visits to colleges as a function of our Visiting Scientist Program and the Teaching Tour, and the dissemination of Laboratory Instructions in Physiology. We can be certain that each of these and other activities have influenced and encouraged the development of careers in physiology. It would not appear too hazardous a supposition that many of the teachers of college physiology are 1) not trained physiologists and 2)

have come into this area of activity through some back-door path. This avenue of introduction may be because of interest in the subject, or often by default, as for example the teacher who is "appointed" or "directed" to teach a course in physiology because it is a requirement of the curriculum or listed in the school catalogue. It would seem reasonable to suggest that the Education Committee of the American Physiological Society explore some additional mechanisms for possible solutions. For example, would it not be better for us to provide some recommendation of a program of study and training which would prepare teachers for college level physiology. Could we not recommend terminal masters study programs which would be acceptable in the teaching of health education courses and physiology "service" courses. Particularly the type which are often a burden of university departments of physiology. Who should be better informed or able to make recommendations than ourselves as to the requirements for preparation and training of these people. If they are needed and can obtain the necessary training in departments of physiology or from physiologists in departments of zoology, why not provide recommendations so as to insure competence and ultimately professional recognition. There are many individuals who, having been trained and educated to the masters level, would do these jobs and do them in an academically proficient manner. It is precisely from the participation in their courses that we can look for neophytes in physiology. Thus if there are men and women who are satisfied at the masters degree level and who are recognized for their professional contribution, and I am absolutely certain that there are such people and more can be added, then why shouldn't we insure the proper development and professional recognition that would welcome them under the mantle of our discipline. It seems to me that in order to insure the burdensome weight of the growing top of the pyramid, we had best add some stone and mortar, and broaden the base.

A Basic Program

A basic program for a terminal masters degree in physiology might be based on the following formula.

A. Preparatory and prerequisite, undergraduate courses in biology, chemistry, mathematics and physics (as recommended by the Educational Committee to the Visiting Scientists).

B. Graduate courses in human, general and/or comparative physiology, elementary biophysics, electronics and statistics. (Total about 20 hours). These can be taken in two or three semesters.

C. A research project which might occupy four to six months of concentrated effort.

D. A final examination based on (B) and (C) above.

This program should not take more than two years. In our experience it has been found feasible. In 16 years, other than my doctoral students, I have had about 16 M. S. students of these about half could be classed as terminal. They have gone to teach in colleges or to work

as research assistants in laboratories of friends and colleagues. The remainder have gone into doctorate programs.

In resume, there is a need for personnel with the terminal masters degree in physiology. They can participate in physiology in a number of areas. Training for these degrees can be in the smaller university department (where it can be an activity of some importance) or in the large university department. Recognition of such a degree and its requirements can only be implemented by the Society.

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TRAVEL FROM HOLLAND TO TOKYO

For those planning to attend the International Congress of the Physiological Sciences in Tokyo, September 1-9, 1965, a trip has been arranged leaving Amsterdam, Holland, by airplane, August 17, and arriving in Yokohama, August 28, with three days in Moscow, and a three-day side trip to Tashkent, Bokhara and Samarkand. The return trip leaves Yokohama September 17, and arrives in Amsterdam September 21. The cost per person for a party of 15 or more is \$857. Travel is by plane except between Nachodka to Yokohama, which is by boat, and a train between Chabarowsk and Nachodka. Further information may be obtained from Professor Jan Duyff, Institute of Physiology, University of Leiden, Leiden, Netherlands.

IF I HAD TO DO IT ALL OVER AGAIN*

A Commentary on Physiology Training

IRWIN W. SIZER

My initial reaction to the question, "If I had it to do over again", is "Would I even be here today?" The first thing that comes to mind, as a physiologist, is that there must be some easier way to earn a living. The typical professor is overworked and underpaid and his energies are channelled in so many different directions that it sometimes appears that no progress whatever is being made toward any visible goal. The typical academic scientist today spends his time as a teacher, research worker, administrator, and committee man. He has non-university duties in professional organizations, he referees papers, and often acts as a consultant to government and industry. The professor often looks with envy at the businessman who works from 9 to 5 and then goes off to spend time with his family and his hobbies.

