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The Physiologist

A Publication for Physiologists and Physiology
Orr E. Reynolds, Editor

Volume 23, No. 3, June 1980

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(Apr. 18-21	-	ASBC)
(Apr. 20-23	-	APS & ASPET)
April 10-15, 1983	-	Chicago
April 1-6, 1984	-	St. Louis
April 21-26, 1985	-	Anaheim

Fall

October 12-17, 1980	-	Toronto, Canada
November 1-6, 1981	-	Boston, MA
October 10-15, 1982	-	San Diego, CA
August or September, 1983	-	Univ. of Hawaii

PRESIDENT'S MESSAGE

While Physiology as an academic discipline has not evolved dramatically over the past few decades, the work of physiologists and the manner in which they communicate their findings have been ever changing, and profoundly so. This but provides testimony for the vigor of physiology as a science, or more properly, as an array of sciences, for the rapidly expanding frontiers of our field have often resulted in the founding of new subdisciplines which then became institutionalized as independent scientific organizations. Biochemistry, biophysics, neuroscience are cases in point. As these neodisciplines prosper and their scientific meetings attract the best work of their most active adherents, the parent discipline and its scientific gatherings are inevitably diminished. This is the natural history of all vigorous scientific endeavors. It is the absence of change which should cause concern not the rapid evolution which we have witnessed in our own science.

The American Physiological Society has adapted to the changing activities and interests of its members by taking several bold steps. One was the sectionalization of The American Journal of Physiology which quickly proved to be an astonishing success, although many of us initially thought that it would be a disastrous move. Clearly, the new sections of the AJP filled a need which was no longer met by the old, unified publication that has served so well for nearly a century.

Sectionalization of the Society as a whole was first formally proposed, some 10 years ago, by Ladd Prosser when he assumed the presidency. Prosser and a few supporters foresaw the inevitable specialization of Physiology and the centrifugal tendencies of the resulting neodisciplines, a process familiarly known as "splintering." His prescient proposal was resisted because the leading figures within the Society were quite certain at the time that sectionalization would be a devisive and disintegrating influence rather than a salutory one. Eventually, a rather loose sectionalization of the Society was initiated, a process which was finally formalized during the past year. This sectionalization will permit more meaningful and relevant inputs from our heterogeneous membership into the scientific programs of the Society. It is our expectation that some of these will be revitalized as a consequence by reattracting the most active and critical investigators in our various subdisciplines.

One of the major limitations in the efforts of the Society to adapt to the changing requirements of its membership is the traditional annual Spring Meeting of FASEB. While the Federation Meetings have been very successful and popular for many years, and at one time subserved a clear need for interdisciplinary communication, many members of our Society increasingly used smaller, more focused and more congenial meetings as outlets for their scientific contributions. The immensely productive and highly prized "intersociety sessions" of old were discontinued for the very reason that they were immensely popular and, therefore, competed with conventional Society programs. The attendance of physiological chemists, endocrinologists, neurophysiologists, cell biologists, biophysicists, cell physiologists and others declined as their own meetings became relatively more attractive. At the same time, the income from the Federation Meetings diminished as fewer exhibitors leased less space while expenses rose.

During the past year, The American Physiological Society has taken the initiative in putting into motion processes which will bring fundamental changes to the structure and format of future Federation Meetings. As of 1986, these meetings will be focused on subjects, fields or themes rather than on the gathering of Societies as corporate entities. There will be several of these in any given year that will vary in size from the Gordon Conference mode held on college campuses to meetings of several thousand participants devoted to broad subjects such as Neuroendocrinology.

The planning for such a profound reorganization of the Federation Meetings is a monumental task which is being undertaken by a newly appointed intersociety FASEB committee chaired by F. Eugene Yates of the APS.

With the passing of the familiar Spring Meeting, our own annual gatherings will assume much greater importance because these will now become the only meetings wherein the business of our Society will be conducted. While many of the activities of our traditional Fall meetings will be retained, these new requirements will have to be fulfilled in the face of shrinking travel budgets and the proliferation of competing speciality meetings. I have appointed a task force chaired by Arthur Vander and composed of Robert Berne, Frank Knox and Orr Reynolds to reconstruct our annual meetings so that they will serve our purposes when our Spring Meeting ceases to exist. The charge given to this task force is no less onerous than that of the group which is planning the restructuring of the Federation Meetings.

As can be seen by perusing the minutes of our business meeting in Anaheim, the various committee reports as well as the summary of Council actions which follows, this has been a most eventful year. I am confident that, as a result of the actions we have taken, we are launched on a course which will ensure that our Society will serve the requirements of our increasingly varied membership as effectively in the future as it has in the simpler time of the past.

Ernst Knobil, President

SUMMARY OF COUNCIL MEETING
APRIL 1980

1. There was discusssion of the possibility of amending the Bylaws to increase the minimum age requirement for Emeritus members.
2. Requests for retirement (25) and reinstatement (2) were approved.
3. The report of the Membership Committee Chairman, John Cook, was received resulting in the nomination of new members which were on the election ballot. Regular (124), Corresponding (13), Associate (40), Student (38).

4. A proposal was approved to amend the Society's Operational Guide prohibiting Associate Members from "sponsoring" papers of which they are not an author for presentation at meetings of the Society.
5. On recommendation of the Chairman of the Committee on Committees, Paul Johnson, new committee members and representatives to other organizations were appointed. These new appointees will be announced in *The Physiologist.*
6. The report of the Finanace Committee was considered and evoked very lengthy discussion of the serious financial deficit in which the Society finds itself this year occasioned largely by the anticipated low net income from both the 1979 and 1980 Spring meetings of FASEB. An increase in dues was reluctantly approved by a divided vote. (See minutes of Business Meeting).
8. The report of the Program Committee presented by H.M. Goodman, was received. Twelve symposia topics were approved for the 1981 Spring Meeting in Atlanta. Two other symposia on topics not in specific scientific specialties are being considered for evening sessions - the animal rights problem and Career Opportunities in Physiology.
9. There was discussion of the prospects of the Society establishing a more active public affairs program of its own supplementing our participation in other public affairs programs such as FASEB, AAMC, AIBS and the Endocrine Related societies. No final decision was reached in this area, but there will be continuing consideration as to how this might be achieved.
10. There was consideration given to the Committee established five years ago for the purpose of generating nominations for awards. After five years, one of our nominees, Julius Comroe was finally selected for the Flexner Award. Nevertheless, the Committee was dissatisfied with the modus operandi. Council concurred with the sentiment of the Committee and acted to discontinue the existing Committee. Further consideration will be given to the manner in which the purposes for which this Committee was established can be achieved.
11. The report of the Animal Care & Experimentation Committee Chairman, Helene Cecil, was received. Consideration was given to the possibility of the direct affiliation of APS with AAALAC. Concern was expressed regarding the current difficulties of the National Society for Medical Research (NSMR). There was agreement that APS has a major interest in the activities of the NSMR and shoud be more active in its support.
12. Dr. Fred J. Karsh was selected as the Bowditch Lecturer.
13. New charters for Sections on Endocrinology & Metabolism, Respiratory and Cardiovascular physiology were approved.
14. An informal meeting was held with representatives of the corporate Sustaining Associate Members with the objective of developing programs of mutual benefit to the Society and the Sustaining Associates.
15. A report was received from one of the Society's representatives to the AAMC. Franklyn Knox, and Council expressed its interest in continued close attention and contact with AAMC activities through the APS representatives.
16. Other reports received and acted upon by Council were as follows:
    Education Committee
    Career Opportunities in Physiology Committee
    Centennial Celebration Committee
    Financial Development Committee
    Representatives of IUPS, AAAS, NRC and AIBS
    Task Force on the Planning of Future APS Meeting formats
17. Reports of Standing Committees of the Society were posted in the APS Office at Anaheim and will appear in this or future issues of *The Physiologist.*

AMERICAN PHYSIOLOGICAL SOCIETY

123rd BUSINESS MEETING

TIME: 4:30 p.m., Tuesday, April 15, 1980
PLACE: Arcade Room, Inn at the Park, Anaheim, CA

I. CALL TO ORDER

Dr. Ernst Knobil, President, called the meeting to order and welcomed the members to the 123rd Business Meeting. The Ballot for Election of New Members, Proposed Amendments to the Bylaws and agenda were distributed.

II. REPORT ON MEMBERSHIP

Dr. Earl Wood, President-Elect, reported on the membership status and deaths since the last meeting.

A. Membership Status

The Society membership has grown since the last meeting with an overall increase of 4% bringing the total to 5,610. As of this report, there are 4,247 Regular members, 476 Emeritus members, eight Honorary members, 652 Associate members, 47 Corresponding members, and 180 Student members.

B. Deaths Reported Since the Last Meeting

Dr. Wood read the names of those members whose deaths have been reported since the previous meeting and asked the members to stand for a moment of silence in tribute to them.

III. ELECTION OF NEW MEMBERS

A. Appointment of Tellers

Dr. Knobil appointed Drs. Helene Cecil, Mary Dallman, and George Hedge as Tellers and asked them to collect the Ballots for Election of New Members.

B. Election of New Members

Dr. Reynolds announced that all candidates on the Ballot for Election of New Members were elected. (page 18)

IV. ELECTION OF OFFICERS

As a result of the Election of Officers by mail ballot, Dr. Reynolds announced that the new President-Elect is Dr. Francis J. Haddy and the new Councilor to serve a four-year term is Dr. Jack L. Kosyto. The total number of ballots cast were 1,758 for President-Elect and 1,647 for Councilor representing more than one third of the voting members.

V. THE RAY G. DAGGS AWARD

(see page 25)

VI. AMENDMENTS TO THE BYLAWS

Dr. Knobil, in referring to the handout on the proposed amendments to the Bylaws dealing with Sectionalization of the Society and the Amendment Procedure, announced that the proposed amendments appeared in the February 1980 issue of *The Physiologist.*

The first amendment deals with the sectionalization of the Society, a process which was initiated several years ago in a rather unstructured manner and has spread throughout the Society. The process must now be formalized to make sectionalization of maximal benefit to the Society, particularly in the structuring of the programs of the annual meetings. The existing sections which have already been given formal recognition by Council and are fully operational are: Gastrointestinal Physiology; Renal Physiology; Environmental, Thermal and Exercise Physiology; Comparative Physiology; and the Nervous System. Sections which are in the developmental stage are: cardiovascular physiology, organized by Paul Johnson; respiratory physiology, organized by Leon Farhi; Endocrinology and Metabolsim, organized by Samuel McCann; and Cellular Physiology and Membrane Transport being organized by John Cook. Council has approved the statement of organization for all but the Section on Cellular Physiology and Membrane Transport. It is anticipated that these sections will be formalized in the near future. There is no limitation to the number of sections which may be formed. Any group of 100 members may initiate the formation of a new section.

Upon motion made and seconded, it was resolved that Article X of the Bylaws be amended as presented. The motion passed with no opposition. (page 7)

The second amendment deals with the amendment procedures. Article XIII, as its exists, provides for amendments to the Bylaws only at the Spring Business Meeting of the Society. Possible reshuffling of meetings in the years ahead might make this provision too restrictive. Therefore, it seemed advisable to relax this requirement so that amendments may be effected at any regular Business Meeting of the Society.

Upon motion made and seconded, it was resolved that Article XIII of the Bylaws be amended as presented. The motion passed with no opposition. (page 7)

VII. ACTIONS OF COUNCIL

Dr. Knobil reported that at the Fall Meeting, that all committee reports would no longer be heard at the Business Meeting but, instead, will be published in *The Physiologist* where they would be available to the entire membership for careful and contemplative scrutiny. In addition, however, Committee reports are posted in the APS office for perusal of members at the meeting.

The actions of Council, at its meetings which began 7:30 a.m. Saturday morning and have relentlessly continued throughout the week, have been numerous and diverse. (page 1)

Dr. Knobil wished, however, to focus on the report of one committee, which we have come to dread in recent years, the report of the Finance Committee. "In the past, we became accustomed to hearing glowing reports from the Finance Committee that the American Physiological Society is in fine financial shape, that all of our enterprises are in the black, and that we have money left over to inititate new ventures. Unhappily, this rosy picture has darkened considerably of late. Specifically in 1980 the Society faced a deficit of $150,000 in its operating budget. This figure, I might add, was reduced from an even more ominous one of $161,000. This is due in considerable measure, to a reduction in the income generated by the Federation Meetings. For reasons which are somewhat complex, the number of exhibitors and the amount of space requested per exhibitor have declined. Since the exhibits were the single largest source of income to FASEB resulting in a return to the member societies, income which we have become accustomed to receiving for decades, suddenly has been dramatically reduced. This lack of income has had a profound impact on the finances of the Society.

"This fact coupled with rampaging inflation is responsible for the changing financial fortunes of the Society, especially since dues have not been increased significantly since 1976. The Council deliberated this issue at length as did the Finance Committee at its winter meeting. The Council took hatchet in hand to cut expenditures as much as possible without doing irrevocable injury to the operation of the Society. Despite these painful efforts, however, a large and potentially destructive deficit, which only promises to become worse in succeeding years, remained. In response to this, the Council reluctantly enacted a dues increase of $20 per Regular Member and $10 for Associate Members. Coupled with this action, the officers of the American Physiological Society, those present and those to follow, were given the mandate to expend their very best efforts to reduce the expenditures incurred by the Society, especially as these apply to our contributions to FASEB which used to be balanced by income from the Spring meetings but no longer will be in the years ahead. This will be a difficult task, but Council is committed to undertake it. I am sure many of you have questions about the financial affairs of the Society, and Dr. Guyton, the Chairman of our Finance Committee, is prepared to answer them."

In response to a question, Dr. Guyton said that of the $20 increase, $13 goes to the Federation and only $7 is for Society operations. It turns out that there was a $5 increase in 1977 and $5 in 1979 with no increase in 1978. From July 1976 to July 1980, when the new dues will become effective, the increase in dues has been small when compared to the rate of inflation. The $7 increase is quite a bit less than inflation so far as our Society operating budget is concerned. However, it is hoped the Federation costs will be reduced. In fact, the Director, Robert Krauss, said his goal was to reduce the costs of FASEB or increase the income. Hopefully, in a few years, these efforts will decrease the Society's assessment to FASEB. For many years, the Society has been collecting money from FASEB and only in the last few years has the assessment exceeded income. Unfortunately, the Spring Meeting is not drawing the numbers it attracted previously; 20,000 used to attend the Atlantic City Meetings as compared to 8,200 in Anaheim. In the past ten years, the Society has spent $480,000 more than it took in. This came from investment income of the publication reserve. In the last three years, $250,000 more was spent than was received in dues.

VIII. OLD BUSINESS

Dr. Knobil reported that at the 1979 Dallas Business Meeting the membership voted to poll the members to determine attitudes about meeting in states which had not ratified the ERA amendment. As reported at the Fall Business Meeting in New Orleans, this was not implemented on advice of legal counsel, to Dr. Reynolds, whose view was that such a poll might be interpreted by the Internal Review Service as a violation of the restrictions on "grass roots" lobbying by tax-exempt organizations. This was duly reported back to Council, who abided by this judgment and recommended that this effort not be undertaken without further discussion at the Business Meeting. Dr. Knobil reiterated that this

was reported at the Fall Business Meeting without response from the members and was duly published in the February issue of *The Physiologist*. Since then, letters have been received questioning the propriety of the decision. Therefore, Dr. Knobil raised the issue to seek the wishes of the members once again as to whether the membership should be polled.

Dr. Neena Schwartz said she has been a member of APS since 1954. She was saddened that the next two Spring Meetings of FASEB will be held in states that had not ratified the ERA amendment. She said it was bad enough to live in such a state, Illinois, but it was worse to spend money in one. Very important issues such as amending the Bylaws have just been acted on at this Business Meeting, and Dr. Schwartz saw no reason why it cannot consider the ERA issue and make a decision regarding it without a poll of the membership.

It was moved by Dr. Schwartz and seconded that the APS refuse to hold any further meetings in states which have not ratified the ERA.

Dr. Knobil noted that the Spring Meeting scheduled for 1981 is in Atlanta, 1982 is in New Orleans, and 1984 in Chicago. These all fall in the list of venues which will be interdicted by the proposed motion. Dr. Knobil talked with Barbara Nichols of the FASEB Office of Scientific Meetings about this and advised that it will probably not be possible to find alternative meeting places for 1981 or 1982, and that it is even unlikely that alternative sites would be found for 1983 and 1984 because of the long lead time usually required to make arrangements for meetings of this size. Dr. Knobil asked if the motion referred to the meetings already scheduled or meetings after 1984? In response, Dr. Schwartz said she would like to take action for immediate implementation. If at all possible, she would like to see APS not go to Georgia. However, if there are legal ramifications to prevent FASEB from canceling the 1981 Meeting in Georgia, then by all means, change the meeting site for 1982 from Louisiana to a state that has ratified the ERA.

Dr. Schwartz indicated that two years ago, the AAAS changed its meeting site within a year from a state that had not ratified the ERA to one which had. If the AAAS can, then so can FASEB.

Dr. Marie Cassidy, speaking in support of the motion, said that some sort of gesture is long overdue on the part of the Society to emphasize the fact that women are wanted as colleagues. Some gesture of support from the Business Meeting, leaving Council to work out the details with interested individuals to ensure they are done, would be satisfactory. But she stressed that something has to be done because APS is about five or six years behind some other societies that offer an alternative for membership. Given the way inflation is going, many people will not be able to afford APS dues and those of another society as well. The Society has a solid historical past but it must look toward the future.

In the ensuing discussion, several substitute motions were proposed, and the following substitute motion, proposed by Dr. A. Farman Farmaian, was accepted by Dr. Schwartz and the seconder of her original motion.

"That it is the intent of APS to support ERA ratification in all states. The APS Council is hereby requested to find suitable means to express this support."

This motion was passed.

IX. NEW BUSINESS

A. American Medical Research Expedition to Mt. Everest

Dr. John West, one of the organizers of the Expedition to Mt. Everest, gave a brief presentation and showed slides on the proposed Expedition. The chief objective of the Expedition is to obtain information on cardiopulmonary function during the extereme hypoxia of very great altitudes. It is to take place in the Fall of 1981, and Dr. West was seeking financial support. He announced that an article will appear in the April issue of *The Physiologist* which he hoped the members would read and make contributions.

With no other business, the meeting was adjourned at 5:50 p.m., April 15, 1980.

Earl H. Wood
President-Elect

RESEARCH ASSOCIATE AWARDS
NASA SPACE BIOLOGY PROGRAM

A new program is being initiated for investigators with usually less than seven (7) years of postdoctoral research experience. Eligible are U.S. citizens holding the Ph.D., M.D., D.V.M., or D.Sc. who are interested in plant or animal related research.

Awards of $14,000 to $16,000 based on experience will be for periods up to twelve (12) months and may be renewed.

The first review will be made for those proposals received prior to October 1, 1980.

Interested parties write to:
Dr. X.J. Musacchia
Gordin Hall
University of Louisville
Louisville, KY 40292

CONSTITUTION AND BYLAWS
(Adopted April 1953, as amended April 1980)

CONSTITUTION

ARTICLE I. *Name*

The name of this organization is THE AMERICAN PHYSIOLOGICAL SOCIETY.

ARTICLE II. *Purpose*

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

BYLAWS

ARTICLE I. *Principal Office*

SECTION 1. The Society shall have its principal place of business at 9650 Rockville Pike, Bethesda, Maryland 20014. The Central Office shall house all activites delegated to the employees of the Society.

ARTICLE II. *Corporate Seal*

SECTION 1. The corporate seal of the Society shall be a circle surrounded by the words, THE AMERICAN PHYSIOLOGICAL SOCIETY. The seal shall also show the founding date and the date and place of incorporation.

SECTION 2. The Executive Secretary-Treasurer shall have custody of the seal. It shall be used on all official documents requiring it, and shall be placed on the documents by the Executive Secretary-Treasurer upon approval by Council.

ARTICLE III. *Membership*

SECTION 1. The Society shall consist of regular members, corresponding members, honorary members, associate members, emeritus members, and sustaining associates.

SECTION 2. *Regular Members.* Any person who has conducted and published meritorious original research in physiology, who is presently engaged in physiological work, and who is a resident of North America shall be eligible for proposal for regular membership in the Society.

SECTION 3. *Corresponding Members.* Any person who has conducted and published meritorious research in physiology, who is presently engaged in physiological work and who resides outside of North America shall be eligible for proposal for corresponding membership in the Society.

SECTION 4. *Honorary Members.* Distinguished scientists of any country who have contributed to the advance of physiology shall be eligible for proposal as honorary members of the Society.

SECTION 5. *Associate Members.* Persons who are engaged in research in physiology or related fields and/or teaching physiology shall be eligible for proposal for associate membership in the Society provided they are residents of North America. Associate members may later be proposed for regular membership.

SECTION 6. *Emeritus Members.* A regular member or associate member, who has reached the age of sixty-five (65) years and/or is retired from regular employment may, upon application to Council, be granted emeritus member status.

SECTION 7. *Student Members.* Any student who is actively engaged in physiological work as attested to by two regular members of the Society and who is a resident of North America. No individual may remain in this category for more than five years, without reapplying.

SECTION 8. *Sustaining Associates.* Individuals and organizations who have an interest in the advancement of biological investigation may be invited by the President, with approval of Council, to become sustaining associates.

SECTION 9. *Nominations for Membership.* Two regular members of the Society must join in proposing a person for regular membership, corresponding membership, honorary membership, associate membership, or student membership, in writing and on forms provided by the Executive Secretary-Treasurer. In the nomination of corresponding members, a corresponding or honorary member of the Society may substitute for one of the regular members in proposing a person for corresponding membership. The Membership Committee shall investigate their qualfications and recommend nominations to Council. Council shall nominate members for election at the Spring and Fall meetings of the Society. A list of nominees shall be posted for consideration by the members attending the meeting two days prior to the Business Meeting at which the election occurs.

SECTION 10. *Election of Members.* Election of regular members, corresponding members, honorary members, associate members, and student members shall be by secret ballot at Spring and Fall Business Meetings of the Society. A two-thirds majority vote of the members present and voting shall be necessary for election.

SECTION 11. *Voting.* Only regular members shall be voting members. Corresponding, honorary, associate, and emeritus members shall have the privilege of attending Business Meetings of the Society but shall have no vote.

ARTICLE IV. *Officers*

SECTION 1. *Council.* The management of the Society shall be vested in a Council consisting of the President, the President-Elect, the immediate Past-President, and four other regular members. The terms of the President and of President-Elect shall be one year. The terms of the four additional Councillors shall be four years each and they shall not be eligible for immediate reelection except those who have served for two years or less in filling interim vacancies.

A quorum for conducting official business of the Society shall be five of the seven elected members of Council.

The Chairman of the Publications Committee, the Chairman of the Finance Committee, and the Executive Secretary-Treasurer are ex officio members of the Council without vote. The Council may fill any interim vacancies in its membership. Council shall appoint members to all committees.

SECTION 2. *President.* A person shall serve only one term as President, except that if the President-Elect becomes President after September 30 he shall continue as President for the year beginning the next July 1. The President shall chair all sessions of the Council and Business Meetings of the Society and shall be an ex offico member of all Committees without vote.

SECTION 3. *President-Elect.* The President-Elect shall serve as Vice-President of the Society and as official secretary of the Council. Should he have to function as President prematurely, the Council shall select from among its own members an official secretary.

SECTION 4. *Election of Officers.* Nominations for President-Elect and for members of Council will be made by mail

ballot on forms provided by the Executive Secretary-Treasurer, before February 1 of each year. Each member may nominate no more than one candidate for each office. If a member wishes to nominate a certain person for President-Elect and for Council he must nominate that individual for each position. The ten candidates that receive the highest number of nominating votes will appear on the appropriate ballot for President-Elect or for Council.

Election of the President-Elect and members of Council will be made by mail ballot on forms provided by the Executive Secretary-Treasurer, prior to April 1 of each year. Each voting member must indicate on the ballot his rank preference for all of the candidates on each ballot. The ballots will be counted according to the Election Plan. Two ballots, one for President-Elect and one for Council will be mailed together. The results of the election will be announced at the Spring Meeting of the Society and the newly elected officers will take office on July 1 following their election.

SECTION 5. *Executive Secretary-Treasurer.* The Council shall be empowered to appoint and compensate an Executive Secretary-Treasurer who shall assist it in carrying on the functions of the Society including the receipt and disbursement of funds under the direction of the Council. He shall be responsible for management of the Central Office of the Society under general supervision of the Council.

ARTICLE V. *Standing Committees*

SECTION 1. *Publications Committe.* A Publications Committee composed of three regular members of the Society appointed by Council shall be responsible for the management of all of the publications of the Society. The term of each member on the Publications Committee shall be three years; a member may not serve more than two consecutive terms. The Council shall designate the Chairman of the Committee who shall be an ex officio member of the Council, without vote. Council is empowered to appoint and compensate a Publications Manager who shall assist in carrying out the functions of the Publications Committee under the supervision of the Executive Secretary-Treasurer. The President, Executive Secretary-Treasurer and the Publications Manager shall be ex officio members of the Publications Committee, without vote. The Committee shall have the power to appoint editorial boards for the Society's publications. The Committee shall present an annual report on publications and policies to the Council for approval and present an annual budget coordinated through the Executive Secretary-Treasurer, to the Finance Committee for its approval and recommendation to Council.

SECTION 2. *Finance Committee.* A Finance Committee, composed of three regular members of the Society appointed by Council, shall receive the total coordinated budget proposals annually from the Executive Secretary-Treasurer and shall determine the annual budgets, reserve funds and investments of the Society, subject to approval by Council. The term of each member of the Finance Committee shall be three years; a member may not serve more than two consecutive terms. The Council shall designate the Chairman of the Committee who shall be an ex offico member of the Council, without vote. Council is empowered to appoint and compensate a Business Manager who shall assist in carrying out the functions of the Finance Committee under the supervision of the Executive Secretary-Treasurer. The President-Elect, Executive Secretary-Treasurer, the Chairman of the Publications Committee, and the Business Manager shall be ex offico members of the Finance Committee, without vote.

SECTION 3. *Membership Committee.* A Membership Committee, composed of six or more regular members of the Society appointed by Council, shall receive and review processed applications for membership and make recommendations for nomination to the Council. The term of each member of the Membership Committee shall be three years; a member shall not be eligible for immediate reappointment. The Chairman of the Committee shall be designated by the Council.

SECTION 4. *Education Committee.* An Education Committee, composed of five or more regular members of the Society and representatives of such other societies as may be designated by the Council, appointed by council, shall conduct such educational, teaching and recruitment programs as may be required or deemed advisable. The term of each member of the Education Committee shall be three years. The Chairman of the Committee shall be designated by the Council. The Executive Secretary-Treasurer may act as Executive Director of the educational programs with approval of the Council. The Committee shall present an annual report to the Council and an annual budget through the Executive Secretary-Treasurer to the Finance Committee for its approval.

SECTION 5. The Council may appoint such special and other standing committees as it deems necessary or that are voted by the Society. The Council may name regular members of the Society as representatives to other organizations whenever it deems such action desirable.

SECTION 6. *Term of Office of Chairman.* The Chairman of a standing committee may serve one full term in that capacity in addition to any consecutive term as a committee member limited by other provisions of these Bylaws.

ARTICLE VI. *Dues*

SECTION 1. *Annual Dues.* The annual dues for regular members, corresponding members, associate members and student members shall be determined by the Council and shall be paid in advance of July 1. Honorary members and emeritus members shall pay no membership dues.

SECTION 2. *Non-payment of Dues.* A regular member, corresponding member, associate member or student member whose dues are two years in arrears shall cease to be a member of the Society, unless, after payment of his dues in arrears and application to the Council, he shall be reinstated at the next meeting by vote of the Council. It shall be the duty of the President-Elect to notify the delinquent of his right to request reinstatement.

SECTION 3. *Retirement.* A regular member, corresponding member, or associate member who has been granted emeritus membership status is relieved from the payment of dues but retains the other privileges of his former membership status, except voting privileges.

ARTICLE VII. *Financial*

SECTION 1. *Society Operating Fund.* The Society Operating Fund shall consist of all funds, other than Publication Operating Funds and Publication Contingency and Reserve Funds, restricted or unrestricted, uninvested or invested, short or long term. The Executive Secretary-Treasurer shall be the responsible agent to the Council with signatory powers. Signatory powers may be delegated to the Business Manager by the Executive Secretary-Treasurer.

SECTION 2. *Publications Operating Fund.* The Publications Operating Fund shall consist of all funds that involve receipts, expenses, short-term investments relating to the annual receipts, disbursements and continuing operation of the Society's publications. The Executive Secretary-Treasurer shall be the responsible

agent to the Council with signatory powers. Signatory powers may be delegated to the Publications Manager and/or the Business Manager by the Executive Secretary-Treasurer.

SECTION 3. *Publications Contingency and Reserve Fund.* The Publications Contingency and Reserve Fund shall consist of the long-term capital investments of publication earnings. The Executive Secretary-Treasurer, with advice from the Finance Committee, shall have discretionary and signatory powers, except for withdrawals. Authority for any withdrawal from this fund shall require the following five signatures: 1) The Chairman of the Publications Committee (Alternate, the senior member of the Commitee); 2) The President of the Society (Alternate, the President-Elect); 3) The Executive Secretary-Treasurer (Alternate, the Pulbications Manager); 4) and 5) Any two members of Council. The Finance Committee shall not recommend to Council the expenditure of any of this capital fund for non-publication purposes without the consent of the Publications Committee. The Finance Committee shall be responsible for the separate investment of the reserve fund for publications; any capital gains from such investment shall accrue to the fund (capital losses will, however, reduce its value). Any dividends, interest or income, other than capital gains, from this invested fund may be used for emergency support of any of the activities of the Society, including publications, as determined annually by the Council but the primary goal shall be to increase the investment capital.

SECTION 4. *Fiscal Year.* The official fiscal year shall be from January 1 through December 31.

SECTION 5. *Audit.* All statements of net assets and related statements of income, expenditures and fund capital shall be audited annually by an independent auditing frim.

SECTION 6. *Bonding.* All persons having signatory powers for the funds of the Society shall be bonded.

ARTICLE VIII. *Publications*

SECTION 1. The official organs of the Society shall be the American Journal of Physiology, the Journal of Applied Physiology, Physiological Reviews, the Journal of Neurophysiology, The Physiologist, and such other publications as the Society may own. All publications shall be under the jurisdiction and management of the Publications Committee unless otherwise designated by the Council. The names of the journals and publications may be changed by the Council on recommendation from the Publications Committee and any publication may be dropped by Council on recommendation from the Publications Committee.

ARTICLE IX. *Meetings*

SECTION 1. *Spring Meeting.* A meeting of the Society for transacting business, electing officers and members, presenting communications, and related activities, shall ordinarily be held in the Spring of each year.

SECTION 2. *Fall Meeting.* A Fall meeting of the Society shall be held at a time and place determined by the Council for presenting communications, electing members, and for transacting business. Under exceptional circumstances Council may cancel such a meeting.

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

SECTION 4. *Quorum.* At all Business Meetings of the Society fifty regular members shall constitute a quorum.

SECTION 5. *Parliamentary Authority.* The rules contained in Roberts Rules of Order, Revised, shall govern the conduct of the Business Meetings of the Society in all cases to which they are applicable and in which they are not inconsistent with the Bylaws or special rules of order of the Society.

ARTICLE X. *Society Sections and Affiliations*

SECTION 1. *Society Sections.* Upon acceptance of a Statement of Organization and Procedures by Council, any group of members of the Society may form a section which encompasses an area of physiology. Such sections shall:

a. Advise the Society on matters of interest to the specialty group represented by the section.
b. Assist the Society in organization of scientific meetings.
c. Nominate individuals for membership on Society Committees.
d. Be open to all members of the Society expressing an interest in section membership.

The Executive Secretary-Treasurer shall provide assistance to sections in the carrying out of section business.

Nothing in a section's Statement of Organization and Procedures may be construed as contradictory to the Constitution and Bylaws or Operational Guide of the Soceity.

SECTION 2. *Society Affiliations.* The Society shall maintain membership in such organizations as determined by Council.

ARTICLE XI. *Regulations*

SECTION 1. *General Prohibitions.* Notwithstanding any provision of the Constitution or Bylaws which might be susceptible to contrary interpretation:

a. The Society is organized and operated exclusively for scientific and educational purposes.
b. No part of the net earnings of the Society shall or may under any circumstances inure to the benefit of any member or individuals.
c. No substantial part of the activities of the Society shall consist of carrying on propaganda, or otherwise attempt to influence local, state or national legislation. (All activities of the Society shall be determined by Council). The Society shall not participate in, or intervene in (including the publishing or distributing of statements) any campaign on behalf of any candidate for public office.
d. The Society shall not be organized or operated for profit.

SECTION 2. *Distribution on Dissolution.* Upon lawful dissolution of the Society and after payment of all just debts and obligations of the Society, Council shall distribute all remaining assets of the Society to one or more organizations selected by Council which have been approved by the United States Internal Revenue Service as organizations formed and dedicated to exempt purposes.

ARTICLE XII. *General*

SECTION 1. *Records.* All official records, archives and historical material shall be held in the Central Office in the custody of the Executive Secretary-Treasurer.

SECTION 2. *Procedures and Customs.* The Society shall maintain a current Operational Guide detailing the procedures and current customs of the Society operations as well as the duties and responsibilities of officers, committees, and major employees. The Operational Guide shall be maintained current by the Executive Secretary-Treasurer as determined by the Council.

ARTICLE XIII. *Amendments*

SECTION 1. *Presentation.* Amendments to these Bylaws may be proposed in writing, by any regular member, to Council at any time up to three months in advance of any Business Meeting of

the Society. Such proposed amendments must be presented in writing at the following Business Meeting for action by the Society.

SECTION 2. *Adoption.* These Bylaws may be amended at any Business Meeting of the Society by a two-thirds majority vote of the regular members present and voting.

COMMITTEE REPORTS

FINANCE COMMITTEE MEETING, MARCH 1, 1980
APS Headquarters, Bethesda, Maryland
Persons Present: Staff: O.E. Reynolds, Executive Secretary-Treasurer; W. Sonnenberg, Business Manager; S. Geiger, Publications Manager and Executive Editor. Committee Members: A.C. Guyton, Chairman; R.E. Forster. Ex officio: E.H. Wood, President-Elect; J.L. Kostyo, not able to attend, but was consulted extensively prior to the meeting.

General Considerations

The details of the proposed 1980 budget were considered at the Fall meeting of the Finance Committee and also at the fall meeting of Council. These details have changed in only one significant way: the FASEB assessment both for 1979 and for the upcoming 1980 budget has increased markedly, and the reimbursement to APS from the FASEB spring meeting has been greatly decreased. Mainly because of this change but also because of slight overruns in expenses within the Society, the Society Operating Fund had a deficit of $87,000 for 1979 and has a projected deficit of $151,000 for 1980. In addition, the cash balance of the Society Operating Fund now stands at less than $20,000, an amount sufficient to pay expenses of Society operations for only two to three weeks. In general, the deficits have been made up by utilizing income generated from investments. The ostensible policy of the Society is that the income from these investments should be returned to the support of publications, but this has not been entirely possible during the past few years.

Since the details of the budget were addressed in the Report of the Finance Committee in the Fall of 1979, this present report will deal only with both those items that need to be addressed in the hope of providing a balanced budget for 1980.

The Major Options for Balancing the Budget

Reduce The Expenses of FASEB. During the last three days of February and the morning of March 1, FASEB held a retreat to discuss the future of FASEB. At that meeting, the financial stresses of FASEB were presented. It was pointed out that the new meeting structure for the Spring meeting of FASEB has resulted in marked decrease in income from that meeting. This is the major reason for decreased reimbursement from FASEB to the Societies. Nevertheless, the expenses of FASEB have remained about the same, so that the FASEB assessment minus the reimbursement has increased from essentially zero two years ago to a net assessment minus reimbursement for 1980 of approximately $20 per APS member.

After long discussion of this problem, it has been concluded that there are only two ways in which the cost of FASEB can be reduced or eliminated. These are: (a) direct the APS Board Members to join with board members of the other Societies to reduce the overall expenditures of FASEB, or (b) resign from FASEB. Since the second one of these alternatives is unlikely, the first one seems to be the only viable approach.

Part of the excess expense of FASEB has been caused by an unfortunate choice of data processing system which has proved to be extremely expensive and unreliable. Nevertheless, the cost is there and must be paid.

Another special expense of FASEB is a present policy of attempting to build up the operating reserve fund of FASEB. During 1979, approximately $150,000 was set aside for the operating reserve fund. Another $100,000 is projected to be set aside for 1980. The reason for this is that the operating reserve fund of FASEB had decreased from approximately $400,000 several years ago to about $300,000 at present. On occasion, it has been necessary for FASEB to borrow money to meet its monthly costs because of the cyclical nature of income to FASEB. However, it would be possible for the Board Members of FASEB to vote to return these funds to the Societies. This would be of only temporary value to our Society and would amount to a total return in the 1980 budget of about $60,000 or $12 per APS member.

Decreases in Society Budget. This will be discussed later in this report with itemized possibilities.

Increase in Dues. The increase in dues that would be necessary to come near to providing a balanced budget for 1980 would be a minimum of $20 per APS member, still assuming reasonable decreases in expenses elsewhere in the budget.

Another possible source of income would be to assess dues for membership in APS Sections. An amount of $5 per Section has been suggested.

Cover the Deficits Using Income from Investments. This is the method that has been used in the past few years to cover Society Operating Fund deficits. Those present at the Finance Committee Meeting were philosophically opposed to this method of funding the Society. However, others within the Society have suggested this as an operating procedure, and discussions with both Ernst Knobil and Jack Kostyo have suggested that this procedure works well for the Endocrine Society.

Possible Ways to Reduce Society Operating Fund Expenses

Reduction in the Cost of The Physiologist. If The Physiologist were reduced to a newsletter plus publication of the abstracts of the Fall meeting, the cost could be reduced to approximately one half. This would be a saving of $25,000 in the 1980 budget. If the cost of the abstracts were then defrayed by an increase in registration fee for the FAll meeting, the total saving from The Physiologist would then be about $37,500.

Decrease in Professional Services. A cut-back of The Physiologist would presumably eliminate The Physiology Teacher. Almost all of the professional services item in the budget has been used to pay for preparation of The Physiology Teacher and for sorting through the archives of the Society. Removal of this cost would reduce the 1980 budget by $7,000. Also, two rooms are now employed in Society Headquarters for these purposes. The elimination of these two rooms could reduce the rent budget to the Society of approximately another $5,000 per year, making a total of $12,000. However, Dr. Reynolds stated that acquiring these extra rooms was more for the purpose of assuring adequate space for the future rather than for these specific purposes.

Decrease in Program Development Costs. Most of the program development cost has been to provide travel and subsistence for symposium speakers. Nothing can be done about this item for the 1980 budget because the money has already been contracted for for the Spring meeting. However, elimination of this practice can save over $20,000 per year in future years.

Possibility of Reducing Computer Services. $5,000 is budgeted for computer services for 1980. This is mainly to sort through membership lists and to provide appropriate mailing lists. It might not be economical to remove much of these costs.

Salaries. The Finance Committee does not have enough information to determine whether or not salaries could be reduced significantly. Dr. Reynolds feels that even with reduction of some of the other expenses listed above there still would be no reduction of workload. However, we have asked for the individual salaries of the different Headquarters personnel to be available, but without distribution, for consideration at the time of the Council meeting.

Hotel and Travel. This item includes hotel and travel for the Spring and Fall meetings for staff personnel and also hotel and travel for committee members going to APS headquarters. The amount that is budgeted is not unreasonable in relation to the present method of operating the Society. With changes in procedure, it might be possible to reduce this amount.

Other Items in the Society Operating Budget. The other items in the Society Operating Budget are small, and it is doubtful that much saving could be effected without decreasing considerably the present functions of the Society. However, these items can be considered individually.

Allocation of Business Office. The allocation of funds to the business office will be automatically decreased in proportion to the other decreases in expenses of the Society. The allocation to the business office is approximately 8 per cent of the direct expenses.

Other Society Budgets

Audio-Visual Production Budget. The audio-visual program of the Society has continued to be a loser. We have a projected budget deficit in 1980 of $31,000, bringing the total cost-over-income to the Society to about $150,000 the authorized amount for this activity. The expenditures for 1980, in general, have already been committed but could theoretically be decreased somewhat by stopping a program that is already partly reduced. The entire production scheme is scheduled to stop at the end of 1980 anyway. It is hoped that a moderate to major amount of the costs will then be recouped during succeeding years.

Publication Budgets. These, in general, are in balance except for annual cyclical changes. There is a possibility of having a deficit in 1980, but hopefully not. It is hoped to set aside a fund of about $400,000 to publish special materials for the 1987 centennial of the APS. Therefore, it is especially desirable not to use publication funds for Society operation expenses.

The one possible place where publication expenses could be reduced significantly would be in the section editor's offices. The present cost of handling manuscripts through the section editor's offices is about $70 per manuscript.

Business Office. The expenses for the business office are mainly for salaries. On a percentage basis, the business office costs are about 8 per cent of the direct costs of publications and society expenses. This is near to the national norm.

Recount

Options have been presented for reducing the expenses of the Society. However, even with considerable decrease in Society expenses, it will still take a dues increase of about $20 per person to balance the budget. Even with a balanced Society Operating Fund Budget, the deficit for the audio-visual program will still be charged to the publications investment income.

FINANCIAL DEVELOPMENT COMMITTEE REPORT

April 1980

The Committee consists of Edward L. Alpen, Edward H. Blain, A. Clifford Barger, Walter Gary, C.R. Park, and David F. Bohr, Chairman

New Sustaining Associate Members

As a result of one of the efforts aimed at broadening the base of financial support, the following responded to our invitation and became Sustaining Associate Members:

ICI Americas Inc.
McNeil Laboratories
Merrell Research Center,
Merrell-National Labs
S.G. Searle and Company
E.R. Squibb and Sons, Inc.