In spite of all these problems, there is no doubt that most of us, if we had the chance to do it over again, would end up once more as scientists. We appreciate full well the rewards associated with creativity and new discovery and the satisfaction which comes from teaching able students. We know the joy that comes from dealing with colleagues of high character who make loyal friends as well as "companions in zealous research". Of all professions, the academic one offers the best opportunity to avoid becoming obsolete by engaging in lifetime study which keeps one at the forefront of knowledge in our field.

The requirement for qualifying as a scientist are high, however, and to even begin with the task requires a high degree of what might be called native intelligence. It would help if only one could make sure he comes from a long line of intelligent ancestors, for despite all that educators try to do there is no getting away from the importance of the genes which contribute to what we call native intelligence or common sense. The setting up of new courses designed for the "under-achiever" and the student of low IQ will never compensate in the end for lack of native ability in the field of science.

If I had it to do over again, I would certainly try to get off to an earlier start. Kindergarten is by no means too soon to begin to appreciate the wonders of the world around us. Perhaps there should be less emphasis upon the "never-never land" of fairy tales and more concentration upon the bees and the flowers. A child at the age of five already has an interest in natural history and finds excitement in learning about plants and animals and the mysteries of the human body. This is the time when keen powers of observation could be trained which might lead to a more exciting experience for the child than merely playing nursery school games.

*From the Spring Meeting 1965 Teaching Session.

In the elementary school which I attended, the training in science was woefully inadequate. It is only in recent years that educators are beginning to appreciate how much can be done at the level of the elementary school. The approach to life science by way of nature study is a sound one provided that it is pursued in depth. For example, a child can learn about life history from a detailed study of frog's eggs, tadpoles, frogs, and as a result acquire some understanding of the phenomena of growth, differentiation, and reproduction. Such an initial study can then be followed by a consideration of the whole world of life. The other day I met a little girl of seven coming up from our pond with a bucket of muddy water and I asked her if she was working on tadpoles. Her reply was that her tadpole work had been finished last year and her present class was now studying protozoa. This is a good example of what can be done in elementary school, but there is much too little of this sort of thing going on across the country. Typical science courses are highly superficial and repetitious year after year with each successive plowing of the field occurring at only a slightly greater depth. Already mathematics and physics are beginning to break away from this superficial approach and have demonstrated that the bright child in elementary school is far more capable of learning about the world around him than any educator even dreamed in my day. Of all the sciences, biology is the one which comes most naturally to the youngster and it is truly amazing that so little has been done in the elementary school to put biology on a firm scientific basis. The child at this stage is quite capable of going far beyond natural history and well into descriptive biology. He is certainly competent to solve simple problems and their consideration may lead to some basic understanding of what science is all about. A vigorously taught biology course which gives the child a chance to reason as well as to describe phenomena is not necessarily more difficult for the child than an authoritarian type course in which the student learns everything by rote memory and must accept knowledge on the basis of faith rather than logic. The concept of the scientific method is basically not a difficult one to grasp, and at an early age a child can be taught this method and the approach to science by setting up simple experiments to test hypotheses.

In addition to receiving a defective training in science in elementary school, I must say that the simple matter of reading and writing was poorly handled in those early years. By contrast, British education at the same level leads to competence in literature and composition. One cannot over-emphasize the importance to a scientist of the ability to read rapidly with comprehension, to pick out the kernels of wisdom and to summarize important points as one goes along. Reading of this type need not necessarily be done with simultaneous loss of the appreciation of the beauty and the imagery of words and all that goes into making an outstanding piece of literature. All our lives we scientists suffer from the lack of ability to write fluently and with clarity and ease. If we had it to do over again we would surely insist on better training in English at the elementary school level.

Fortunately the situation with reference to the training of scientists is rapidly improving in the secondary school. Certainly if I had it to do over again I would never have attended a high school which taught

physics without laboratory, in which we finally ended up with some understanding of pulleys, levers, falling bodies, and a knowledge of how an automobile engine works. Chemistry was no better with lessons in bending glass tubing, the use of indicators for study of acids and bases, and the production of little-understood odors and colors which were formed in the test tube. Worst of all was biology in which we learned a little natural history plus the elements of landscape gardening. If we had it to do over again with modern high level courses in math, physics, chemistry, and biology there is no doubt we would be much better scientists today.

With the exception of Latin, English and foreign languages were poorly taught and as a result our generation acquired little ability in reading or writing English or foreign languages. In retrospect, my best courses in high school were Latin, in which we covered in some detail Caesar, Cicero, and Virgil in four years. Even so, in retrospect, I would gladly swap that last year of Latin for a good modern course in high school calculus. The outlook for the future with reference to the training of scientists in the secondary school is very good, with the possible exception of English composition. So much emphasis has been given to modern type examinations with true or false answers that it is no longer necessary for the student to be able to write a good sentence, let alone a well-constructed paragraph, in order to get good grades. There is a real need at the secondary school level to get back to English composition with all the modern tools of pedagogy applied to this task.

At the college level it is, for better or worse, necessary for the future scientist to begin to concentrate. If I had it to do over again I would not take the typical liberal arts program with its assortment of courses in ancient history, music, art, etc. Of course these humanities are necessary for the scientist since he too must apply himself to the solution of complex problems of modern society. Nonetheless, I am increasingly impressed with the ability of the mature scientist to understand the humanities and to hold his own with the rest of society when it comes to an appreciation of drama, art, music, literature, economics, etc. Of course it is by no means necessary to eliminate all of the humanities from the training of a scientist. It is, however, essential that he major in science and not in liberal arts.

The days are over when a life scientist could major in biology without taking any other type of science. As biology has evolved from being a descriptive science to becoming a quantitative one with interpretations of living phenomena based on math, chemistry, and physics, one cannot become a life scientist without fundamental training in the physical sciences. The question naturally arises, should a student therefore take math, chemistry, and physics prior to any study of biology? Since elementary biology still uses relatively little math and physics it seems practical to begin most biology courses without regard to whether or not the student has had math and physics. The situation is quite different with chemistry, however, since even general biology today makes extensive use of chemistry and of necessity includes considerable biochemistry. It is therefore preferable to take chemistry prior to biology

or at least simultaneously with it.

For the physiologist or biochemist as well as other types of quantitative biologists there is no getting away from the need to concentrate considerable time on the physical sciences. If I had it to do over again I would certainly, as an undergraduate, take more than the traditional one year of physics and calculus and three years of chemistry. Even today, however, there is the common attitude among certain life scientists that one year of physics and math and three years of chemistry are sufficient for the botanist, zoologist, etc. The frontiers especially in the borderline fields of the life sciences are being advanced, however, by scientists who have had much more than this minimum in the physical sciences. Such courses as statistics, integral equations, information theory, computer technology, nuclear physics, theoretical physics, electronics, thermodynamics, physical-organic chemistry, and radiation chemistry are becoming important aspects of the basic training of certain types of life scientists.

In life sciences the traditional curriculum which I took in zoology and botany is undergoing rapid evolution. If I had it to do over again I would not bother to classify in detail animals and plants and to dissect many different types of organisms. Such descriptive biology has certainly been overdone in the past and the tendency to emphasize quantitative modern biology is a good one, even though an individual may not acquire the broad training which the previous generation received. More and more emphasis is being placed upon an understanding of the way in which living organisms function, and the approach of the biochemist and physiologist as well as the molecular biologist is being used in the solution of all types of problems. The fields of microbiology and genetics are now making great contributions to such subjects as cell physiology, growth and development. These trends away from the traditional classical biology have been on the whole most valuable and as a result the student quickly becomes aware of the relevance of the physical sciences to the life sciences. In the laboratory there is a trend away from the endless dissection and drawing of laboratory specimens. The embryology laboratory is evolving away from the study of tissue sections of the chick and pig embryos with the result that experimental problems are being set up which illustrate the principles of growth and development.

The problems of teaching modern quantitative biology in the undergraduate student laboratory are extremely severe when coupled with the population explosion which is having an impact upon most of our universities. There has been a tendency in many institutions to acknowledge defeat and to conclude that what the student learns in a classical biology laboratory is often trivial and hence one might as well abandon the laboratory completely. Other institutions have attempted to solve the problem by setting up demonstrations on television or making use of motion pictures of laboratory experiments. This tendency to get away from the student laboratory applies to certain courses in chemistry and physics as well as biology. Already its effects are showing up in the graduate students who are often quite helpless when put into the research laboratory. Very often a student with a brilliant record who has somehow escaped basic training in experimental work will display

a complete lack of competence in research.