(The total number of Sustaining Associates Members is now 19.)

Sustaining Associate Contributions

The following Sustaining Associate Members increased their annual contributions to the Society:

Abbott Laboratories
Hoechst-Roussel Pharmaceuticals, Inc.

Members Voluntary Contributions

Voluntary contributions from members in 1979 were solicited with the members dues invoices. These resulted in contributions of $8,322 from 559 members. The members were asked to designate the purpose for the voluntary contributions. Accordingly, the following distribution was made:

General Purpose	$6,948
Education Activities	640
Program Development	131
Porter Development Fund	133
Perkins Fund	177
Centennial Program	293

Emeritus Members Contributions

Contributions were also solicited from our Emeritus Members and in 1979, contributions of $4,404 were received from 164 individuals.

Contributions in Support of Symposia

Through the efforts of the following 1980 Spring Meeting symposia organizers, $5,700 was contributed to the Society to supplement or offset costs for conducting their symposia:

Francois M. Abboud
Judith R. Walters
Jonathan R. Wolpaw
Paul J. Yarowsky

The following contributed to the support of 1980 Spring APS symposia:

Abbott Laboratories
CIBA-GEIGY Corporation
The Dow Chemical Company
EG&G ORTEC
Hoffmann-La Roche Inc.
Lilly Research Laboratories
Merck Institute for Therapeutic Research
New England Nuclear Corporation
Smith Kline & French Laboratories
The Upjohn Company
Warner-Lambert Company

David F. Bohr, Chairman

SOCIETY PUBLICATIONS IN 1979

In 1979, the regular publications programs of the Society were continued: several new initiatives were completed, and a few fresh projects were begun. Highlights of the year included:

1. Publication of 1040 more journal pages than in 1978, a 10 percent increase.
2. Publication of the *Handbook of Physiology* volume *The Heart,* R.M. Berne, Editor, and N. Sperelakis, Associate Editor.
3. Publication of the third book in the Clinical Physiology Series, *Pulmonary Edema,* edited by A.P. Fishman and E.M. Renkin.
4. Publication of a cumulative index to all issues of the *Journal of Neurophysiology* from Volume 1 through 40.
5. Decision to split the *American Journal of Physiology: Endocrinology, Metabolism and Gastrointestinal Physiology* into two journals beginning in January 1980. The two new journals are the *American Journal of Physiology: Endocrinology and Metabolism,* edited by E. Knobil and the *American Journal of Physiology: Gastrointestinal and Liver Physiology,* edited by L.R. Johnson.
6. Decision to change the frequency of publication of the *Journal of Neurophysiology* from bimonthly to monthly in January 1980.

Subscription rates for all journals remained as in 1978, unchanged since the journals were reorganized. The number of paid subscriptions for the consolidated *American Journal of Physiology, Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology, Journal of Neurophysiology,* and *Physiological Reviews* were down by one to two percent in 1979, compared to 1978. The number of subscriptions for each of the specialty journals of the *American Journal of Physiology* continues to increase.

In 1979, journal expenses were higher than in 1978 because 10 percent more pages were published, the *Journal of Neurophysiology* cumulative index was printed, editorial expenses began for the *American Journal of Physiology: Endocrinology and Metabolsim* and the *American Journal of Physiology: Gastrointestinal and Liver Physiology,* and inflation. These expenses were counterbalanced by continued competition in the printing industry that kept increases in printing price below the general inflation rate, purchase of reprints and page charges by authors, and by income from interest, dividends and royalties. The journals again operated in the black during 1979.

More than 2,000 copies of the *Handbook, The Heart,* were sold in the first six months since it was issued. Income from the sale of this volume and the older ones in the series helped to reduce the overall deficit of which this project naturally runs. However, in viewing this deficit, it should be kept in mind that income from the sale of books in inventory would be sufficient to recover costs if for some reason the series needed to be discontinued. By the end of the year the costs of all completed books in the Clinical Physiology Series, including the newest *Pulmonary Edema,* had been recovered.

In 1980 the Publications Committee looks forward to the continued evolution of the journals, the completion of the *Handbook* on *Vascular Smooth Muscle,* and the Clinical Physiology Series book on *Secretory Diarrhea.* The Committee will be busy helping various editors in preparing revisions, which are underway, of the first three *Handbook* sections on neurophysiology, circulation, and respiration, and a new section on skeletal muscle. It also hopes to see the Clinical Physiology Series expanded and a monograph series launched.

The success of the publications program depends on the input and cooperation of Society members as authors, editors, reviewers, and reader-subscriptions. The Publications Committee welcomes suggestions for improvements from members.

Alfred P. Fishman, Chairman

MEMBERSHIP COMMITTEE

SUMMARY OF MEETING OF APRIL 13 AND CHAIRPERSON'S REPORT TO COUNCIL APRIL 14, 1980

Present: I.J. Fox, J.C.S. Fray, A.E.V. Haschemeyer, R.E. Hyatt, M.C. Neville, J.S. Cook (Chairman).

1) Committee approved all Regular applications except four, recommending that these be offered Associate status. All other applications, including those in the Corresponding and Student categories were approved. The Committee's actions were sent to Council as a motion for nomination, with the exceptions noted.

   Council seconded and adopted the Committee's nominations. All were subsequently elected at the business meeting of members on April15 (see Membership Status Report p.18).

2) The proposal from the Membership Committee dated February 20, 1980 to Council regarding the modification of the Associate Membership denying Associate Members the privilege of sponsoring papers of which they are not authors was discussed at the Committee meeting and reaffirmed. At Council meeting the proposal was received and appeared strongly endorsed in the discussion. Orr Reynolds, an ex-officio member of Council, pointed out that the status of Associate Members and their paper-presenting privileges at FASEB meetings was a matter of negotiation with the Federation. It was suggested that this was a technical question that could be resolved in Dr. Reynolds' office. Dr. Reynolds promised to try. The proposal was passed by Council.

3) In the Committee meeting the status of women in the American Physiological Society was discussed and statistics available from the Scientific Manpower Commission were reviewed. The Committee appointed a subcommittee composed of Margaret Neville and John Cook to draw up a brief summary statement of this discussion for Cook's presentation to Council on the following morning. This subcommittee met on April 13.

At Council meeting Cook presented a summary along the following lines. He pointed out that the Membership Committee was the filter through which the composition of the APS was regulated, but that the role of the Membership Committee was passive in the sense that it acted only on received applications. No one recruits positively for the Society as a whole, although individual members certainly recruit. The present composition of the Society is approximately 7% women, the women among Ph.Ds. awarded in physiological sciences over the past five years runs approximately 18-20%, and among the new members run approximately 13-15%. Membership on the committees of the Society is approximately 10%. Cook pointed out that the Council should take an interest in determining why the new members lag 5% behind the rate of training of women. He also pointed out that while the Committee memberships were a reasonable reflection of the present composition of the Society, they nevertheless reflect the older membership and that perhaps a little affirmative action in this regard might be useful in changing the perception of the Society by its newer women members. Paul Johnson (Chairman of Committee on Committees) pointed out that two of his committee members were women, but that the question of affirmative action in making appointments was not explicitly considered by his committee. Cook pointed out that the Council and committees of the Biophysical Society are 29% women and the committees and council of the American Society for Cell Biology are 27% women, and that these high percentages represent deliberate actions by the societies in which there are active women's caucuses. It was generally recognized that the fact that there are no women on Council of APS reflects the fact that there is no nominating committee for Council, rather that nominations are made by petition from the membership. E. Knobil affirmed the need for special action in this area, and expressed the hope that the women of the Society would take a conscientiously more active role in the Society's affairs. Mo Goodman, chairman of the Program Committee, pointed out for the past several years the program Committee had deliberately sought a high proportion of women among the chairmen of sessions in order to give them greater visibility. Cook requested that data routinely collected by the Association of Chairmen of Departments of Physiology on the training of students and postdoctoral fellows should include a breakdown by sex so that Council and the Membership Committee could better recognize how the Society reflects and supports the career goals of women in training. Walter Randall assured that such data could be collected and made available, possibly including its publication in *The Physiologist* with the reports of the ACDP.

John S. Cook, Chairman

CURRENT ACTIVITIES OF THE APS EDUCATION COMMITTEE

This report summarizes current activities and plans of the Education Committee and includes business conducted at its most recent meeting held at FASEB at Anaheim.

I. The Audiovisual Project

The history and recent progress of the Audiovisual Project was summarized in detail in this committee's last report. In brief, the Education Committee recommended to Council last October that a moratorium should be set for the production of new slide tapes beginning at the end of 1980. This date was chosen for several reasons: first, the program will have come close to the maximal financial commitment authorized by Council by that date, approximately $150,000. Even should it break even with continued production beyond 1980 it would almost certainly have remained very close to this maximal value for several years; in contrast, continued sales with no production costs to the society for several years should cut the deficit by an estimated $75,000 to $100,000. The second reason chosen for setting the end of 1980 as a beginning of the moratorium is that this period would allow orderly completion of those materials now in production; these include 4 slide tapes on cardiac electro-physiology and 7 slide tapes dealing with peripheral circulation, as well as 1 revision of a previously existing slide tape on the renal handling of sodium. Council approved this recommendation at it's October 1979 meeting. At present it appears that both predictions were correct. The financial burden of the slide tape production will be approximately $150,000 by the end of calender year 1980, and all slide tapes presently being produced should be completed by August or September of this year. During the coming moratorium of at least two years (1981 and 1982) the Education Committee will evaluate all aspects of the program; this information should make it possible to determine whether the program should be restarted at all, what form it should take, what reasonable financial consideration can be predicted and whether supplementary outside funds can be obtained for support. By that time also the society may have found it possible to maintain a full time education officer to oversee projects of this kind. At some future time, therefore, the Education Committee would bring to Council recommendations for the program beyond the period of the moratorium.

II. Fall 1980 Refresher Course

The topic for the fall 1980 refresher course is "Physiology of Calcium, Phosphorus and Bone." It is being organized by Dr. Frank Knox of the Mayo Clinic.

III. Learning Resource Center at Meetings

The third learning resource center was held at the APS fall meetings at New Orleans in October of 1979. Six demonstrations were given by the APS members along with the presentation of the society's slide tape programs. Exhibits were shown over a 2½ day period with scheduled one hour demonstrations given each morning and afternoon. Attendance was estimated to be about 400 people the first day, 250 the second, and 125 the third day, morning only. The exhibits presented included three poster demonstrations, one computer demonstration, one model of the circulatory system, and one video tape demonstration. Booth space with tables, chairs, poster-boards and electrical outlets were provided for each exhibitor. In addition audio-visual equipment was rented for one exhibitor. The total expense for the educational exhibits was approximately $1600. Plans for the

fourth learning resource center at the FASEB meeting in Anaheim, April 1980, included expansion to include members from all FASEB Societies. The exhibit format was to be lengthened to 4 days with each participant scheduled for one two-hour presentation the first day and a one hour presentation each of the following 3 days. Twelve participants are scheduled, seven members of APS and five from other societies, with three computer related demonstrations, four poster demonstrations, and five audio-visual presentations.

Members wishing to avail themselves of an opportunity to present educational material at future meetings should specify "teaching materials and methods" topic in the topic category list, provide an abstract on the regular abstract form for publication and write an accompanying letter describing their equipment requirements. Presentations and abstracts in this category do not constitute use of a franchise for research slide presentation or poster sesion.

In the fall 1980 meeting a new mechanism for facilitating exchange of educational information will be tried. Under the organization of John West a program on the teaching of respiratory physiology will be presented. It will take the form of a poster session and discussion in which approximately 4 different individuals will present their methods for the teaching of respiratory physiology to medical students. Materials will be available for those attending the session to take away with them and the participants will be available for discussion and interchange among themselves as to various aspects of their teaching. Several other similar sessions are also being prepared; one by Terry Mackem, of the University of California, Berkeley, on the teaching of an undergraduate course in physiology using independent study methods and one by Paola Timiras, also of the University of California, Berkeley, on the teaching of aging and development. It is hoped that all of these sessions will provide prototypes for future presentations covering all areas of physiology at various levels. The committee welcomes suggestions concerning other areas to be covered in the future and individuals who would be appropriate for serving as organizers of such sessions.

IV. Educational Objectives

The Education Committee is now attempting to set-up a mechanism of compiling a comprehensive set of objectives for medical physiology representing the consensus of opinion of many physiologists. We believe that this compilation will provide valuable information for physiology departments and an essential foundation on which to base future society educational endeavors such as the slide-tape materials.

V. Educational Materials Review Board

Approximately 100 APS members continue to serve as an educational materials review board which provides continuing reviews of audio-visual productions as well as reviews of articles, text books, laboratory experiments, etc. Each year the board abstracts materials from published papers that may be useful in teaching physiology and these abstracts are published in the spring issue of The Physiologist.

VI. A National Bank of Examination Questions

The committee is exploring the possibility of creating a national bank of examination questions which will be stored in a computer and which can be used by participating schools. The office of medical education, research and development at Michigan State University has previously helped the pharmacology and biochemical societies to create such banks of examination questions, which seem to be functioning quite well. The plan is for the cost to be borne by participating schools and for an editorial board to over-see the initial compilation and maintenance of the examination bank. A formal proposal to the chairman of the various physiology departments throughout the country should be available within the next six months.

VII. Articles in The Physiologist

The committee is exploring ways for encouraging and facilitating the publication in The Physiologist of several kinds of articles, particularly those describing laboratory exercises, the use of computers in the teaching of physiology, clinical case histories appropriate in the teaching of physiology, and articles dealing with historical subjects. It is our hope to have each of these areas supervised by a particular individual and to have the articles on each subject ultimately collated into a small book which could be used as a primary source in physiology courses.

VIII. Public Education

Throughout it's existence the Education Committee has felt that one of it's major goals should be to devise programs that can contribute to the education of the general public in the areas of human physiology and health. Therefore, we are continuing to explore possible avenues for achieving this goal through the publication of materials aimed at the general public and through the possible collaboration with public television in the launching of television material concerning physiology. The committee would greatly welcome creative suggestions from the membership as to how best to achieve it's mission in the realm of public education.

A.J. Vander, Chairman
S. Ochs; R.B. Gunn;
B.M. Twarog; J.B. Bassingthwaighte;
E.O. Feigl; P.S. Timiras;
J.B. West; J.H. Szurszewski;
O.E. Reynolds, Education Officer

PROGRAM COMMITTEE'S REPORT

Committee Membership

Current members of the Program Advisory and Executive Committees are listed in the attachment.

Spring Meeting Abstracts

As a result of APS action taken at the FASEB Program Committee Meeting, the 1980 Spring Meeting marks the first time since ASBC elected to meet separately that its members have been invited to participate in the Spring Meeting. ASBC members were furnished with the call for abstracts and invited to submit their abstracts to APS. As a result 352 members responded by submitting abstracts for the meeting.

APS was the recipient of 2158 abstracts (of the total 4,940 received by FASEB) a record breaking number. In addition to the ASBC abstracts submitted to APS, BMES members submitted 4, Reticuloendothelial Society members submitted 74, Society for Experimental Biology and Medicine submitted 225 and the Society for Mathematical Biology 10.

Because the program for this meeting was integrated among the participating Federation Societies, abstracts were transferred between societies depending on the topic assigned to each. As a result APS was responsible for programming 1609 abstracts. Eight hundred sixty two were programmed into slide sessions and 747 into poster sessions.

Spring Meeting Sessions

APS programmed: 74 Slide Sessions
44 Poster Sessions
1 Session on Teaching Materials and Methods
22 APS Symposia
5 Guest society symposia (SEB-1, RES-1, SMB-3)
1 Special session for BMES

Poster - Symposium

A unique type of session is being tested at this meeting. Based on an idea by Norman Staub, a Program Advisory Committee member, a "Poster Symposium" has been organized for Tuesday morning April 15. This session, titled Lung Fluid Balance II includes 20 poster boards arranged around a slide session type room.

The Poster-Symposium is an attempt to improve the efficiency of information exchange. In a slide session a maximum of 12 papers can be presented in the allocated 3 hours. In this experimental session 10 of the 20 Posters is manned by the author in each of the first two hours of the session. The third hour is presided over by an invited principal discussant who conducts a review of the information presented in the posters and then moderates an open discussion.

Each participant in the Poster-Symposium was furnished with detailed guidance on how to assemble a good poster. Dr. Staub developed these instructions since he felt that posters developed using the FASEB instructions were small, crowded and contain too much detail.

Each attendee at this experimental session will be asked to complete a questionnaire which will be evaluated to determine the future of this type of scientific session.

Analysis of Spring-Fall Meeting Attendance

An analysis of APS attendees at the 1979 Spring and Fall Meetings was conducted in an attempt to obtain information on the APS attendance.

Of the 281 students who registered at the Fall Meeting in New Orleans, 17 were Student Members.

Paid APS members attending the Spring Meeting in Dallas numbered 1083. Six hundred and seventy two paid to attend the Fall Meeting in New Orleans. Of these APS attendees, 318 individuals attended both meetings.

Based on the members paid attendance at the two 1979 meetings, it was concluded that a total of 1437 individuals holding APS membership (other than Student) attend the two meetings.

A breakdown of the registration at the APS Fall Meetings since 1975 is shown below.

1980 Fall Meeting

The Meeting will be held in Toronto at the Sheraton Centre, October 12 through 17, 1980. Joining APS will be the Canadian Physiological Society, the Canadian Zoological Society Section of Comparative Physiology and Biochemistry and, the American Society of Zoologists Section on Comparative Physiology and Biochemistry.

Symposia

The following 9 symposia will be presented:

Comfort and survival in the cold. R.F. Goldman, U.S. Army Res. Inst. of Environmental Medicine

Comparative physiology of diffusion in respiratory gas exchange. J. Piiper and P. Scheid, Max Planck Inst.

Physiology of the splanchnic circulation. E.D. Jacobson, Univ. of Cincinnati

Neurophysiology of autonomic preganglionic neurons. F.R. Calaresu, Univ. of Western Ontairo

Quantitative dynamic regulation of glucose metabolism in physiology and diabetes. M. Vranic, Univ. of Toronto

Control of breathing during fetal and early post-natal life. V. Chernick, Univ. of Manitoba

Hormonal regulation of foregut development. B.T. Smith and D.B. Jennings, Queen's Univ.

Morphological aspects of renal function. A.P. Evan, Indiana Univ.

Endocrine regulation of vertebrate seasonal reproduction. R.E. Peter, Univ. of Alberta

Refresher Course

Franklyn G. Knox has organized the Refresher Course "Physiology of Calcium and Phosphate Regulation" that will be held on Monday, October 13, 1980. Speakers include: Claude D. Arnaud, Raji V. Kumar, Andre B. Borle, John H. Dirks, Wadi N. Suki, Vincent W. Dennis, Lawrence G. Rasiz, Roger Sutton.

A novel idea has been incorporated in this Refresher Course. Dr. Knox has arranged for a separate speaker in the morning and afternoon sessions to critique the lectures concerning concepts that should be presented to students. John Dirks will critique the morning session and Roger Sutton will do the same for the afternoon session.

Tutorial Lectures

Follicle stimulating hormone. Jennifer H. Dorrington, Univ. of Toronto

Computer assisted tomography. Earl H. Wood, Mayo Foundation

Protein synthesis. Bert W. O'Malley, Baylor Coll. of Med.

Review of the history of respiratory gases. Ralph H. Kellogg, Univ. of California (San Francisco)

Radioactive iodine metabolism and nuclear accidents. Lester Van Middlesworth, Univ. of Tennessee

The mechanism and biological value of fever and the significance of endogenous antipyresis. Keith E. Cooper, Univ. of Calgary

Elements of motor control. Serge Rossignol, Univ. of Montreal

Specialization in movement systems: lesson learned from examination of the physiology of head movement. V.C. Abrahams, Queen's Univ.

Vestibular physiology. G. Melville Jones, McGill Univ.