Although the problems of mass education may seem insurmountable and the difficulties of going from a laboratory of classical biology to a quantitative experimental one are extremely difficult, there is no reason for giving in and acknowledging defeat. One of the most promising approaches to the problem is to set up project laboratories, in which the student is introduced to quantitative techniques by solving problems which are relevant to recent advances being made in the life sciences. The old "cookbook" approach which we learned is now being abandoned in favor of laboratories which develop know-how, methodology and the philosophy of research by letting the student solve real, although relatively unsophisticated, problems. Such laboratories, however, are unbelievably expensive in terms of space, equipment, and teaching personnel. They may contribute in the end, however, to the development of scientists who are far more competent in the research laboratory than our generation.

At the graduate level, training should no longer be identical with that for the undergraduate. If I had it to do over again I would take fewer formal courses and would concentrate more on seminars, tutorials, and preceptorship training in the laboratory. For the graduate student the most valuable type of training comes from constant contact with fellow students, postdoctoral fellows, and faculty. It is this living together every day of a professor and his students which ultimately leads to a well-trained student and creative investigator.

The typical graduate student starts off with so many deficiencies that often much of the first year is spent in remedial work and is basically no different from undergraduate training. Very often this emphasis upon formal course work occupies much of the second year as well. It is essential that the graduate student get into the laboratory early in his career and at least by the end of the first year of graduate study. His initial work need not develop into a doctoral thesis and indeed the professor who supervises him in the laboratory may not become the supervisor of the Ph.D. thesis. This does not mean that the student must give up course work but rather it will be found that by carrying it along simultaneously a synergism will develop between laboratory experience and the classroom. Work in the laboratory also provides an excellent yardstick in addition to course grades for evaluating the student as a doctoral candidate.

In view of the fact that physiology has a broad base which is becoming more extensive all of the time, it is essential that the graduate student receive advanced training in the physical as well as in the life sciences. In many institutions there is a tendency to assume that the student by the end of the first graduate year has all of the training outside of his major in physiology that he needs. Hence the remainder of the doctoral program is devoted solely to physiology courses, seminars and research. This type of training is much too narrow for many types of physiologists who may need broad training in such advanced courses as enzymology, pharmacology, microbiology, genetics, developmental biology, information theory, thermodynamics, control systems, etc.

Very often the advanced graduate student tends to settle down in a professor's laboratory and concentrate narrowly on research and the immediately pertinent literature. He needs to be taught how to exchange ideas orally and in the form of written reports as well as to discuss research and recent advances in physiology with graduate students and staff who are not working in his field of specialization. It is no longer possible for a man to become an outstanding life scientist by isolating himself in an ivy-covered tower or in a corner of the research laboratory.

One of the most valuable aspects of graduate training for the typical student is to require him to participate in the teaching program. By contributing to the training of other future scientists he himself is forced to organize his knowledge and present it in a fashion that non-specialists can understand. Much of the training which a graduate student receives will be by example. By keeping his eyes open and listening to the people around him the able student in the research laboratory will learn about its organization, administration, and the way in which it receives financial support. Of all aspects of graduate training, perhaps the most valuable is the two to three years he spends in the research laboratory learning the historical background, the methodology, the techniques, and the philosophy of original investigation. The training in how to set up crucial experiments and in how to analyze and interpret objectively the data will constitute a vital part of the Ph.D. program.

In retrospect, if I had to do it all over again, it is clear that even at a very early age I would do things quite differently and obtain far better training than I possess today. Hopefully, however, I would end up in the same academic position in the role of scientist, teacher, administrator, and consultant.

TENTH BOWDITCH LECTURE

Dr. Ernst Knobil, Richard Beatty Mellon Professor and Chairman of the Physiology Department at the University of Pittsburgh Medical School has been chosen to give the tenth Bowditch Lecture at the Society's Fall Meeting at the University of California at Los Angeles. The title of his lecture will be "The Pituitary Growth Hormone: an adventure in Physiology."

SUMMARY*

CHARLES G. WILBER

This panel of distinguished physiologists has presented a many sided program full of challenging ideas. It is evident from their discussions that each has given much thought to teaching, curricula, and theoretical considerations in graduate physiology. I am sure that their concern reflects that of all their fellow physiologists for improved training of future scientists.