Sympathetic abnormalities in experimental and human hypertension. Jacques D'Champlain, Univ. of Montreal

Marine mammal physiology. Three lectures organized by F.R. Engelhardt, Univ. of Ottawa. Lecturers are K. Norris, J. Gerachi and P. Hochachka

APS PROGRAM COMMITTEES

(Spring 1980)

Program Executive Committee

H. Maurice Goodman, Chairman (1981)
Melvin J. Fregly (1980) Education Committee Liaison
Franklyn G. Knox (1982)
Harvey V. Sparks, FP Editorial Board Liaison (non-voting)

Program Advisory Committee
Special Interest Representatives

Circulatory Physiology (Peripheral) - vacant
Circulatory Physiology (Heart) - Eugene Morkin
Clincial Physiology (ex officio) - Francois M. Abboud
Comparative Physiology - Bruce L. Umminger
Environmental, Thermal & Exercise Physiology - Reynoldo Elizondo
G.I. Physiology - Michael Jackson
Membrane and Transport - Ernest M. Wright
Muscle Physiology - M.J. Kushmerick
Neural Control of Circulation - J.W. Manning
Neuroendocrinology - Joseph Meites
Neurophysiology - David Carpenter
Physiological Chemistry - Thomas B. Miller, Jr.
Renal Physiology - James A. Schafer
Respiratory Physiology - N.C. Staub

AMERICAN PHYSIOLOGICAL SOCIETY

Fall Meeting

TOTAL REGISTRATION

SCIENTIFIC REGISTRATION	1975	1977	1978	1979
SCIENTIFIC REGISTRATION				
Members	666	432	568	672
Nonmembers	477	331	314	430
Students	242	170	312	281
TOTAL SCIENTIFIC REGISTRATION	1,385	933	1,194	1,383
GUESTS OF SCIENTISTS	89	31	25	64
TOTAL REGISTRATION	1,474	964	1,219	1,447

H.M. Goodman, Chairman

COMMITTEE ON CAREER OPPORTUNITIES IN PHYSIOLOGY

Report to Council, April 16, 1980

Examination of the Committee Report to Council, October, 1979 (New Orleans Meeting of APS) reveals the source of the first three topics presented here. Individual committee members prepared final drafts of manuscripts for presentation to Council at the Anaheim (Spring, 1980) meeting with ultimate plans for publication in *The Physiologist* for APS membership information.

Item I, PRIMARY CAREER OPPORTUNITES IN PHYSIOLOGY.....Dr. Saba

Seven different professional areas are currently open to properly trained physiologists: 1) Full-time appointment in a Physiology Department, Medical School, 2) Full-time appointment in Clinical Department with primary responsibilities in research, 3) Full-time appointment with responsibilities in research institute, 4) Full-time appointment with research responsibilities in industry, 5) Full-time appointment with academic responsibilities in Clinical Departments with emphasis upon teaching plus research, 6) Full-time appointment with academic responsibilities in Biology Department in undergraduate setting, 7) Full-time appointment in government with research and/or administrative responsibilities.

It is essential that graduate students in Physiology be prepared to assume full-time responsibilities of a faculty member and/or for pursuit of a career in research. The following qualities are included: 1) Ability to develop an independent research program, 2) Assume teaching responsibilities in a broad area of Physiology, 3) Accept combined teaching, research, and administrative assignments and be able to maintain all on a viable level of operation at the same time, 4) Be informed on the essentials of "grantsmanship" and be familiar with grant application preparation, 5) Emphasis must be placed upon *quality* of trainees with great care in selection of students, rigor of performance standards, and demand for quality in the end product.

Importance of postdoctoral training experience was stressed in preparation and polishing of doctoral candidates for faculty positions. Interviews with job applicants frequently reveals remarkable differences in levels of preparation of candidates from different training programs. Should some kind of accreditation with emphasis upon certain *minimal* standards in training be considered? The committee believes the balance between supply and demand of young physiologists could be greatly improved if training programs were reminded that quality of product is more to be encouraged than quantity.

Item II, QUESTIONNAIRE GENERATING INFORMATION ON TRAINING.....Dr. Ramsey

Addition of only a few questions in each of 4 sections of the ACDP questionnaire will provide much solid information upon the numbers of physiologists in training as well as opportunities for employment in academic settings. The questionnaire can be circulated to a modestly enlarged group of training programs to provide the necessary data, including male-female comparisons. Dr. Franklyn Knox has indicated such additions were practical, and the new questionnaires can go out this summer.

Item III, OPPORTUNITIES FOR PHYSIOLOGISTS IN INDUSTRY AND GOVERNMENT.....Drs. Ridley and MacCanon

A survey of nine different representatives of the Pharmaceutical Industry revealed dramatic changes in such opportunities over last ten years. Whereas "only Pharmacologists" were expected to apply a few years ago, Physiologists, because of perceived broader expertise and training, are being hired at an accelerating rate. More emphasis is being placed upon fundamental mechanisms in biological systems, and Physiologists are perceived as being better prepared for these openings. About 10 to 20% of researchers in large R & D corporations now have doctorates in Physiology or have obtained postdoctoral training in Physiology Departments. It is estimated that about 300 Ph.D's are now employed in industry and more and more of these are Physiologists.

Comparable data are being worked up for employment of Physiologists in government, as well as under research grants

and contracts awarded by NIH. These data, together with those from the industry study, will be prepared for publication in *The Physiologist.*

Item IV, M.D. TRAINING AS A SOURCE OF PROFESSIONAL PHYSIOLOGISTS.....Dr. Bohr

Precise information is extremely difficult to obtain, but *trends* may be defined. This study will be actively pursued before the next committee meeting. An accompanying problem is associated with dramatic reductions in numbers of research-oriented physicians currently being prepared for teaching and research careers. There is a very real threat that such professionals are an "endangered species."

Item V, EMPLOYMENT OPPORTUNITIES IN CLINICAL DEPARTMENTS.....Dr. Blankenship

There appear to be dramatic changes in the attractiveness of careers in Clinical Department settings. The potential exists for productive and creative opportunities. Research funding, independence in research, teaching research procedures at the resident level, teaching basic physiology at the resident level, etc. combine to make the opportunities more attractive. This subject will be actively pursued and prepared for final draft at the fall meeting.

Item VI, PREPARATION OF DESCRIPTIVE BROCHURE

To be examined before the fall meeting.

AGENDA ITEMS, April 14, 1980

1. Primary Career Opportunities in Physiology.....Dr. Saba
2. Questionnaire for collection of reliable data on training and job opportunities for Physiologists.....Dr. Ramsey
3. Placement opportunities and potential careers for Physiologists in Industry and Government.....Dr. Ridley
4. Opportunities for young Physiologists in Clinical Departments.....Dr. Blankenship
5. Recruitment of Professional Physiologists from the ranks of M.D. Training programs.....Dr. Bohr
6. Preparation of list of topics which should be actively pursued by Career Opportunities Committee

Walter C. Randall, Chairman

CENTENNIAL CELEBRATION COMMITTEE

ANAHEIM, CALIFORNIA, APRIL 17, 1980

The Committee Meeting was held at the Inn-at-the-Park at 12:00 Noon on April 17 with the following members in attendance: Dr. Earl Wood, Chairman; Drs. Peter Chevalier, Ralph Kellogg, Arthur Otis, Orr Reynolds (ex officio), M.C. Shelesnyak, Task Force Director (ex officio). Also by invitation, Dr. Leroy L. Langley and Mr. Stephen Geiger (representing the Publications Committee on behalf of Dr. A.P. Fishman). Absent with permission, Dr. A.P. Fishman, M. Kafka, E. Knobil, and J.D. Neill.

The Agenda included: Discussion of Special Projects; Publications, by S. Geiger, Otis, Kellogg and Shelesnyak; Meeting Conferences, by Reynolds and Shelesnyak; Promotional Activities by Reynolds; Exhibitions by Shelesnyak; Scienfific Relations by Shelesnyak; Funding and Financing by Wood; Committee Membership by Wood.

Mr. Geiger reported on the History of the American Physiological Society. A proposal submitted by members of the History and Sociology of Science Department of the University of Pennsylvania is under review. A second project under review is a collection of reviews of subfields of physiology over the past century, written by distinguished members, with an overall Editor and Special Editorial Review Board. The third item, is the reprinting of the History of the American Physiological Society Semicentennial, 1887-1937, edited by Walter J. Meek, and the APS- The Third Quarter Century, 1937-1962, Wallace O. Fenn, plus a Society History of the Fourth Quarter. Dr. Shelesnyak invited attention to his activities with the Washington scholars interested in the History of Military Medicine, for the examination of the role of APS and American physiologists in the military services.

Dr. Otis has assumed responsibility for encouraging Departmental Histories. Dr. Davenport, a member of this Committee since its inception, (he resigned this term) has prepared "Guidelines to writing Departmental Histories." Dr. Reynolds has received a number of offers volunteering to write Department Histories. These will be conveyed to Dr. Otis.

Dr. Kellogg reported on his plan to activate more Vignettes.

Biographical Directories were discussed by Dr. Reynolds and Dr. Shelesnyak. Dr. Reynolds spoke of the computer bank of all APS members, living - active and resigned, and dead, based mainly on existing computer data available to APS.

It was moved: Dr. Reynolds and staff be directed to develop a computer data bank of all members (Living-Active and Resigned, and Dead) to include name, degrees, affiliation (current or last known), specialty field, date of birth, election to membership, (if relevant, date of death or resignation). Other data need not be excluded.

Motion made by Ralph Kellogg and seconded by Dr. Otis.

Since the 30th International Congress of Physiological Sciences is scheduled for 1986 - the program for the centennial celebration of the Society, proposed inviting the IUPS to "introduce" the APS centennial year at the 30th Congress, particularly if the Congress is convened in the Western Hemisphere. With the probability of a Western Hemisphere site, a discussion of the relationship of the Centennial to the Congress ensued. There existed a basic misunderstaning. The Proposal (generated by the Task Force in 1978) was to simply mark the advent of the APS Centennial, perhaps with a special historical lecture, not to make the Congress an APS Centennial affair. The Committee suggested the matter be approached in a low key manner to avoid possible adverse reactions.

Dr. Shelesnyak submitted his report on the evaluation and selection of a site for the 1987 Centennial Meeting. Suggestions were made by members to consider Baltimore, Boston, New York, Pittsburgh, Philadephia, St. Louis, and the Washington, D.C. area. Invitations to host the meeting have come only from Pittsburgh and the Washington area. The Uniformed Services University of the Health Sciences invited APS to use its facilities in Bethesda. The City of Pittsburgh proposed considering it, since the Bicentennial of the University of Pittsburgh is in the same year.

For a number of reasons, Dr. Shelesnyak recommended Washington, D.C. and its environs. The Committee, however, suggested pursuing the matter further, and report back at the Fall

Meeting. The Task Force Executive Committee (Drs. Chevalier, Reynolds and Shelesnyak) was directed to pursue the matter by motion of Dr. Wood and seconded by Dr. Kellogg.

Dr. Shelesnyak reported his activities with the Office of Symposia and Seminars of the Smithsonian. This office organizes and conducts three to four-day symposia "as an interdisciplinary feature of its regular educational programs. Formal meetings bring together scholars and specialists in humanities and sciences from many countries for examination of a central theme of common concern." The Advisory Committee to the OSSS reviewed the proposition of a symposium in 1987 on "American Physiology and its place in the structure of American social fabric," (not the specific title); and accepted the concept as a suitable activity for the Smithsonian. The Advisory Committee requested Dr. Shelesnyak to initiate the process by convening an in-house (SI) group (Dr. Shelesnyak is a member of the Advisory Committee).

Dr. Reynolds reported on promotional activities which dealt with requests for contributions to the CCC Fund, and various Society Logo paraphernalia which would be awarded contributors. The matter will be pursued. It was considered that now is the time to begin more active promotional activities.

Dr. Wood discussed committee membership. His election to President of the Society meant that he could not continue as Chairman of the CCC. (Dr. Peter Chevalier was later approved by Council as the Chairman for a three-year period). Dr. Marian Kafka was moved from ex officio to regular member of the Committee. The Committee was strengthened by the addition of two new members, Dr. Lee Langley and Dr. Sidney Ochs. We regretted the resignations of Drs. Davenport and Moe.

The meeting was adjourned at 3:30 PM.

ANIMAL CARE AND EXPERIMENTATION COMMITTEE

Report for October 1979 - April 1980

Committee Members: Charles Cornelius, David Donald, Malcolm Hast, Robert Hazelwood, and Helene Cecil, Chairman

The Animal Care and Experimentation Committee did not meet during this period. Listed below are the activities of the Committee.

I. *Guidelines for Animal Use*

A revision of the current "Guiding Principles in the Care and Use of Animals" was submitted to the Council and approved. The approved revision of the "Guiding Principles" appears on page 38.

II. *Symposium on Bioethical Issues of Animal Use in Research*

A symposium addressing the ethical issues in animal research was approved by the Program Committee and is tentatively scheduled as an evening symposium during the Spring '81 meeting in Atlanta. A. Clifford Barger was appointed to advise the Animal Care Committee.

III. *Accreditation of Laboratory Animal Facilities*

The APS received a request to review APS's input into the promulgation of the standards used by the American Association of Laboratory Animal Care (AAALAC) to accredit animal facilities. The APS is currently represented by FASEB delegate, Dr. Lloyd C. Faulkner. The AAALAC uses the "NIH Guide for Care and Use of Laboratory Animals" as their accreditation standard and stringent interpretation of the NIH Guide could make accreditation very difficult. Our Committee has endorsed the NIH Guide to guide APS members in conducting their animal research, and has inserted this endorsement in the revised "Guiding Principles in the Care and Use of Animals." The Committee felt the NIH Guide was the best available source which concisely defines good animal care and management. The Committee has not reviewed the NIH Guide item by item to assess the appropriateness of each standard, nor does the Committee know how many physiologists use animal facilities which cannot meet the NIH Guide standards.

Because the APS is concerned with having appropriate standards for animal care and surgery and because the AAALAC accreditation is becoming increasingly important, the Committee will explore the possibility of (a) APS being a member organization on the AAALAC Board of Trustees and (b) submitting *curriculum vitae* of nominees as consultants to the AAALAC Council on Accreditation.

IV. *Organizations Concerned with Animal Use in Research*

The Committee wishes to maintain a dialogue with organizations interested in animal welfare and a rapport with organizations sanctioning the use of animals in research.

The National Society for Medical Research (NSMR) monitors state and federal legislation on research animal use and laboratory practices and also educates the public on the use of animals in research. To meet the rising costs of inflation the NSMR reorganized its executive structure to monitor expenditures more closely. Dr. John F. Sherman was elected President and Dr. Thurmond S. Grafton continues as Executive Director of NSMR. The Committee recommends that the APS continue to support the NSMR.

In February, H. Cecil met with Dr. Leon Bernstein, a consultant to the Animal Welfare Institute, Mrs. Christine Stevens, AWI President, and her staff. We discussed the use of animals in research and alternatives to animal use. The discussion was more philosophical than physiological. Mrs. Stevens was interested in documentation of the actual numbers of animal used in research and the ways animals use in teaching and research has been reduced by other means e.g. models, films, computers.

To maintain a source of information on animal welfare the Committee is compiling (I) a list of organizations concerned with animal welfare and a brief description of each organization's objectives and (2) a bibliography of publications pertaining to the ethics and appropriateness of animal use in research. The Committee would appreciate receiving information on animal welfare from APS members.

Helene Cecil, Chairman

REPORT OF THE PERKINS MEMORIAL FUND COMMITTEE, 1979

The Perkins Memorial Fund provided partial support for two visiting physiologists and their families during 1979. Dr. and Mrs. Ran Arieli from the University of Tel-Aviv, Israel, came with their four children to work with Dr. H. Van Liew at the University of Buffalo. Dr. and Mrs. Syozo Koyama from Shinsu University, Japan, came with their two children to work with Dr. J.W. Manning at Emory University.

Applications of high standard have been received for the 1980 academic year and there seem to be no reasons at this time to alter either the goals or the mode of operation of the Perkins Committee.

John R. Pappenheimer, Chairman

REPORT OF APS REPRESENTATIVE TO CAS, AAMC

Franklyn G. Knox, M.D., Ph.D.
Professor and Chairman

The Council of Academic Societies met March 18-19 in Washington. The American Physiological Society was represented by myself as CAS representative, and by Brian Curtis as the Public Affairs representative. Bob Crane represented the Association of Chairman of Departments of Physiology. This report will deal with legislative update, remarks by Senator Richard Schweiker, and the group discussions.

Budget Reduction. In response to the President's call for a balanced budget, reductions for Public Health Service programs and specific reductions for NIH are proposed. To accomplish the reduction in 1980, a rescission of $163.5 million is proposed. The 1980 reduction will permit the awarding of 1,368 fewer research projects, 350 fewer trainees, and 110 fewer research contracts. The total number of competing research projects is reduced from 5,000 to 3,500 for both 1980 and 1981.

The Health Research Act of 1980 (HR 6522). This act needs considerable additional input from the scientific community. However, the major overriding consideration at the moment is that the Act does contain extensions for expiring authorities. Therefore, it is important to try to get an extension of the expiring authorities *only* at this time.

Remarks by Senator Richard Schweiker. Senator Schweiker appeared to have an excellent grasp of the problems facing the academic community. He indicated that retrenchment was inevitable, that there would be little or no growth in biomedical research, and that the appropriations for this area have become harder and harder to protect, particularly in the face of a federal budget cut which is estimated to range from $13 to $22 billion. He addressed training programs specifically and indicated that the burden or justification would fall on the training programs. He indicated the most alarming feature of the current budget was that there would be no new or renewal training grants, an aspect he felt was penny-wise and pound-foolish. He identified the decline in clinician-investigators and associated this with an insecurity of research as a profession. He indicated that we should work together toward a stability with a balanced level of support rather than working toward separate specific goals. He addressed the rhetorical question, Why is research always the first to go? He indicated that this was one of the few controllable features in the budget. He indicated that 95% of the Human Services area budget was in the uncontrollable category. His advice for the research community was to publicize the cost effectiveness of biomedical research, the consequences and importance toward human health. He indicated that the public is not anxious to support scientists to indulge their curiosity. He did indicate that basic research merits public support, but that this must be in the framework of its potential contribution. He encouraged the motivation of young scientists even though the future looks unstable. He encouraged the joining together with lay health organizations to work toward common goals. All in all, he presented a rather gloomy picture which is even further eroded by the fact that Senator Schweiker is not going to stand for relection. One of the difficulties indicated was that there are fewer and fewer advocates for biomedical research in Congress with "no institutional memory." New staff members with special interests have had input, such as in the NIH bill, who have "no concept of what they're doing."

The *Group Discussions* involved development of policies to assure an adequate national research effort. A new mechanism of stability at 5,000 grants per year was discussed with the pros and cons. Unfortunately, even this goal has been significantly eroded by recent actions. The ideal to link research support as a percentage of the health budget was endorsed. Currently, health research is about 2% of the health budget, with a goal of 5%. An additional provision that some funds should be earmarked for young investigators was included.

An additional group discussed health manpower. The Health Professional Assistance Act expires in 1980. Two bills have been prepared by Senators Schweiker and Kennedy. Analysis of those bills are available. In brief, there is very little continued support for capitation.

The last discussion area was essential research training. There was a general notion that research training programs, including Ph.D. programs, should not be accredited. However, it is noteworthy that a dual review process involving the LCME and regional graduate programs reviews has been initiated which suggests a trend toward accreditation of Ph.D. programs. It was concluded that the Boards are too restrictive in regard to dealing with clinician-investigator research training programs. Suggestions to forgive loans to those embarking upon research careers were made.

It is likely that every special interest group in the country that faces severe budget cuts will try to protect their turf. I think that we must be no exception, recognizing that a balanced budget is perhaps in the nation's best interest, and that we might attempt to do our part, but not to the extent of completely dismantling biomedical research training.

MEMBERSHIP STATUS

Regular	4,247
Honorary	8
Emeritus	476
Associate	652
Corresponding	47
Student	180
Total	5,610

DEATHS REPORTED SINCE THE 1979 FALL MEETING

E.M. Bogdanove (R) -10-23-79- Med. Coll. of VA, Richmond
Thomas B. Calhoon (R) - 2- 2-80- Univ. of Louisville
Efren C. Del Pozo (R) - 5-14-79- Mexico City
Charles L. Hamilton (R) -11-15-79- Univ. of Pennsylvania
Julia F. Herrick (R) -12-27-79- Indianapolis Ctr. for Advanced Res.
Fred A. Hitchcock (R) - 2-15-80- Columus, OH
Laurence Irving (R) -12-31-79- Univ. of Alaska, Fairbanks
Frederick Lang (R) - - - - Marine Biol. Lab., Woods Hole
Amedeo S. Marrazzi (E) - 1- 80- Wayne State Univ., Detroit
Edward C. Meyer (R) 10-11-79- Fitzgerald Mercy Hosp., Darby, PA
George S. O'Brien (R) -11-19-79- Lake Forest, IL
Alexis L. Romanoff (E) -11-19-79- Cornell Univ., Ithaca
Andrew H. Ryan (E) - 3-18-76- Chicago Med. Sch.
S.E. Steiman (R) - 9- 79- Lynn, MA
Edward J. Van Liere (E)- - -W. VA. Sch. Med., Morgantown
Roderich W. Walter (R) - 9-18-79- Univ. of Illinois, Urbana
Marlin W. Welling (A) -11-30-79- VA Wadsworth Hosp. Ctr., Los Angeles

R - Regular
E - Emeritus
A - Associate

FIFTY-YEAR MEMBERS AND YEAR OF ELECTION

Abramson, Harold A., 1930 (R)
Adolph, Edward F., 1921 (E)
Baetjer, Anna M., 1929 (E)
Bergeim, Olaf, 1916 (E)
Bing, Richard J., 1922 (R)
Bourquin, Helen, 1925 (R)
Boyd, T.E., 1925 (E)
Cattell, McKeen, 1923 (E)
Chen, K.K., 1929 (R)
Crandall, Jr., Lathan, 1930 (E)
Davis, Hallowell, 1925 (R)
Dragstedt, Carl A., 1928 (E)
Friedman, Maurice H., 1929 (R)
Gemmill, Chalmers L., 1928 (E)
Gilson, Arthur S., 1927 (E)
Greisheimer, Esther M., 1925 (E)
Grollman, Arthur, 1925 (E)
Gross, Erwin G., 1927 (E)
Hartline, H.K., 1929 (E)
Hastings, Albert B., 1927 (E)
Hayman, Jr., Joseph M. 1928 (E)
Hertzman, Alrick B., 1925 (E)
Hinrichs, Marie A., 1928 (R)
Hinsey, Joseph C., 1929 (E)
Jackson, Dennis E., 1910 (E)
Jacobson, Edmund, 1929 (R)
Johnson, Jane S. R., 1925 (E)
Jung, Frederic T., 1930 (E)
Kleitman, Nathaniel, 1923 (E)
Koppanyi, Theodore, 1924 (E)
Landis, Eugene M., 1928 (E)
Mayerson, H.S., 1928 (R)
Pond, Samuel E., 1924 (E)
Redfield, Alfred C., 1919 (E)
Reznikoff, Paul, 1927 (E)
Richter, Curt P., 1924 (E)
Schmidt, Carl F., 1929 (E)
Schmitt, Francis O., 1930 (E)
Soskin, Samuel, 1930 (E)
Starr, Isaac, 1929 (R)
Still, Eugene U., 1928 (E)
Tainter, Maurice L., 1929 (E)
Visscher, Maurice B., 1927 (E)
Wearn, Joseph T. 1921 (E)
Wyman, Leland C., 1927 (E)
Zwemer, Raymund L., 1930 (E)

(R) Regular
(E) Emeritus

NEWLY ELECTED MEMBERS

The following, nominated by Council, were elected to membership in the Society at the Spring Meeting, 1980.

REGULAR MEMBERS

ADAMS III, George K.: Clin. Immunol., Good Samaritan Hosp., Baltimore
AL-BAZZAZ, Faiq J.: Med. Service, West Side VA Med. Ctr. Chicago
ANURAS, Sinn: Dept. Med., Univ. of Iowa, Iowa City
ARVANITAKIS, Constantine: Dept. Med., Kansas Univ. Med. Ctr., Kansas City
BAIER, Horst J.: Pulmonary Div., Univ. of Miami Sch. Med.
BARDIN, C. Wayne: Population Council, Rockefeller Univ., New York City
BEALER, Steven L.: Dept. Physiol. & Biophys., Univ., of Tennessee, Memphis
BETZ, Alert L.: Dept. Pediat., Univ. of Michigan, Ann Arbor
BEVAN, Rosemary D.: Dept. Pharmacol., UCLA Sch. Med.
BLANKEMEYER, James T.: Dept. Physiol. Sci., Oklahoma State Univ., Stillwater
BOERBOOM, Lawrence E.: Dept. Cardiothoracic Surg., Med. Coll. of Wisconsin, Milwaukee
BOURDEAU, James E.: 505 Lake Shore Dr., Chicago
BRAND, Paul H.: Dept. Physiol., Med. Coll. of Ohio, Toledo
BUNGER, Rolf: Dept. Physiol., Uniformed Services Univ., Bethesda, MD
BURKE, John F.: Dept. Surg., Mass. Gen. Hosp., Boston
CAFFREY, James L.: Dept. Physiol., North Texas Univ., Fort Worth
CAREY, Rita A.: Cardiol. Sect., Health Sci. Ctr., Philadelphia
CHAUDHURI, Tapan K.: Nuclear Med. Service, VA Med. Ctr., Hampton, VA
CHEN, Jing S.: Dept. Physiol. & Biophys., Georgetown Univ. Med. Ctr., Washington, DC
CHEUNG, CECILIA Y-M: Dept. Physiol., Loma Linda Univ., Loma Linda, CA
CHIASSON, Jean L.: Howard Hughes Med. Inst., Vanderbilt Univ., Nashville
CLARKE, John R.: Naval Med. Res. Inst., Bethesda, MD
COTTON, David J.: Pulmonary Med., Univ. Hosp., Saskatooon, Canada
CROFTON, Joan T.: Dept. Physiol. & Biophys., Univ. of Tennessee, Memphis
DAVIS, James A.: Div. Resp. Physiol. & Med., Harbor-UCLA Med. Ctr., Torrance
DEAL, Eugene C., Jr.: Cleveland Heights, OH
DEAVERS, DANIEL R.: Dept. Physiol. & Biophys., Univ. of Louisville
DEFORREST, Jack M.: Sr. Investgator, Squibb Inst. Med. Res., Princeton, NJ
DIAMOND, Louis: Coll. Pharmacy, Univ. of Kentucky, Lexington
DRAY, Andre: Dept. Pharmacol., Univ. Arizona, Tucson
ENGELKING, Larry R.: Coll. Osteopathic Med of the Pacific, Pomona, CA
EVELOFF, Jill L.: Dept. Physiol., Albert Einstein Coll. Med., Bronx, NY
FERGUSON, Earl W.: Dept. Biochem., Uniformed Services Univ., Bethesda, MD

FLAIM, Stephen F.: Div. Cardiol., Penn State Univ., Hershey, PA
FOSSEL, Eric T.: West Newton, MA
FRANCIS, Kennon T.: Univ. of Alabama, Birmingham
FRANK, H. Lee: Pulmonary Div., Univ. of Miami Med. Sch.
FRANK, Joy S.: Cardiovasc. Res. Lab., UCLA Sch. Med.
FREEDMAN, Jeffrey C.: Dept. Physiol., SUNY Upstate Med. Ctr., Syracuse
FREY, Mary Anne B.: Wright State Univ., Dayton, OH
GOLDBERG, Howard S.: Resp. Lab., Winnipeg, Canada
GORIN, Arnold B.: Dept. Int. Med., Univ. of California, Davis
GOULD, Kenneth G.: Yerkes Primate Res. Ctr., Emory Univ., Atlanta
GUGGINO, William B.: Dept. Physiol., Yale Univ., New Haven
GULLNER, Hans-Georg: Res. Service, VA Hosp., San Antonio
HADDAD, Gabriel G.: Pediat. Pul. Div., Columbia Presb. Med. Ctr., New York
HAGAN, Raymond D.: Inst. Aerobics Res., Dallas
HANSON, Robert C.: Dept. Biol. Res., Mead Johnson Co., Evansville, IN
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EUROPEAN SYMPOSIUM FOR STEREOLOGY

The Third European Symposium for Stereology will be held at Ljubljana, capital of Slovenia, Yugoslavia, June 22 to 27, 1981. The sessions of the Symposium will cover the following subjects: Mathematics; Life Sciences; Materials Science; Instrumentation; and Others. For further information write to: Prof. Dr. Miroslav Kalisnik, Inst. for Histology and Embryology, P.O. Box 10, 61105 Ljubljana, Yugoslavia.

UNDERSEA MEDICAL SOCIETY - GREAT LAKES CHAPTER

ANNUAL MEETING

October 12 and 13, 1980

Defense and Civil Institute of Environmental Medicine, Downsview, Toronto, Canada

SUN. Oct. 12 - 9AM-10AM - Registration
10AM-1PM - SESSION I: Diving in the Great Lakes Area
1PM-3PM - Lunch & Business Meeting
3PM-6PM - SESSION II: Medical Problems of Cold Water Diving
MON. Oct. 13 - 9AM-Noon - SESSION III: General Physiology of Diving

Each session will have 6 speakers with topics of interest to commercial and sport divers as well as to physicians, researchers, etc. In addition to the scientific sessions, tours will be conducted at the diving research facility at DCIEM and at the Canadian Underwater Training Centre (Toronto Harbour).
Registration fee - $5.00 for UMS members and $10.00 for nonmembers. Inquiries and or payments should be sent to:

Ronald Y. Nishi, Program Chairman
DCIEM
P.O. Box 2000
Downsview, Ontario M3M 3B9
Tel. - (416) 633-4240

STATISTICS ON APS MEMBERSHIP

(As of May 1980)

DISTRIBUTION BY EMPLOYMENT*

	#	%
MEDICAL SCHOOLS	3,217	65
Physiology Departments	(1,681)	(34)
Other Preclinical Departments	(430)	(09)
Clinical	(1,054)	(21)
Administration	(52)	(01)
HOSPITALS AND CLINICS	218	04
VETERINARY SCHOOLS	95	02
DENTAL SCHOOLS	47	01
PUBLIC HEALTH AND GRADUATE SCHOOLS	235	05
UNDERGRADUATE SCHOOLS	342	07
COMMERCIAL COMPANIES	102	02
GOVERNMENT	327	07
INSTITUTES AND FOUNDATIONS	221	04
PRIVATE PRACTICE	52	01
OTHER, EMERITUS OR INACTIVE	125	03

*4,982 Respondents

DISTRIBUTION BY EARNED DEGREE*

(Includes 625 individuals with multiple doctorate degrees)

	#
Ph.D.	3,272
M.D.	1,991
D.V.M.	134
D.D.S. and other	29

*4,801 Respondents

PRINCIPAL TYPE OF WORK*

	%
Research	68
Teaching	17
Administration	08
Clinical	06
Other	01

*4,973 Respondents

DISTRIBUTION BY PRIMARY SPECIALITY*

	%		%
Cardiovascular	19	Cellular and Tissue	04
Neurophysiology	14	Blood	03
Endocrines	10	Comparative	03
Respiration	09	Energy Metabolism and Temperature Regulation	02
Electrolyte and Water Balance	05	Pharmacology	02
Renal	05	Reproduction	02
Muscle and Exercise	05	All other Categories (None above 1%)	08
Gastrointestinal, Food and Nutrition	04		
Environmental	04		

*4,856 Respondents

DISTRIBUTION BY AGE*

70+	381
60–69	622
50–59	1,581
40–49	1,401
30–39	1,213
20–29	180

DISTRIBUTION BY RACIAL BACKGROUND AND HERITAGE*

American Indian or Alaskan	7
Asian or Pacific Islander	175
Black	28
White	3,707
Hispanic Heritage	78

* Optional Personal Data (Numbers represent total respondents)

DISTRIBUTION BY SEX*

Female	471
Male	4,063

* Optional Personal Data (Numbers represent total respondents)

APS NORTH AMERICAN MEMBERSHIP

United States	5,146
Canada	224
Mexico	10

STATES IN U.S. WITH MORE THAN 100 MEMBERS*

California	595	North Carolina	131
New York	582	Florida	129
Pennsylvania	310	New Jersey	123
Maryland	294	Missouri	121
Texas	290	Virginia	119
Massachusetts	263	Minnesota	114
Illinois	247		
Ohio	188		
Michigan	154		

* 50 States plus Puerto Rico & Virgin Islands

CANADIAN PROVINCES WITH 5 OR MORE MEMBERS*

Ontario	87
Quebec	65
British Columbia	22
Alberta	17
Manitoba	16
Nova Scotia	8
Saskatchewan	6

Other Provinces represented:

New Brunswick
Newfoundland
Yukon Territory

APS MEMBERSHIP OUTSIDE OF NORTH AMERICA

COUNTRIES WITH 5 OR MORE MEMBERS

Germany, Federal Republic	17
Japan	16
United Kingdom	16
Switzerland	15
France	8
Israel	7
Australia	6
Denmark	5
Belgium	5
Norway	5
Spain & Canary Islands	5
Venezuela	5

Other countries represented:

Poland	Chile
Sweden	Hong Kong
Argentina	Iceland
Greece	Kuwait
Netherlands	Lebanon
Peru	New Guinea
South Africa	Peoples Rep. of China
Hungary	Portugal
Italy	Rhodesia
New Zealand	Saudi Arabia
Nigeria	Taiwan Rep. of China
Austria	USSR
Brazil	

APPORTIONMENT OF REGULAR MEMBER DUES INCOME

(Budgeted Figures Approximated to Nearest Dollar)

FASEB Assessment	1978	1979	1980
Federation Proceedings	$ 7.00	$ 9.00	$11.00
Membership Directory	4.00	5.00	5.00
Public Affairs/Newsletter	7.00	8.00	9.00
Placement Service	2.00	1.00	1.00
Other Services	2.00	3.00	2.00
	$22.00	$26.00	$28.00
Society Operating Fund Expenses			
Council and Committee Support	$ 3.00	$ 4.00	$ 4.00
Membership Services	6.00	6.00	6.00
Meeting Program Costs	13.00	13.00	13.00
Education Office	7.00	7.00	7.00
The Physiologist	8.00	10.00	10.00
Specialty Group Services	3.00	3.00	3.00
Business Office	5.00	6.00	6.00
Communications & Miscellaneous	4.00	5.00	5.00
Dues to Other Organizations	1.00	1.00	1.00
	$50.00	$55.00	$55.00
Total cost/member	$72.00	$81.00	$83.00
Distribution of FASEB annual meeting income	22.00	14.00	8.00
Net cost/member	$50.00	$67.00	$75.00
Dues	50.00	55.00	75.00
Net gain (Deficit)	0.00	($12.00)[1]	0.00

[1] Deficit of $12.00/member paid from APS publication reserves.

THE RAY G. DAGGS AWARD

The presentation of the Ray G. Daggs Award was made by Dr. Ernst Knobil who announced that the President has but one pleasant task during his year of service and that is to announce the recipient of the highest and only award of the APS, the Daggs Award, for distinguished service to physiology and to our Society.

"This singular pleasure is even more acute this year because the recipient of this honor is Professor John R. Brobeck. He was born in Steamboat Springs, Colorado, where he experienced the entirety of his primary and secondary education. He then went to Wheaton College in Wheaton, Illinois. Following completion of his undergraduate work, he went to Northwestern University and entered graduate study under Professor Ranson and, under his aegis, completed the requirements for the Ph.D. in neurophysiology. But he did not rest on this accomplishment and went on to study medicine at Yale University from which he received the doctorate in medicine in 1943. He did not, however, go on to an internship or residency. I was told on good authority that John Brobeck graduated from Medical School on a Saturday and began teaching duties as an instructor in the Department of Physiology at Yale on the following Monday. That Department was an uncommonly seminal place at that time, at least from the viewpoint of an endocrinologist like myself. Fulton was the Chairman; C.N.H. Long, one of the great leaders in the study of the control of metabolism and the endocrine system (what would be thought of in retrospect as neuroendocrinology) was there. Jane Russell, Alfred Wilhelmi, George Sayers and Jay Tepperman were also in attendance. The only incomprehensible thing about this early exposure is that John did not become a full-blooded endocrinologist. But he did almost as well. While still at Yale, he contributed to one of the great classics of physiology, of psychology, of medicine and, indeed, of biology generally: the role of the hypothalamus in the control of appetitive behavior and food intake.

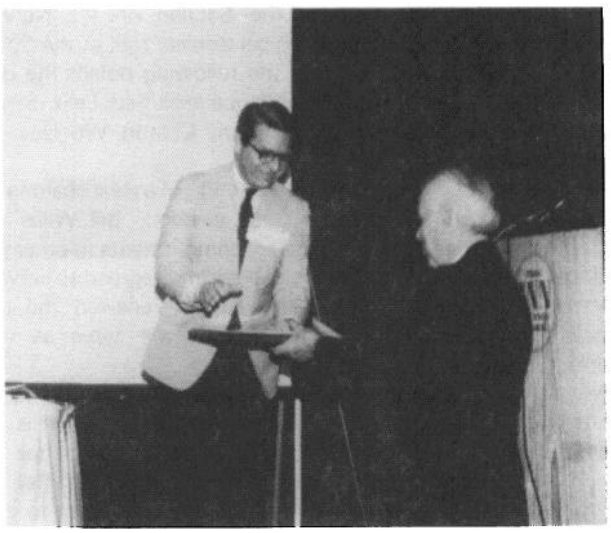
John Brobeck left New Haven to take the Chair of Physiology at the University of Pennsylvania in 1952. He retained that post until 1970, when he was relieved from that onus to become Herbert C. Rorer Professor of Medical Sciences at the University of Pennsylvaia, a post which he still holds.

He was President of the American Physiological Society in 1971-72 having served the Society faithfully and well before that as Editor-in-Chief of *Physiological Reviews* and in a number of other capacities. His editorial career began early when he was at Yale where he served as Editor of the *Yale Journal of Biology and Medicine* in 1949-52. He continues to give the Society, the unstinting benefits of his time and wisdom.

Beyond his service to the Society and his signal contribution to the field, he has been instrumental in the affairs of the Federation of the American Societies for Experimental Biology as Treasurer and as Chairman of its Finance Committee. I am certain that if it had not been for Dr. Brobeck's recent tutelage, I never would have acquired even the faintest glimmer of understanding of the finances of the Federation.

John Brobeck, it is a great honor for us to present to you the highest accolade of the American Physiological Society, The Ray G. Daggs Award for 1980."

Dr. Brobeck said it would be ungracious to ask for equal time. "I do want to say thank you. A few months ago, I was introduced



at a rather formal dinner at the University of Pennsylvania by a close friend who said, 'I want you to meet a great friend and I want you to know that he did a great thing for the University of Pennsylvania. He resigned as Chairman of the Department of Physiology. I thought that Ernie Knobil was going to find something like that, that I had done for the American Physiological Society.

I know about the Ray G. Daggs Award because I was there when it was invented. It was not adopted by the Council to honor aging members of the Society but to honor the contributions that Ray Daggs made during his years he served the Society. If it is appropriate for me to receive this award, it is only because there is no one in the Society who is more indebted to Ray Daggs for the help and friendship that he gave me. As soon as I go back, I am going over to New Jersey and take the plaque over so Ray can see it.

Thank you."

SECTION ON THE NERVOUS SYSTEM

SPRING MEETING REPORT

The Steering Committee for the Section on the Nervous System of the American Physiological Society met at the Spring FASEB Meeting in Anaheim and the following details the decisions reached. Members in attendance included Felix Strumwasser, Dick Orkand, George Somjen, Clinton Woolsey and David Carpenter.

A major item of business was the election of a new chairman of the Steering Committee. In a close election, Bill Willis was elected but declined because of heavy commitments to other professional duties. Dick Orkand, a close second, agreed to serve as chairman of the committee. Larry Kruger received the next highest number of votes and therefore will serve as vice-chairman.

We discussed persons to be nominated for election to the steering committee to replace Clinton Woolsey, Bill Willis and Charlie Edwards, who are due to rotate off the committee this fall. As we have done in the past, the steering committee will choose six nominees whose names will be submitted to APS members who have indicated a special interest in neurosciences and three will be elected to serve three-year terms on the committee. By secret ballot, the six persons receiving the most votes for nomination include Janet Trubatch, Washington, D.C.; A. M. (Buzz) Brown, Galveston; Ben Libet (San Francisco); Betty Twarog (Stony Brook); Carl Cotman (Irvine); and Joe Coulter, Galveston. Runners up included Evelyn Satinoff, Champagne-Urbana; David Cohen, Stony Brook; Kris Krenjevic, Montreal; and Loren Mendell, Durham, North Carolina. Of the members presently on this committee, Ochs, Kruger and Strumwasser will serve for one more year, and Orkand, Stuart and Somjen will have regular terms of two more years. As indicated in our charter, the chairman of the committee is elected for a term of three years independent of his normal rotation date, while the vice-chairman is elected for a term of one year.

At the request of Orr Reynolds and Steve Geiger of APS, the steering committee was asked to make recommendations to the editor of the Journal of Neurophysiology as to possible new members of the editorial board who would provide increased breadth. It appeared to be the strong consensus of the committee that the Journal of Neurophysiology was doing very well as it was. Nevertheless, the following names were discussed as appropriate members to be considered to the editorial board: Zach Hall, Tom Reese, Hal Gainer, Roger Gorski, Perry Molinoff, Paul Greengard and Wiley Vale.

An item of major business was discussion of symposia to be scheduled for the spring meeting of 1981. The program advisory committee and the program committee have approved once again the presentation of six symposia in neurobiology. Our first choices were:

1. Symposium on the use of brain slices and elucidation of synaptic mechanisms. Possible chairman and organizer: Glenn Hatton, Michigan State
2. New understandings of motor units. Possible organizer: Doug Stuart, University of Arizona
3. Axoplasmic transport (with particular emphasis on pharmacologic advances). Suggested organizer: Sid Ochs, Indiana University
4. Pepditergic neurons in invertebrates and vertebrates. Confirmed Organizer: Felix Strumwasser, Cal Tech
5. Mechanisms of sensory transduction. Suggested organizer: Dennis Baylor, Stanford. Suggested speakers: J. Adler, University of Wisconsin of bacterial chemotaxis; Kung, University of Wisconsin on sensory transduction in *Paramecia,* D. Baylor, Stanford, on sensory transduction in photoreceptors, Ake Flock, Stockholm, Sweden or Jim Hudspeth, Cal Tech on ciliated receptor cell transduction.
6. Thermoregulatory effects of the newer putative central neurotransmitters. Suggested organizer: Clark Blatteis, University of Tennessee

A number of symposia subjects were suggested but were considered to be either alternatives for next year or preferably delayed for 1982. These included a symposium on neural toxicology (suggested organizer George Somjen) behavioral correlation of synaptic modulation (to be organized by Don Woodward at Houston), innervation of the gut (to be organized by Jack Wood at Reno), the electrophysiological responses in brain to GI hormones (to be organized by a person to be designated later) and ionic gating currents (to be organized by Raynor or Armstrong).