It seems evident that there is no one way to produce a competent physiologist. The central role of research in the formation of the future professional in our discipline has been re-emphasized. However, realistic evaluation of staffing needs in the near future may force a reconsideration of terminal training programs in physiology.

Dr. Share rightly emphasizes that one's view of a graduate curriculum will be formed by an answer to the question, "What kind of product do you intend to produce?" He belongs to the school of graduate educators who hope that their "graduates' primary orientation in their professional lives will be research." They admit the importance of the future physiologist's teaching function in graduate or professional school but contend that the successful physiologist today is the one with a successful research program.

He points out that excellence in research and excellence in teaching are not mutually exclusive - but more often than not, the really good teacher is also a competent, productive investigator. This latter fact should give the lie to the wails of professional educationists about the poor teaching in higher education. Hopefully, recognition of the complementary roles of teaching and research will help to destroy any effect which the recent biased and factually worthless Carnegie tract called "The Flight From Teaching" may have.

An appropriate combination of breadth and depth in physiology seems assured by a discrete combining of course work and research. Dr. Share urges, and rightly, that all effort must be made to insure that graduate education in physiology is an active, not passive, process on the part of the graduate student.

Based on experience as a graduate school dean and a physiology professor of many years standing, Dr. Farner has presented many thought-provoking ideas. His concern over the not infrequent course-oriented character of graduate programs is shared by many of us. The critical master-apprentice relationship between professor and graduate student in physiology must be preserved at all costs.

*From the Spring Meeting 1965 Teaching Session.

The problem of oral and written communication is one which faces every department engaged in graduate education of physiologists. The fact that up to now the problem is not being handled adequately is dramatically illustrated by these Federation Meetings in which we are subjected to more than a reasonable share of mumblers, grunters, disorganized speakers, and a chamber of lantern slide horrors for which there is little excuse. As professional physiologists charged with the training of future physiologists, these sorry defects are our defects. They are glaring evidence of our inadequacies and derelictions as American physiologists. The blame can be placed nowhere else; the blame cannot be discussed out of existence.

A point which needs serious thought is Dr. Farner's plea that we attempt to identify and encourage graduate students with interests and abilities in writing of monographs, for it is becoming eminently clear that "an increasing fraction of the effort of research scientists must, of necessity, be invested in the production of critical and synthetic reviews." I might add that granting agencies and their study groups should face these realities and responsibilities by supporting such writing with spendable cash.

Dr. Musacchia has pointed out that in physiology at the present time the terminal master's degree is not held in the highest esteem. Developments in higher education, however, may change the picture. In order to strengthen the master's program, financial support is clearly needed. The American Physiological Society is suggested as the logical professional society to explore the feasibility of giving new status to the master's degree.

The overwhelming task of staffing science departments in higher education during the coming years clearly will not be completed with Ph.D. holders. If physiology is to be taught with a modicum of excellence, we must face up to our responsibilities and make available terminal master's programs for those who cannot or will not complete a doctoral program.

A basic program for a terminal master's degree curriculum in physiology has been proposed. It would cover two years of study and would result in a graduate, holding the master's degree, well able to teach physiology at the college level but with an appreciation of research, although the latter endeavor would not be of great interest to him.

Dr. Sizer referred to the many duties demanded of a physiologist today - over and above his scientific pursuits. He emphasizes the basic importance of native intelligence in a potential scientist and contends with justification that special courses and curricula for the so-called "under-achiever" or person of limited IQ "will never compensate in the end for lack of native ability in the field of science."

He urges that scientific training begin as early as possible; biology is uniquely fitted in this regard, even for kindergarten students.

Ability to write and speak effectively is a crucial tool for the physiologist; this ability must be developed more effectively. However, secondary schools are not yet geared to do this job - and colleges apparently do not pretend to do so.

The fundamental nature of the physical sciences in modern physiology demands a large part of the student's time for these subjects today.

In all this one must not forget that ability to teach should be nurtured in all our graduate students.

Our goal is really a rather ambitious one. We are attempting to produce an individual well equipped by formal education to be a research scientist, teacher, administrator, and consultant.

The National Institute of General Medical Sciences proposes a new climate for faculty fellowships which will now be available for those who may need retraining in mathematics. Many choices of retraining are available for outstanding men in the 35-50 year age bracket. Summer institutes may prove to be the most popular. At present the National Institute of General Medical Sciences program is small, but it should grow.



REPORT OF PORTER FELLOWSHIP COMMITTEE

During the past year you were invited to reaffirm your respect for the William T. Porter Fellowship award by searching for the finest students to be candidates. The result of your response was fewer applications but ones with such superior qualifications that the goal appears reached. For the first time in several years, all applicants were serious contenders, rather than the few who previously stood out among many. This made the task of the Porter Fellowship Committee a difficult but welcome one. Each applicant may feel honored to have been placed in contention for this award.

WILLIAM F. HAMILTON

William Ferguson Hamilton was born in Tombstone, Arizona, March 8, 1893, and died in Augusta, Georgia, December 18, 1964. He graduated from Pomona College in 1917 and, after two years of army service, received his Ph.D. in zoology at the University of California in 1921. His academic affiliations included one year as zoology Instructor at Texas, two as Instructor in physiology at Yale, nine years at Louisville (Assistant Professor to Professor) and two years at George Washington before coming to The Medical College of Georgia in 1934 as Professor and Chairman of physiology (and, until 1942, pharmacology). In 1960 he became Emeritus Professor.

His early research dealt with animal behavior, and while at Louisville he made significant contributions to sensory physiology, particularly vision. Later from Louisville appeared the first of the "Studies on the Circulation" which continued under various titles to the present (one still in press). As a student of hemodynamics, his name is universally associated with leading methods for measurement of both pressure and flow; the Hamilton metal membrane manometer and the Stewart-Hamilton indicator dilution technique. With H. G. Barbour he also contributed the falling drop method for specific gravity of body fluids. But methods were never an end in themselves - only their use to increase the understanding of physiological functions and regulations.

As a class teacher he was at his best with small groups of students, and his insistence on achievable goals led to the production of the "Text-book of Human Physiology", an early "short" text. As a research teacher, his stimulation has led to a series of collaborative research papers covering some forty years.

Among many honors he listed the Connor lectureship of the American Heart Association in 1953 and its Gold Heart Award in 1958; the Silver Heart of the Georgia Heart Association; the Gairdner Foundation Award in 1960; and the Modern Medicine Award in 1960. He served terms on several review boards, including the N. I. H. Physiology Study Section and that of the Life Insurance Medical Research Fund. In the American Heart Association he was a founder and first chairman of its Basic Science Council.

Dr. Hamilton's scientific life was very closely bound to the American Physiological Society, which he joined in 1924 and whose meetings he attended faithfully for forty years. He served the Society in various official capacities. He was a member of the long term council of the war years, 1942-49 and became President-Elect in 1954. His chief love was the publications, for which he served on the journal Editorial Boards from 1940 to 1958 and on the Board of Publications Trustees from 1951 to 1954 and 1957 to 1959. He was a leader in the successful deal for the purchase of what is now Beaumont House (Headquarters of the Federation), and in the unsuccessful effort to maintain the trusteeship control of publication matters. As Section Editor of the Circulation Section of the Handbook of Physiology, he gave every chapter of the three volumes his close editorial attention, from author invitation to

completed text, and had finished this conscientious labor only days before his death.

Other services to the Society have included the organization of the second Fall Meeting, 1949, an active recent role in the Visiting Scientist Program, and collaboration with Dr. Dill in the search for opportunities for senior physiologists.

But it is in the scientific sessions of the Society that his absence will be most keenly felt. Through his forty years of membership his attendance regularly spanned the entire meeting and included more complete sessions of ten-minute papers than most of the rest of us cared for. At the 1964 Spring Meeting he was still a very lively contributor to the discussions, with congratulation and encouragement where it was deserved, criticism of unworthy efforts, and frequent suggestions for extension of reported work.

The Circulation Section of the Society will feel the bereavement most intimately. Dr. Hamilton was one of the original ten who arranged for the formation of the group and was a member of the Steering Committee which kept interest alive during the meetingless war years. He was a formal participant in many meetings and was ever a staunch supporter of the group's basic principle of free and fair discussion of issues. He will be missed sorely indeed and could ask no greater memorial than the perpetuation of these things for which he stood.

Philip Dow