I am very grateful for all of the help and cooperation I received during the several years that I have served as chairman on this committee. It's been fun and I think been productive and valuable. This last meeting in Anaheim was particularly satisfying in terms of the attendance and general level of enthusiasm that we had at the symposia and sessions. I think that we're fighting a worthy battle!

David O. Carpenter

ANDREW C. IVY PAPERS

The Archive of Contemporary History at the University of Wyoming is collecting the papers of Andrew C. Ivy. If you have letters, manuscripts, or any other kinds of literary memorabilia pertaining to Ivy which you wish to give to the Archive, write to Gene M. Gressley, Director, Archive of Contemporary History, Box 3334, Laramie, WY 82071.

FIFTY-THIRD PRESIDENT OF APS

The fifty-third President of the American Physiological Society, Earl H. Wood, will assume office on July 1, 1980. Dr. Wood, senior consultant in physiology and professor of physiology and medicine in Mayo Medical School, is nearing the end of the 38th year of a remarkable and distinguished career as a researcher at Mayo Clinic.

His many contributions to. APS activities have included Presidency of the Circulation group (1964), membership on the AJP-JAP Editorial Board (1963-65), the Committee on Committees (1976-77), Council (1977-78), Chairmanship of the Committee for Celebration of the Centennial (1978-79), and President-Elect (1979).

A native of Mankato, Minn., he holds a B.A. degree from Macalester College, St. Paul, and B.S., M.S., Ph.D. (physiology under Professor M.B. Visscher) and M.D. degrees from the University of Minnesota, the latter two degrees received in 1941.

He was awarded a National Research Council Fellowship in the Medical Sciences to work under Professor A.N. Richards, Department of Pharmacology, University of Pennsylvania in 1940-41, then spent the following year as an instructor in pharmacology at Harvard Medical School under Professor Otto Krayer.

He was appointed a research assistant in Mayo Clinic's Aeromedical Unit in 1942 and during the subsequent four years studied the physiology and methods for prevention of the pathophysiologic effects of positive ($+G_2$) acceleration experienced by fighter and dive bomber pilots during World War II, simulated under controlled laboratory conditions on the Mayo Human Centrifuge and subsequently under actual flight conditions in a specially instrumented dive bomber.

The studies of Dr. Wood and his colleagues led to the development of voluntary self protective maneuvers, a simplifed antigravity suit to protect fighter pilots against "blackout" and of the valves which automatically pressurize the suits. In 1947, Dr. Wood received a certificate of merit signed by President Truman for the contribution of these efforts to the war effort.

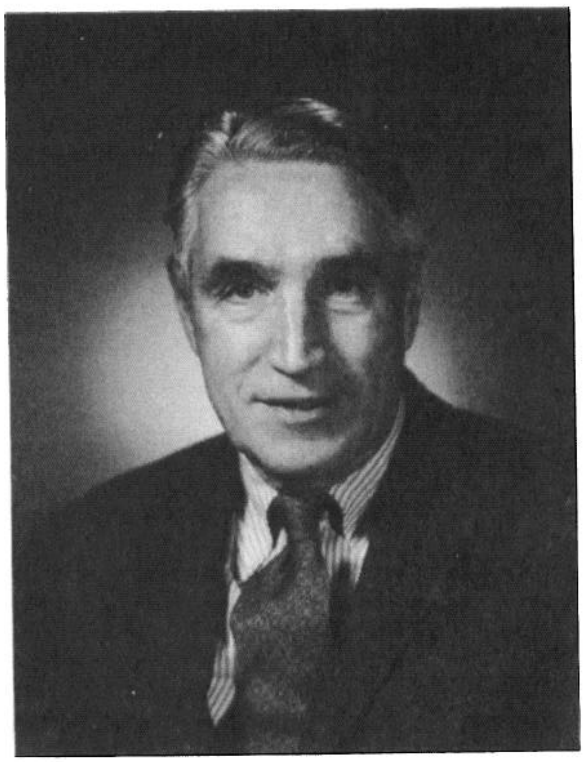
He was named a consultant in physiology at Mayo Clinic in 1946 and became a professor in physiology in the Mayo Graduate School, University of Minnesota, in 1951.

During the late 1940s and through the 1950s, Dr. Wood, as head of Mayo's Cardiovascular Laboratory, was intensively involved in the development of instrumentation and multichannel recording methods required to carry out simultaneous diagnostic right heart, left heart and arterial catheterization procedures in adults and children with a wide variety of cardiac diseases.

His research in dilution techniques for studying blood flow led to today's widely used diagnostic tests for circulatory defects. He is identified especially with the refinement of the photoelectric instrumentation which provides a continuous record of the amount of oxygen in the blood (oximetry) and the development and application of the light-absorbing dye (indocyanine green) for evaluation of the circulatory system.

Since the 1960s, Dr. Wood has directed his efforts at finding means of quantitating the functional status of the contractile elements of the heart, i.e., the cardiac reserve, and at finding ways of measuring and displaying blood flow and the shape and volume of the heart.

At the same time, he has continued to study the effects of



gravitational and inertial forces on the cardiopulmonary system. These studies, along with his water immersion studies, where dogs breathe liquid fluorocarbon while submerged, have yielded information of how man may better cope with pressures and forces encountered in space flight, the depths of the ocean or vehicular collisions.

In recent years, Dr. Wood and his colleagues in the Biodynamics Research Unit, have been working on the development of a high speed, computer-based x-ray scanning system which will give scientists the ability to obtain accurate, three-dimensional measurements, in living animals and man, of anatomic changes in the lungs, heart and circulation from instant-to-instant during individual cardiac and respiratory cycles. This revolutionary new system, called the Dynamic Spatial Reconstructor, was installed in the Biodynamics Laboratory of the Mayo Clinic during August 1979 and is now being evaluated.

In 1962 Dr. Wood became the tenth scientist to be named a Career Investgator of the American Heart Association.

Among other awards presented to Dr. Wood during his career are the American Medical Association award in 1962, the Aerospace Medicine Award in 1963, the Carl J. Wiggers Award from the American Physiological Society in 1968, the Phi Beta Kappa Alumni Award in 1970 and the Research Achievement Award in 1973 from the American Heart Association (which called Dr. Wood "a daring and briliant investigator.")

Dr. Wood comes from a remarkable family, all of whom have had distinguished careers in a variety of fields: his brother Harland earned an international reputation as a biochemist at Case Western Reserve University; Wilbur, an M.D., founded a clinic in Littleton, Colo.; Delbert was a lawyer and special agent; Chester, a Ph.D., was a college administrator; and the

lone sister, Louise, was director of the American Red Cross Recreational Clubs in Europe during World War II and is a former executive director of the Girl Scouts of America.

An interesting note: all five Wood brothers won varsity letters in football, basketball and track in high school at Mankato and all were captains of the football team in their senior years in high school and college.

Each fall the brothers gather for an annual deer hunt in northern Minnesota.

Dr. and Mrs. Wood have four children: Phoebe is a high school teacher in Colorado, Mark, an ophthalmologist practicing in California; Guy, an instructor in foreign languages at the University of Colorado; and E. Andrew, a physical therapist in Colorado.

HONORS AND AWARDS

Dr. **Howard E. Morgan** has been appointed to the National Heart, Lung, and Blood Advisory Council of HEW's National Heart, Lung, and Blood Institute.

Dr. Morgan is the Evan Pugh Professor of Physiology, Associate Dean for Research, and Chairman of the Department of Physiology at The Milton S. Hershey Medical Center, Pennsylvania State University of Pennsylvania, Hershey, PA.

As a council member, Dr. Morgan will take part in the evaluation of the institute's cardiovascular blood and lung disease programs and will make recommendations to the institute director and the director of NIH concerning directions, goals and priorities of these programs. Dr. Morgan's term of service runs through 1983. The Council meets periodically at NIH to consider applications for research and training support in the field of cardiovascular, blood and lung diseases and to advise on general NHLBI programs. It also reports annually to the President and the Congress on the current status of institute programs and recommends future program activities.

Dr. Morgan served on the editorial boards of the *American Journal of Physiology, Circulation Research*; former editor of *Physiological Reviews*; and associate editor of the *American Journal of Physiology: Endocrinology and Metabolism.*

The National Academy of Sciences announced the election of twelve distinguished scientists from eight countries as foreign associates of the Academy. Two APS members were elected:

Honorary Member **Hans H. Ussing,** Department of Biochemistry, University of Copenhagen, Denmark, and

Torsten N. Wiesel (Sweden), Robert Winthrop Professor of Neurobiology, Harvard Medical School, Boston.

John C.S. Fray, former Porter Development Fellow, has been awarded a Research Career Development Award by the National Heart, Lung and Blood Institute. Dr. Fray is in the Department of Physiology, University of Massachusetts Medical School at Worcester.

Sidney S. Sobin, University of Southern California professor of physiology, received the Eugene M. Landis Award at the annual meeting of the Microcirculatory Society, April 13, in Anaheim. Dr. Sobin is a 30-year member of APS.

The award, established in 1970, is the society's way of recognizing and encouraging outstanding investigators who exemplify the potential and high standards of scholarly achievement characterized by the distinguished career of Dr. Landis, a world-renowned researcher of the physiology of blood capillaries.

Dr. Sobin is the director of the American Heart Association Greater Los Angeles affiliate USC Cardiovascular Research Laboratory. He also conducts research on vascular physiology, concentrating on microcirculation in the lungs.

Sobin was named director of the laboratory in 1958 and USC professor of physiology in 1966. Prior to joining the USC faculty, he was a research professor of medicine at Loma Linda University.

He is the recipient of numerous awards, including the Distinguished Service Award from the California Heart Association, the Research Achievement Award from Loma Linda University, the Man of the Year Award from the Children's Heart Foundation, and the Distinguished Scientific Achievement Award and Award of Merit from the Los Angeles County Heart Association.

A resident of Del Mar, Sobin received his bachelor of science degree and doctorates of physiology and medicine from the University of Michigan.

EMERITUS MEMBER CONTRIBUTIONS

Contributions to the Society may be made to the General Operating Fund or other designated purpose. The donor may commemorate an event or memorialize an individual.

We gratefully acknowledge the contributions recently received from the following Emeritus Members:

Edward F. Adolph
John W. Bean
Richard W. Eckstein
Robert A. Kehoe
Aldo Luisada
Eleanor Mason
Louis J. Pecora
Ernest A. Pinson
Carlos E. Rapela
Paul Sekelj

REPORT OF VISIT TO THE PEOPLES REPUBLIC OF CHINA

Earl H. Wood
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It was my privilege to spend the period of September 23, 1979, to October 19, 1979, as a member of an American Medical Teaching Delegation to the Peoples Republic of China. This delegation was organized and sponsored by the American College of Physicians in response to an invitation from the Chinese Medical Association. The Chinese Medical Association arranged the itinerary and assumed all travel and living expenses for the American Delegation while in China.

The delegation consisted of 13 members, all of whom were physicians or surgeons, from various parts of the U.S. whose areas of expertise covered the major fields of medicine. I was the only non-clinician physiologist in the group and learned after arrival in China that my presence was the result of an inquiry received from the Chinese Embassy in Washington for information concerning the Dynamic Spatial Reconstructor (DSR), a high temporal resolution synchronous volumetric CAT scanner which has been developed during recent years in our laboratory.

The delegation visited Peking (Beijing), Chengdu, Chungking, Wuhan and Shanghai spending from 3 to 5 days in each city successively.

We were kept very busy visiting hospitals and medical schools, giving lectures and sight seeing natural and man made wonders in or near each city. The latter were tremendous; the highlight being a three day boat trip down the Yangtze River from Chungking to Wuhan.

Each member of the delegation had been asked to submit the titles and abstracts of five lectures prepared and forwarded to the Chinese Medical Association one month prior to our visit.

The delegation was split into 3-4 groups for visits to hospitals, medical schools and for lectures. Each member gave lectures in each city on from 2-4 of the previously submitted titles. In addition, each member acted as the central figure during 1 to 2 approximately one hour free discussion question and answer periods on the subject of 1 or more of his previously presented lectures.

The cities are a study in contrast which have to be seen to be appreciated. There are people everywhere, wide boulevards, narrow streets, large modern and old buildings, bicycles by the thousands, myriads of buses, trucks, pedestrians, hovels, open markets, human male and female and horse-drawn vehcles, fields, parks, all mixed together, construction everywhere. The weather was beautiful (like Indian summer in Minnesota) marred frequently by smog in the morning.

The hordes of people as pedestrians, bicycle riders and at work appear healthy, happy and very friendly. There is practically no obesity, nearly all wear Chairman Mao type suits, so there is a sameness. Only the children are dressed smartly with colorful clothes, ribbons in their hair, etc. The women wear no cosmetics and I saw only one in a skirt.

The following account of a meeting with some of the officers and members of the Chinese Association for Physiological Sciences is perhaps of greatest interest to the membership of the American Physiological Society.

The afternoon of September 30, I was told that officers of the Chinese Physiological Society would like to meet with me at the Headquarters of the Chinese Medical Association in Beijing. This was a surprise to me, since I had had no reply from letters expressing my interest in meeting Chinese physiologists which had been sent several months before my visit.

In any event, when I arrived at the Chinese Medical Association I was greeted by a group of 15 very friendly Chinese men. We sat around a large table, drank tea and talked for about an hour. The leader of this group and president of the Chinese Physiology Society was Dr. Chiao Tsai, Director, Basic Medical Research Institute, 11 Taiping Rd., Peking.

Dr. Chen-Kang Wang, Dept. of Pharmacology, Institute of Basic Medical Sciences, Chinese Academy of Medical Science, Peking, China, who is the General Secretary of Chinese Association for Physiological Sciences, had hand written in English a brief history of the Chinese Physiological Society, which he read at the meeting and gave to me. A copy of this history is reproduced after this account. The history, a picture of the Chinese delegation and a list of their names and positions is on file in the central office of APS.

Dr. C.H. Wu, Prof. of Physiology, Zunyi Medical College, Kweichow, was one of the group. He was a 1946-47 graduate student in Dr. M.B. Visscher's Dept. at the University of Minnesota.

These men all understood and most of them spoke English, they are very friendly and very anxious to increase their contacts with the APS and send their warmest greetings to our Society.

I urged them to attend the July 1980 International Physiological Congress in Budapest and told them that the Taiwanese problem (i.e. who was to represent China) had been solved by the International Union of Biochemists by changing the rules to indicate that representatives could be sent from different scientific communities rather than nations. They apparently could not and did not make any definitive statements concerning these possibilities, but did express forcibly their wish to increase and foster communications and inter-relationships with APS and international physiology.

Dr. Chao Tsai is a member of the English Physiology Society and had received the announcement and literature regarding the Budapest Congress.

They stated that they have practically no interchange with clinicians. They had not been informed of our visit until the previous day.

All of these men were in the older age group and I believe most of them had spent time before the revolution in the U.S. or other Western countries. Their younger colleagues have had no such training. There are at present different medical schools for Chinese Traditional Medicine, and Modern Medicine. However, teaching of the basic medical sciences is very similar in these different schools. Clinical teaching however differs. They expressed the hope that in the future these schools would combine and stated that conditions are improving quite rapidly after the "dark

period for science and education" during the Cultural Revolution and the "Gang of Four."

Since my return, there has been a friendly interchange of letters with a number of the scientists I met in each of the cities we visited. Particularly noteworthy was an almost immediate inquiry from Professor Chao Tsai concerning the possibility of two of his former students spending two years in our laboratory with their travel and living expenses paid by the Chinese government.

One of these students, Dr. Jinhe Wei, a 39-year-old bioengineer, has recently joined our group as a visiting scientist, the second has gone to another laboratory in California, and a third has joined the molecualr biology group at Mayo.

This is part of an apparently quite large program to increase scientific and technological interchange between China and western countries. The individuals are selected in China on the basis of competitive examinations.

I was very impressed by the immensity and diversity of China and particularly the tremendous number and apparent character of the people. They are very friendly, open, hard working, and apparently happy and enthusiastic concerning the progress which has been made and the future. It seems certain that the future welfare of mankind will be best served and to a major degree be dependent on the fostering and permanent maintenance of friendly, peaceful cooperation between our two nations.

BRIEF HISTORY OF CHINESE PHYSIOLOGICAL SOCIETY

It is a great pleasure for us to meet you in Peking, especially here in the Headquarters of the Chinese Association for Physiological Sciences.

First of all please allow me on behalf of the members here and also all the members of our Society to pay warm welcome to our respectable guest, Professor E.H. Wood as President-Elect of the American Physiological Society.

On account of time limitation, let me give you a brief account of history of our Society.

The original name of our Society was the Chinese Physiological Soceity. It was founded in 1926 in Peking.

In the next year 1927 the Chinese Physiological Journal was also founded.

In the beginning of our Society, the members were less than 20. In 1938 maybe 120. The members were from different disciplines such as Physiology, Biochemistry, Pharmacology, Nutrition, Anatomy and Histology as well as Medicine and Surgery.

After liberation in 1956 the name of our Society was changed to The Chinese Association of Physiological Sciences. It consists of six different major subjects:

Physiology	Biophysics
Pharmacology	Nutrology
Pathological Physiology	Biochemistry

At present the members of our Society may be over ten thousand or more. But under the Gang of Four the scientific workers were greatly disturbed and all the activities of societies were disrupted.

In 1977 the activities began to recover. We had the 15th annual meeting in Tsaitong in October 1978 with delegates over four hundred and abstracts of papers, 1,200 pieces. In the early part of this month the annual meeting of Nutrition and Pharmacology were held over six hundred delegates and 700 abstracts.

We shall have another annual meeting next year.

We also edited Acta Physiologica, Vol. 31.

Recent Advances of Physiological Sciences, Vol. 10.

Journal of Pharmacology will be published in 1980.

We have great pleasure here to inform you that the Chinese Association of Physiological Sciences is looking forward to taking part in the activities sponsored by the International and American Physiological Societies.

Let us hope the friendship between the people of China and America will be closer and scientific workers of two countries will cooperate closer in the foreseeable future.

We believe a new chapter in the relations between our two countries will be opened and strengthened.

1980 BROOKDALE AWARDS FOR RESEARCH IN GERONTOLOGY

The Gerontological Society announces the 1980 Brookdale Awards for Research in Gerontology. Two awards will be made, one in biological and clinical research and the other in social and behavioral research. The amount of each award will be $20,000.

Nominees must be citizens of the United States and have been recognized both nationally and internationally for their distinguished scholarly and scientific contributions to research in gerontology.

The Brookdale awardees in 1979 were APS member, Dr. Nathan W. Shock and Dr. Robert J. Havighurst. Deadline for receipt of nominations is August 15. Awards will be conferred at the Annual Scientific Meeting of the Gerontological Society in San Diego, November 21-25, 1980. For details of how to nominate candidates for the Brookdale Awards please write to: Chairperson, Brookdale Awards Screening Committee, The Gerontological Society, Suite #305, 1835 K. St., N.W., Washington, DC 20006.

McKeen Cattell to Edward Adolph:

This is a response to the letter from you and other members of the Society. I hope you are enjoying the joys of laboratory work. As for me, I am quite beyond that but still have an office at Cornell where I continue to do a little writing in connection with the *Journal of Clinical Pharmacology* of which I am an associate editor. In this I get a good deal of satisfaction, but it obviously cannot last forever, especially since my home is in Garrison, N.Y. (where I was born) and is located more than fifty miles from the City and train service is deteriorating. With best wishes to the seven distinguished physiologists signing the letter.

Richard Whitehead to Bruce Dill:

I am happy to be living at a time when one can appreciate the advances being made in so many fields of medicine, many of which have long been neglected. I would like to comment on a few items contained in the Medical News paper which were of interest to me. There was an article about studies on melanomas by a former student of mine, Dr. William Robinson. Bill and I are Breckenridge, Colorado natives. Bill's grandparents and parents were pioneers in that mining camp. He is making experimental studies on melanomas. He is a highly regarded pathologist. Also there was an article with the intriguing title of "Operation Cork" which has an important objective to improve alcoholism education of medical students. It is directed by Richard A. Deitrich, a member of my staff (before retirement) and a well-known investigator in the field of fundamental research on alcoholism. Deitrich is a native son of Colorado also. His graduate education and Ph.D. were taken in my department. There are also articles about two former students of mine, Dr. Deane "Skip" Jacques and Dr. Robert Virtue who have made a good record in their respective fields - neurosurgery and anesthesiology. Dr. Virtue has had an illustrious career in anesthesiology research. Both Virtue and Jacques are native Coloradoans and former students of mine. I do not wish to infer that Colorado natives alone have excelled in research. I tend to "boost" natives but you know why.

I must mention some work being done at Colorado which should be of special interest to you - the new spectrometer which measures gas concentrations quickly and accurately. The designer is Al Micco who has worked on it nine years.

I do not get to the mountains as often as I would like but I live where on a clear day I can see Pike's Peak and Long's and all the places where I used to hike and work, fish and just plain enjoy myself.

John J. Sampson to Bruce:

I trust that you are continuing in good health and enjoying life in the city that built the Hoover (Boulder) Dam. We visited it first during its construction by means of two friends as tops of two of the eight companies and went into diversion tunnels.

I am now 82, born in 1898. Am still teaching in a consultant capacity on the faculty at the University of California, San Francisco. Not real experimental research but am publishing two articles - now in press - "Compliance in Patients" and a review of the "Intermediate Syndrome." Also see patients daily. The University of California gave me an LLD three years ago. Best regards.

Samuel E. Pond to Bruce:

My recent celebration of the 90th birthday was on Cape Cod with my daughter's family. We changed residence in 1973 from near Hartford, Connecticut to East Winthrop, Maine in a lakeside camp in rural, central Maine to enjoy a rather quiet lake-chain country as a retirement home which had been in the family for some time and we used to come here seasonally.

Transferring from teaching and guiding college students (at University of Hartford) to pseudo-academic confrontations in the last decade has added some zest to retirement and exciting at times when technical problems arise in the community area. We have five undergraduate institutions within close reach: Bates, Colby, Bowdoin, Thomas and Augusta branch of the University of Maine. There are continuing opportunities for one's time and skill as with the anti-pollution work in the chain of nine lakes: monitoring, sampling, testing, and consulting.

There are all sorts of personal and public health activities with recreation and rehabilitation work going on in voluntary and organized groups bringing together professional and scientific personnel to advise the elderly and those close to retirement. In our lake-shore area, folks need assistance with wells, sewage and semi-agricultural tasks, and anyone with tools or even a little experience is utilized. We even take care of an active Lighthouse, mechanically and navigationally, within local and state regulations, as boaters and wild-life co-mingle. A yacht club, some 75 years old, requires administrative time and tricks (dues, membership, and reports). Our state (like others) is in need of money from taxes, and much riddled with need for conservation (all forms of energy losses) hence retired taxpayers are utilized to the hilt. Best wishes to APS and all its related branches.

Edmund Jacobson to Bruce:

You have very kindly requested that I indicate my present interests. I continue to act as director of the Laboratory for Clinical Physiology, Chicago. Research currently includes the measurement of momentary human energy expenditures in supine adults. The integrating neurovoltmeter developed with the aid of the Bell Telephone Laboratories many years ago is still being used today, now in conjunction with a computer and other modern equipment.

Currently under my direction, Richard Lange and Helene Duda are engaged in investigative measurements on human energy expenditures in adults lying supine while carrying out brief and simple assigned tasks. Black and white adults are employed who state that to their best knowledge and belief they are in good health and who show no signs of any type of malady. The integrating neurovoltmeter employed for action potentials measurements is carefully checked for accuracy in its microvoltage measurements of striated muscle activities involved in a task contrasted with the potentials when the subject has been requested to rest. There are six input channels, each one of which corresponds with an output channel. Following their initiation by Richard Lange, all computer procedures occur automatically. (Oxygen and other gas employed in these measurements have kindly been contributed by Mr. Amir Attari, Assistant Director of Chemical Research of the Illinois Institute of Gas Technology.)

Recently I completed the manuscript, *The Human Mind: A Physiological Clarification*. This enlarges the description given in the invited lecture of 1977 at the International Congress of Physiological Sciences in Paris. I trust that this will soon appear in book form. In addition, manuscripts relating to Nature and others relating to metaphysics from a relational standpoint are being completed.

I am President of the National Foundation for Progressive Relaxation and Treasurer of the Foundation for Scientific Relaxation, both non-profit organizations devoted to furthering our investigations.

Sara E. Huggins to Bruce:

Now is a good time to write because I am very busy and doing something interesting. At the present time I have a short term contract as a visiting professor at the Federal University of Pernambuco in Recife, Brazil.

My assignment in Recife is to study some aspects of the physiology of the three-toed sloth, *Bradypus tridactylus*. In the past several well known physiologists have spent a pleasant vacation or sabbatical in such studies but there remains much to be learned and the laboratory in which I am working is attempting to answer some of the questions which previous workers have raised. I have two local graduate students working with me and we hope to have their master's theses near completion before I return to Houston in the spring. Their English and my Portugese are weak and at times both sides are frustrated as only language barriers can make one. On ordinary days, however, we communicate reasonably well in "Portuglaise."

My previous experience with sloths had been very limited and I was surprised to find them attractive and charming little animals and usually very easy to work with in the laboratory. Certainly they are an interesting change from my first love, alligators and their kind.

In the process of going over the literature on the sloth recently, I checked out the third volume of *Science* for the year 1939, that is July-September. I did so intending to read a short communication from Britton and Kline "On Deslothing the Sloth." I realized then that this volume contained the numbers of *Science* for the first three months immediately after I had received my doctorate. For this reason I leafed through, reading, here and there, items which were evocative of another age. There were, of course, obituaries of giants of science of earlier days; there were directions for making laboratory apparatus, now commonly sold commercially; there were hints of scientific developments long since common classroom knowledge; and there were, though surprisingly few, special signs of those very crucial days, such as the announcement of the hiring by American institutions of one or more persons who, judging by origins, must have been fleeing Hitler's regime and the announcement of locations for various colleges of the University of London in evacuating that soon to be dangerous city. There was a short editorial copied from *Nature* explaining why the UK had been forced to declare war. The general commentary deplored the current teaching trends and examined the place of science in society, very familiar themes at all times. As you can well imagine, there was much of a curious kind of interest. One short communication was on the production of luminescence by breaking "Necco" wafers, particularly the wintergreen flavor. That made me wish for a roll of those old candies for eating as well as for testing a scientific fact I did not know.

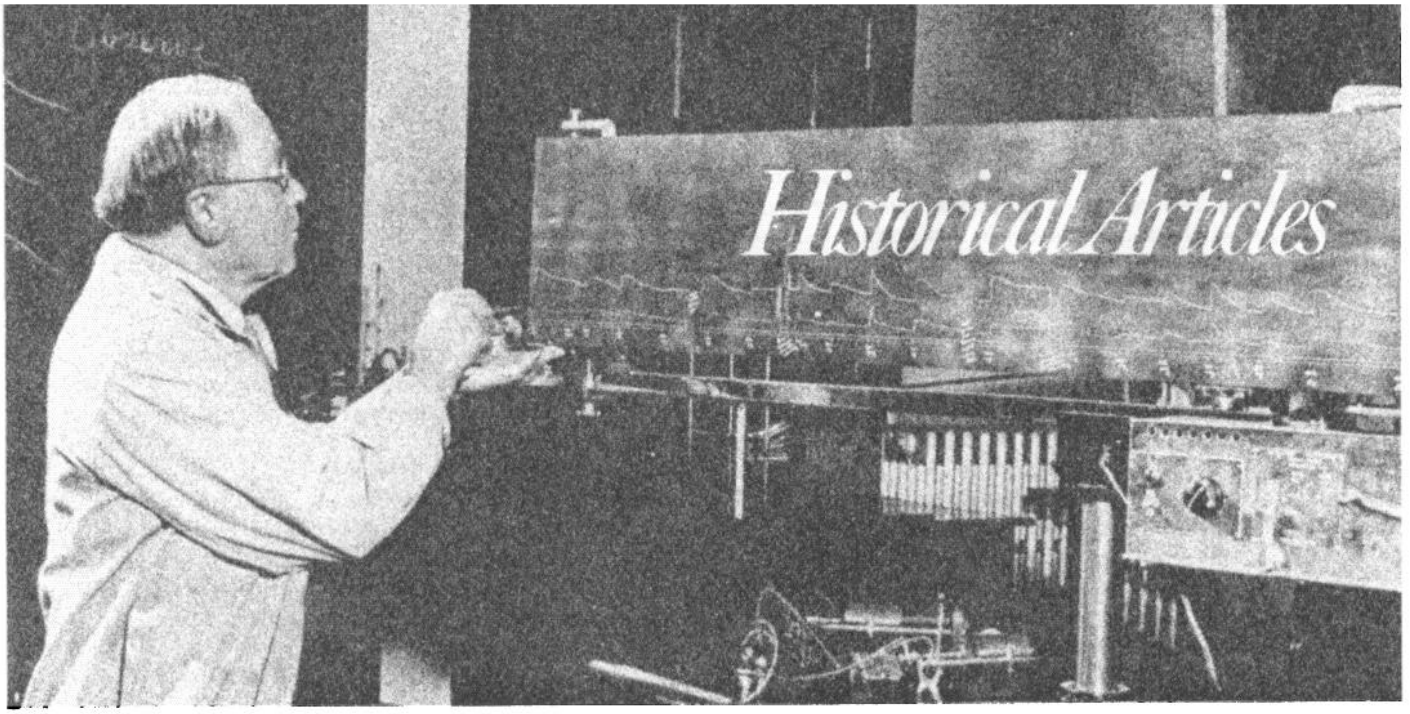
So far since retirement I have had a small grant and the University of Houston has been very generous in allowing me use of space. I hope to continue in this way for some time to come. Immediate plans call for a detour from Brazil to the southern portions of South America on my way home. This summer I hope to join my husband*, who is currently a visiting professor at the National University of Malaysia and to return with him by way of Germany where one of our sons is working. Those plans, even though I am a travel enthusiast, should make home and Houston look very good--for at least six months.

*APS member, Russell A. Huggins.

FRED A. HITCHCOCK
1889-1980

Word of the death of my long-time friend Fred A. Hitchcock on February 15, 1980 came to me from his good friend of 30 years, Miss Dorothy Mees. She writes that he had been ill for about six months. My wife and I enjoyed Fred's infectious hearty laugh in 1971 when he came to Las Vegas to help celebrate my 80th birthday. A memorial service was held at Ohio State University on March 14, 1980. The reference to his having been on the Society's Council reminds me of his election. The several candidates by several ballots were narrowed to two. In the final vote Fred won over the illustrious Detlev Bronk. This was such a noteworthy event that I wrote about it to the President of Ohio State University acquainting him with how highly his Professor Hitchcock was rated by his colleagues.

Bruce Dill



BACKGROUND ON MANUAL ARTIFICIAL RESPIRATION AND MOUTH-TO-MOUTH RESUSCITATION

D. B. Dill

ADDENDUM: BACKGROUND ON CARDIOPULMONARY RESUSCITATION

Archer S. Gordon

When Orr Reynolds sounded out old-time presidents on possibly bringing up to date their addresses delivered at the fall meetings and published in *The Physiologist*, I replied that my address on resuscitation was not published, but that I might take advantage of his suggestion to review research on resuscitation at the Medical Laboratories of the Army Chemical Corps and arrange for a colleague, Archer S. Gordon, to bring the story up to date from mouth-to-mouth ventilation to CPR.

The search for improved methods for manual artificial respiration was conducted at several universities with support from the Medical Laboratories, a component of what was then called the Army Chemical Corps. The Commanding Officer was assigned to the Chemical Corps for this post by the Army's Surgeon General. I was Scientific Director of the Medical Laboratories responsible to the Medical Corps officer for the research programs. A major goal was to develop improved methods for protection against attack by nerve gases developed in World War II in Germany. These chemicals would cause paralysis of respiratory muscles, hence improvements in procedures for resuscitation were required. We arranged through contracts for experts in pertinent fields of physiology to attack the problem.

Among experts who agreed to help were: Joseph H. Holmes, Medical School, University of Colorado, Denver; A.C. Ivy, Archer S. Gordon, and Max Sadove, Medical School, University of Illinois, Chicago; James L. Whittenberger and Edward F. Radford, School of Public Health, Harvard University, Boston; Peter V. Karpovich, Springfield College, Springfield, Massachusetts; Julius H. Comroe, Jr., Medical School, University of Pennsylvania, Philadelphia; A.M. Harvey and David Grob, Medical School, Johns Hopkins University, Baltimore; and David B. Greene, Medical School, University of Buffalo.

The first meeting of these participants at the Army Chemical Corps Medical Laboratories addressed various problems of resuscitation. Gordon and associates presented comparative studies of various manual methods of artificial respiration performed first on a large series of warm corpses (17) and subsequently on curarized, anesthetized, normal adult human volunteers (19). These studies were supported by the American National Red Cross and demonstrated that the manual methods that produced both active inspiration and active expirations provided greater ventilatory volumes than other methods.

Key roles also were played by young medical officers. Through a mutually advantageous arrangement, the Army's Surgeon

General assigned several outstanding physicians, who had a real zest for research, to serve their two-year tour of duty at Medical Laboratories: John A. Clements, James O. Elam, John R. Ward, Elwyn S. Brown, and Richard J. Johns. David Y. Cooper was another physician assigned to us for a short time by the Navy. One more young physician, a leader in research on mouth-to-mouth breathing, Peter Safar, was supported by the Army's Surgeon General: he conducted his research at the Baltimore City Hospital.

Among the earliest publications on this research in scientific literature were ten papers in the *Journal of Applied Physiology*, Volume 4, December, 1951. These dealt with manual methods and included studies by the Gordon, Whittenberger, Comroe and Karpovich groups.

About the same time, Dill reviewed the findings of the investigators as presented at the National Research Council, October, 1951. The investigators presented their findings to representatives of the Armed Forces, American National Red Cross, Boy Scouts, Girl Scouts, Y.M.C.A., public utilities, and civilian defense organizations; I was chairman. The presentations led to the subsequent adoption of the back-pressure arm-lift (modified Holger Nielsen) method of artificial respiration. Formal approval was given by the Armed Forces Medical Policy Council on November 5, 1951, and was published in the U.S. Armed Forces Medical Journal in 1952 (7).

At this stage, the investigators began thinking about the practicability of mouth-to-mouth resuscitation. Back in 1950, Cooper and Johns made their first device for mouth-to-mouth resuscitation; it was described in a Medical Laboratories report. Later Elam, Brown and Clements found that with the device, resuscitation was highly effective, as reported in a Medical Laboratories report, November 28, 1953. A year later the device was described by Elam et al in the New England Journal of Medicine.[10]. Research by our contractors on mouth-to-mouth resuscitation continued.

In 1957 a conference was held at Denver on "Artificial Respiration and Nerve Gas Poisoning." Research on mouth-to-mouth resuscitation was reported. It was suggested that Archer Gordon undertake to have the papers published as a symposium by the Journal of the American Medical Association. I was asked to write the introduction. Reports of that symposium by Gordon and associates[18] and by Elam and associates[12] demonstrated the effectiveness of mouth-to-mouth resuscitation. Safar's demonstration of the inadequacy of manual methods[26] to maintain a patent airway provided the evidence needed for adoption of the mouth-to-mouth method. On the basis of these studies, the National Academy of Sciences-National Research Council recommended in 1957 that mouth-to-mouth resuscitation was the preferred method of artificial respiration for infants and small children. In 1958, they recommended mouth-to-mouth resuscitation as the preferred technique for all individuals requiring emergency artificial ventilation.

It was also agreed at the Denver meeting to ask Whittenberger and Comroe to write a book on Artificial Respiration. This appeared in 1962; Whittenberger edited a volume dealing with many aspects of artificial respiration[29]. In addition to the fifteen chapters by many of those involved in the Medical Laboratories research on artificial respiration, there were case reports on poisoning by anticholincolerases, including a dramatic case of nerve gas poisoning described by John Ward.

In my introduction to the 1958 Symposium[8] I reported the development by two of our medical officers David Y. Cooper III, and Richard J. Johns of a mouth-to-mouth resuscitator suitable for use on nerve casualties in a contaminated atmosphere. Recently Cooper in a colorful account has related the full story of this device which was eventually patented[6]. Cooper, assigned to us by the Navy, is now professor of surgery in the Harrison Department of Surgical Research, School of Medicine, University of Pennsylvania, Philadelphia.

After the 1958 conference, Elam and co-workers[25] used serial roentgenography and cinefluoroscopy to demonstrate that maximum backward tilt of the head was the most important step for opening the air passages and was the quickest and easiest maneuver to apply. Further studies by his group,[11,13] as well as by Safar and co-workers[23] and by Gordon[15], established maximum backward head-tilt as the preferred method for mouth-to-mouth resuscitation.

My colleagues at the University of Nevada, Las Vegas, M.K. Yousef and at UC Santa Barbara, S.M. Horvath, through the symposium that they arranged in celebration of my eighty-eighth birthday, have brought me into touch with five of my colleagues of the 50's, Archer S. Gordon, James L. Whittenberger, James O. Elam, Peter Safar, and Arthur DuBois. Archer had been invited to the symposium, but was unable to attend. He had become known as the "father of CPR" because of his continuing leading role in research and teaching with the American Heart Association and American National Red Cross that brought CPR to world-wide attention. He wrote in part as follows:

Dear Bruce:

I'm sure you realize how much I regret not being in Las Vegas to help honor you next week. It is almost thirty years since we first met at Edgewood when I presented our studies on artificial respiration. Those were memorable days and I've considered you a close friend, guiding light and physiological father since that time. Although the field of resuscitation has made tremendous strides since that time, there are not too many who appreciate the impact of your program which brought together such outstanding investigators as Jim Whittenberger, Julius Comroe, Peter Karpovich, Jim Elam, Peter Safar, John Clements and others who provided the physiological background that made possible world-wide acceptance first of improved methods of manual artificial respiration, then mouth-to-mouth resuscitation and ultimately cardiopulmonary resuscitation.

I send my heart felt congratulations on your past achievements and my best wishes for your future achievements.

Archer S. Gordon, M.D.

He enclosed the following historical account:

I would like to bring to the attention of this SYMPOSIUM ON LIFE, HEAT AND ALTITUDE another highly significant contribution which Bruce Dill made.

In 1950, he arranged a Conference on Artificial Respiration at the Army Chemical Center Medical Laboratories at Edgewood, Maryland in order to help determine the best method of artificial respiration for the Department of Defense and the American National Red Cross. This led to an intensive program of physiological studies on manual methods of resuscitation by Jim Whittenberger at Harvard, Julius Comroe at the University of Pennsylvania, Peter Karpovich at Springfield College and Drs. Andrew Ivy and Archer Gordon at the University of Illinois. Bruce acted as the organizing strength and cohesive force that coordinated the activities of this group and drove them forward to a National

Academy of Sciences-National Research Council conference in 1951 which resulted in nation-wide recognition of the modified Holger Nielsen Back-Pressure Arm-Lift method of artificial respiration.

But with his usual tenacity and insight, he did not stop when this goal was achieved. He continued the program and through his efforts adequate funding, frequent meetings and the addition of other outstanding investigators such as Jim Elam, Peter Safar, John Clements, and many others were added to the program. By 1958, continuing research led to the abandonment of the manual methods and acceptance of mouth-to-mouth breathing for all victims requiring emergency resuscitation. Subsequently, external cardiac compression and cardiopulmonary resuscitation (CPR) evolved, the external DC defibrillator was developed, emergency drug therapy and central venous routes for emergency drug administration were perfected, and local and regional Emergency Medical Systems were adopted.

Today, in the United States, there are over one million sudden deaths every year. These result from heart attacks and accidents such as choking, drowning, electrocution, suffocation, drug overdosage, etc. But today many of these victims are being saved by cardiopulmonary resuscitation. Bruce Dill neither asks for nor receives any of the credit for this medical break-through which has swept beyond our shores to be accepted and practiced on a world-wide basis. But those of us who met with him in 1950 know that his guidance and his foresight were the prime mover in initiating, organizing and promoting the studies which ultimately led to development of this life-saving technique that today is saving hundreds of thousands of lives each year.

As one of those who was intimately involved in this work and who has known Bruce Dill for the past thirty years as a friend, a teacher and an inspiration, I would like to take this opportunity to honor him for his contribution to mankind.

Another of my colleagues of the 50's, Jim Elam, wrote from Chicago where he is professor of Anesthesiology, University of Chicago:

Several of us remember the key role Bruce Dill played over many years in the research and development of resuscitation. During the 50's he vigorously supported and encouraged our work and stimulated us to continue the attempt to secure recognition for the mouth-to-mouth methods of resuscitation. His skillful influence in sponsoring the adoption of mouth-to-mouth resuscitation at the Office of the Surgeon General, Department of the Army, and at the NRC-NAS was strategic and unflagging. It was Bruce Dill's timing which always resulted in policy making conferences as the data accumulated. His active interest and participation had a great impact upon the beginning of an era of revolutionary advances in life-saving which has continued for two decades.

James O. Elam, M.D.

Another colleague, Peter Safar sent me an autographed copy of "Advances in Cardiopulmonary Resuscitation"[28] that he and Jim Elam had edited. Peter's inscription read, "To Bruce Dill with thanks for and in recognition of his contributions to resuscitation research." The many contributors besides Safar included Jim Elam, Associate Editor and Archer S. Gordon. On pp. 264 and 265 Elam has listed some interesting historical notes. Peter reviews in chapter 40 his experiences in teaching mouth-to-mouth resuscitation. He invited John Clements and me to visit the operating room at the Baltimore City Hospital one Saturday morning to observe procedures. An intern, anesthetized and curarized, was lying on the floor kept well oxygenated with nitrous oxide. About 20 volunteers were ready to gain first hand experience in resuscitation. Peter was giving them instructions while Capt. McMahon of the Baltimore City Fire Department was passing through the group getting names in order on a clip board. When he came to John and me, I explained we were there as observers but he saw no reason to omit our names; in due time my turn came. I started the procedure thinking, What a fiasco if I fail! But I succeeded as shown by the oximeter indicative of normal arterial saturation. The session was a great success: only one of 20 or more volunteers failed to ventilate the lungs of the intern adequately and at the end he recovered completely, $150 richer for his role in resuscitation research.

Finally, there follows a letter to Dr. Yousef from Arthur B. DuBois, now Director of the Pierce Foundation Laboratory in New Haven. I became acquainted with Arthur during his years in Philadelphia. It was my privilege to write for *Science* an obituary of my good friend, his distinguished father Eugene F. DuBois[9].

Dear Dr. Yousef:

Congratulations on completion of a fine Scientific Symposium on Environmental Stress honoring Bruce Dill on his 88th birthday.

I observed Wallace Fenn's progress during preparation of his two great papers at age 78, and prior to that my father's preparation of his last important paper when he was 76. But Bruce Dill occupies the lead position in proving that whatever biological scientists accomplish is independent of the age at which they undertake it.

At Penn, we had a long, active association between several pharmacologists and physiologists and Bruce Dill at the Medical Laboratories of the Army Chemical Corps. With Dr. Dill's encouragement and the Army's financial support, Julius Comroe and his associates developed methods for assessment of lung function, particularly airway constriction in man, while at the same time John Clements initiated his important work on pulmonary surface active material. Meanwhile, George Koelle was progressing with acetyl cholinesterase inhibitors. Two decades later, we have not seen the end of the medical implications of this work.

Contrasting resuscitation of people in respiratory failure when I was an intern in 1947, with current practice thirty-two years later, I rate Bruce Dill's conceptual, scientific and administrative contributions as fundamental to the present successful management of such cases. By calculation of the cost benefit ratio, it would be possible to prove that Dr. Dill is one of Nevada's most successful gamblers, as shown by the results of placement of his bets throughout his career.

Arthur B. DuBois, M.D.

ADDENDUM

BACKGROUND ON CARDIOPULMONARY RESUSCITATION

Archer S. Gordon

In 1960, a dramatic new note was added to the concepts of emergency resuscitation with the observation of Kouwenhoven, Jude, and Knickerbocker at Johns Hopkins University, that adequate and properly applied pressure over the lower sternum can provide sufficient artificual circulation to sustain life in animals

and humans who are in cardiac arrest[22]. Widespread interest in this technique of external cardiac compression resulted in rapid verification of their results. Additional studies indicated the necessity for combining external cardiac compression and artificial respiration into the technique of cardiopulmonary resuscitation (CPR)[15,27]. This combination of artificial respiration and artificial circulation was one of the important recommendations made by the International Symposium on Emergency Resuscitation held in Stavanger, Norway in August 1961[1].

Realizing the tremendous lifesaving potential of cardiopulmonary resuscitation, the American Heart Association formed a Committee on Cardiopulmonary Resuscitation in 1963. This was later expanded into a Committee on CPR and Emergency Cardiac Care. The first chairman of this Committee was Leonard Scherlis of the University of Maryland. He was followed by James R. Jude of the University of Miami and Archer S. Gordon of UCLA Medical Center, Los Angeles. This organization spearheaded an intensive drive for additional research, for training programs, and for standardization of CPR. Their campaign has continued to the present and has expanded the horizons of CPR to include all aspects of basic life support (BLS) and advanced cardiac life support (ACLS).

The development of manikins for CPR practice occurred concommitantly with the early evolution of CPR techniques and training programs. Whereas the earlier manual methods and even mouth-to-mouth resuscitation could be simulated or practiced on classmates in training sessions, effective external cardiac compression can result in trauma and requires the use of realistic, lifelike, life-sized manikins. Spurred on by the Scandinavian Society of Anesthesiologists, Asmund S. Laerdal, a doll-maker from Stavanger, Norway created Resusci-Anne, a beautiful, blonde, female manikin with heart, lungs, carotid pulse, and eyes with pupils that constrict and dilate. She became the progenitor of a whole family of manikins, including Resusci-Andy, Resusci-Baby, Anatomic Resusci-Anne, Arrhythmia Resusci-Anne and Recording Resusci-Anne; and these dolls have become the basis for effective CPR training on a world-wide scale.

The early enthusiasm for CPR and the possible dangers in its indiscriminate use prompted a statement on its benefits and hazards in an editorial in *Circulation* in September, 1962[2]. This was signed by the American Heart Association (AHA), the American Red Cross (ARC), and the Industrial Medical Association (IMA). It suggested that CPR is a *"medical procedure"* to be applied only by carefully trained personnel; that CPR training for the general public should be postponed until further experience accumulated; and that emphasis should be placed on training physicians, dentists, nurses, and specially qualified emergency rescue personnel.

With the accumulation of additional experience on the benefits and hazards of CPR, a revised statement was published in the May, 1965 issue of *Circulation*[3]and signed by the AHA, the ARC, the IMA, and the U.S. Public Health Service. This reclassified the technique as an *"emergency procedure."* It stressed training and retraining to ensure prompt recognition of the need for CPR and its proper performance. It urged that training be widely disseminated to members of the medical, dental, nursing, and allied health professions and rescue squads. However, it recommended that more experience be accumulated before training in CPR was extended to the general public.

By 1966, the American Red Cross, American Heart Association and various other national and federal agencies requested a further review of recommendations on emergency resuscitation by the National Academy of Sciences-National Research Council. Accordingly, and *ad hoc* Conference on Cardiopulmonary Resuscitation was convened in Washington, D.C. in May, 1966. Their recommendations were edited by Gordon and published in the *Journal of the American Medical Association*[4].

These recommendations served to standardize the performance of CPR and to spark widespread training programs both at the first aid and the professional rescuer levels. The development of community-wide paramedic programs with vehicles equipped with sophisticated advanced life support instruments, communication systems and highly trained personnel enhanced the evolution of CPR. They also highlighted the necessity for training the general public in the basic life support steps of CPR.

For this purpose, an NAS-NRC National Conference on Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC) met in 1973 with Archer S. Gordon as Chairman. In addition to doctors, nurses, allied health and paramedical personnel, it recommended training of the general public in CPR. The Conference set CPR standards that were published in the *Journal of the American Medical Association* in 1974[14]. These included recommendations for: optimum CPR techniques; CPR training programs and certification; medico-legal aspects; participation by the American Red Cross, medical organizations and other agencies concerned with lifesaving; and integration of public CPR programs with life support units and hospitals on a community-wide basis. After years of painstaking research and effort, the loop had been closed and all segments of society were to be involved in CPR.

Then, in 1975 a new consideration came to the fore. Studies by Heimlich[21] directed the attention of both the U.S. public and the medical community to the problem of emergency management of foreign body obstruction of airway resulting from choking on food or other foreign bodies. He recommended a "quick upward thrust" on a victim's abdomen between the navel and cage by a rescuer standing behind a conscious victim or astride an unconscious victim. Tremendous interest resulted in widespread application of the method by the public and the accumulation of a large series of successful anecdotal case reports.

Animal and human studies were performed by Gordon[16] and Guildner[20] which indicated that this abdominal thrust was an effective emergency technique for total obstruction of the airway by foreign bodies. However, they also showed: that other maneuvers such as chest thrusts, back blows and finger sweeps are also effective in some cases: that all methods fail in some cases; and that a combination of various methods is frequently superior to any one method alone. This issue generated such interest and controversy that the NAS-NRC sponsored an Emergency Airway Management Conference in Washington, D.C. in June 1976[5].

Based on the evidence available at that time, the Conference recommended a rapid sequence of four back blows followed by four abdominal thrusts for victims who were consicious and could not speak due to choking. For the unconscious victim, an initial attempt to ventilate by mouth-to-mouth resuscitation was recommended followed by back blows and abdominal thrusts, if necessary. Extrication of the foreign body by the rescuer sweeping his finger through the victim's mouth was recommended for use if the other manual maneuvers failed or if the foreign body could be seen. Infants and small children should be placed in a head down position for back blows and abdominal thrusts in order to add the beneficial effects of gravity to the maneuvers. Subsequently, in 1979 a study of 386 anecdotal cases collected by the American Heart Association was made by Redding[24] and substantiated these NAS-NRC recommendations. Successes and failures were reported with each of the maneuvers; some of the maneuvers worked alone or in combination with others; and

none of the methods worked in some cases. Another important conclusion from the Redding study was that measures for the relief of foreign body obstruction should be taught as related to other CPR measures.

This review of the evolution of modern techniques of resuscitation points up the progress made during the past thirty years. Additional improvements, modifications and developments presage further forward strides in the battle against sudden death from heart attack and accidental death -- two of the epidemic diseases of modern man.

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GUIDING PRINCIPLES IN THE CARE

AND USE OF ANIMALS

(APPROVED BY THE COUNCIL OF THE AMERICAN PHYSIOLOGICAL SOCIETY)[1]

Animal experiments are to be undertaken only with the purpose of advancing knowledge. Consideration should be given to the appropriateness of experimental procedures, species of animals used, and number of animals required.

Only animals that are lawfully acquired shall be used in this laboratory, and their retention and use shall be in every case in compliance with federal, state and local laws and regulations, and in accordance with the NIH Guide.[2]

Animals in the laboratory must receive every consideration for their comfort; they must be properly housed, fed, and their surroundings kept in a sanitary condition.

Appropriate anesthetics must be used to eliminate sensibility to pain during all surgical procedures. Where recovery from anesthesia is necessary during the study, acceptable technique to minimize pain must be followed. Muscle relaxants or paralytics are not anesthetics and they should not be used alone for surgical restraint. They may be used for surgery in conjunction with drugs known to produce adequate analgesia. Where use of anesthetics would negate the results of the experiment such procedures should be carried out in strict accordance with the NIH Guide.[2] If the study requires the death of the animal, the animal must be killed in a humane manner at the conclusion of the observations.

The postoperative care of animals shall be such as to minimize discomfort and pain, and in any case shall be equivalent to accepted practices in schools of veterinary medicine.

When animals are used by students for their education or the advancement of science, such work shall be under the direct supervision of an experienced teacher or investigator. The rules for the care of such animals must be the same as for animals used for research.

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Investigator

[1]Revised 1980

[2]Guide for the Care and Use of Laboratory Animals, DHEW Publication No. (NIH) 78-23, Revised 1978, Office of Science and Health Reports, DRR/NIH, Bethesda, MD 20205.

PLEASE POST

IN MEMORY OF OUR VISITING PROFESSOR

WALTER B. CANNON AT PEKING

This material was provided by Dr. A.C. Barger who received it from Professor Chang. The photo was taken when Dr. Cannon was in the old Department of Physiology at the Peking Union Medical College. Dr. Chang is the young man at the right end of the front line.

We, the members of the department of physiology of the Peking Union Medical College, were overwhelmed with joy, to welcome Prof. W. B. Cannon of Harvard Medical School to be with us as visiting Professor for half year in 1935. Prof. R. K .S. Lim and all the staff members, as well as Professor Cannon's daughters, Wilma and Marian met Prof. and Mrs. Cannon and another daughter, Helen at the air field. That day was bright; the sun was shining; the atmosphere was jolly and cheerful. Prof. and Mrs. Cannon smilingly shaked our hands, and we greeted them warmly in Chinese. Oh! It was a joyful occasion, indeed!

Prof. Cannon reported to duty the next day. Prof. Lim assigned one assistant, Mr. S. C. Shen and a senior technician Mr. K. C. Chin, to assist him in his work.

Forty-five years have elapsed, but our good impression of Prof. Cannon in research, teaching, public lectures and social contacts has been kept deeply and everlastingly in our minds!

I had the privilege of meeting Prof. Cannon earlier when I visited him on my second trip to the States in 1933. He invited me to dinner at his home, sitting with all members of his family including his sister in such a friendly air that I felt quite at home. He took me round his department. There I met Dr. Rosenblueth showing me his experiment. From this short visit, I gained the impression of Prof. Cannon being a kind and friendly teacher. This impression was much more strengthened and amplified during his stay with us in Peking.

Professional Activities of Prof. Cannon at Peking

In research, he worked enthusiastically. He was very fond of our College library. Once he told me: "Chang! I thought I had found something new, but when I searched the ancient literatures in your well-equipped library, I found it had been reported by a French worker a long time ago!" He finished a paper with Mr. S. C .Shen on "Sensitization of denervated pupilary sphincter to acetylcholine" which was published in *Chinese J. Physiology* 10, #2, 359-372, 1936.

A research student, Dr. Stephen Chang, under the direction of Prof. Cannon, finished a paper on "A comparative study of the effect of adrenaline on the blood sugar, blood pressure, dener-

vated heart, nictitating membrane, stomach, iris, hair and salivary gland in the cat" published in the *Chinese J. Physiology* 12, #4, 397-404, 1937.

In class teaching, he talked slowly and clearly so that most of the students could follow him readily. When he gave public lectures, each session was heavily crowded. All of us enjoyed his lectures on homeostasis, physiological activities of the sympathetic nervous system and "sympathin."

In demonstrations, he impressed us with his skillful technics. I remember once he showed us how to tie a living cat on the animal board by himself alone. It gave the young students inspiration and encouragement. Prof. C. H. Chow, a pharmacologist, remarked: "Prof. Cannon taught us not only by talking, but also by his hands doing actual experiments alone. This is something we should do." Altogether, he gave demonstrations more than ten times about different operations, including total sympathectomy, denervation of the heart, denervation of the sympathetic nerves of the liver, etc. He showed us also how to observe the motitlity of the gastro-intestinal tract under X-ray. He told us that he had introduced this useful technic for clinical diagnosis when he was a sophomore student in the medical school.

Prof. Cannon's residence in Peking

Prof. and Mrs. Cannon lived with their daughter and son-in-law, Wilma and John Fairbank, in a court yard house near the department. They liked the place and sometimes invited us for a tea party. Prof. Cannon was given reception dinners by many authorities and friends, one of which was given by president Mei I-chi of Tsing Hua College gave me the priviledge of meeting Prof. Cannon's son-in-law, Prof. John King Fairbank who was teaching in that College then. His Chinese name Fei Cheng-Ching is better known in China as an authority in Chinese History and Cultures. Mrs. Cannon and her daughter Wilma (Mrs. Fairbank) were present at the same party.

Professor Cannon sometimes went to the Sleeping Buddha Temple, near the Western Hills, with his family members on week-ends in the summer and slept in the open air. Once he invited me to join them. When I said: "I am afraid, I am not used to it," he replied smilingly "Well, Chang, you miss the fresh air!"

Attending the 15th International Congress of Physiology at Leningrad

The Chinese Physiological Delegation, consisting of R.K.S. Lim, H. Wu, C. Chiang, T.C. Shen, H.C. Chang, T.P. Feng, C.H. Chow, S.M. Ling, took the train from Peking to Leningrad to attend the 15th International Congress of Physiology. It took two weeks or more. Prof. and Mrs. Cannon left Peking for Japan and later went alone across Siberia from Vladivostock to Leningrad. We met again at the Congress.

The American and Chinese gastro-physiologists as guests of Pavlov in his home at Koluszki

Professors Cannon, Carlson, Lim, Chang and others enjoyed a visit to Prof. Pavlov at his home. Pavlov had the habit of taking a nap immediately after supper. It was around 10 in the evening, he woke up and received us. I was very glad to meet him for the 3rd time, the 1st being in Chicago, when he visited the physiological department (1924) and saw my demonstration of the metabolic experiment on trained dog, and the 2nd time being in the 14th International Physiological Congress (1933) in Rome where I attended his lecture on the mosaic theory.

Farewell party

At the Congress Dinner Party after the closure of the Congress, we said good-bye to each other. Prof. Cannon returned to America, Prof. A.J. Carlson came with the Chinese Delegation to Peking.

It is a great pleasure to review the sweet memory of Prof. W.B. Cannon, our beloved and respected American teacher and friend, when China and America have just renewed friendly relations after separation for a long time. Let the tie of friendship between the departments of physiology of Harvard and Peking, fastened by Professors Cannon and Lim, be further tightened and strengthened!

Long live the scientific spirit of Prof. Walter B. Cannon!

WILLIAM B. LENNOX POSTDOCTORAL FELLOWSHIP IN EPILEPSY

The American Epilepsy Society announces a one year William B. Lennox Postdoctoral Fellowship of $15,000 which will be awarded in 1981 (and alternate years thereafter) to a selected applicant with interests in epilepsy research.

Candidates of any nationality who have completed their doctoral training (Ph.D., M.D., or equivalent degree) and desire postdoctoral research experience are eligible. Previous experience in seizure disorders is preferable. Applicants should submit a curriculum vitae, list of publications, a letter from the sponsor and an outline of their projected research. The latter, focused on any aspect of epilepsy, should be reasonably detailed (not to exceed 5 pages) and contain information with respect to: 1) the candidate's qualifications and goals; 2) scientific background for project; 3) methods; 4) significance; 5) sponsor; and 6) research facilities and support available for the project. Applications (6 copies) should be submitted to the Secretary of the American Epilepsy Society, Jerome Engle, Jr., M.D., Dept. of Neurology, University of California Medical School, Los Angeles, 90024. Deadline for receipt of Fellowship applications is January 15, 1981. Candidates will receive notification by March 1, 1981, for the award beginning July-September, 1981.

INSTRUCTIONS FOR APPLYING FOR APS MEMBERSHIP

CURRENT APPLICATION FORMS

Most issues of The Physiologist routinely carry one copy of the current application form (following). This form will serve for all categories of membership. Any member desiring to sponsor more than one applicant may use a Xerox copy of this form. Any application submitted on an out-dated form will be redone on the acceptable form.

One application form serves all membership categories. There are, however, specific sets of instructions for each category. Therefore it is essential that sponsors and applicants carefully attend to those instructions specific to their desired category.

GENERAL INSTRUCTIONS

FOR ALL CATEGORIES:

Use only the current application form. Check the box indicating the category of membership for which you are applying. Use the SPECIAL INSTRUCTIONS for that category when filling out the form. Type the Application. Fill out all applicable spaces. Only completed applications will be reviewed.

The Bibliography must be submitted in the form found in the Society's journals. An example of the correct form is:

JONES, A.B., and C.D. Smith. Effect of organic ions on the neuromuscular junction in the frog. Am. J. Physiol. 220:110-115, 1974.

Send no reprints.

Deadline Dates: Completed applications received between February 1 and July 1 are considered for nomination by the Council at the Fall Meeting. Applications received between July 1 and February 1 are considered for nomination by the Council at the Spring Meeting. Applications are not complete until all materials, including sponsor's letters, are received.

QUALIFICATIONS (Except Students):

The Membership Advisory Committee uses the following 5 categories in evaluating an application:

1. Educational History. Academic degree and postdoctoral training are evaluated and assessed with regard to how closely the applicant's training has been tied to physiology.
2. Occupational History. Particular emphasis is given to those applicants who have a full time position in a department of physiology, or are responsible for physiology in another department. Relatively high ratings are given to people with positions in clinical departments and to people functioning as independent investigators in commercial or government laboratories.
3. Contributions to the Physiological Literature. This category is of major importance. The applicant's bibliography is evaluated on the basis of publications in major, refereed journals which are concerned with problems judged to be primarily physiological in nature. Emphasis is given to papers published as the result of independent research. Special note is taken of publications on which the applicant is sole author or first author.
4. Interest in and Commitment to Teaching Physiology. This evaluation is based on: (1) the fraction of the applicant's time devoted to teaching, (2) publications related to activities as a teacher including production of educational materials, and (3) special awards or other recognition the applicant has received for outstanding teaching effectiveness.
5. Special Considerations. This category permits the Membership Advisory Committee to acknowledge unique accomplishments of an applicant. These might be excellence in a specific area, or unusual contributions to Physiology resulting from talents, interest or a background substantially different from the average.

SPONSORS:

Primary responsibility for membership rests with the two sponsors who must be regular members of the Society. Sponsors should discuss the appropriateness of the selected category of membership in this Society with prospective applicants.

Each sponsor should write an independent confidential letter about the candidate using the five categories listed above to evaluate the candidate.

CHECK LIST:

1. Original copy of application signed by both sponsors.
2. Application on a current form, including the bibliography (1 original and 7 copies).
3. Mail the original, which has been signed by the two sponsors, plus 7 copies to:

Executive Secretary
American Physiological Society
9650 Rockville Pike
Bethesda, Maryland 20014

SPECIAL INFORMATION AND INSTRUCTIONS

FOR REGULAR MEMBERSHIP

Bylaws of the Society:

Article III, Section 2 - Regular Members. Any person who had conducted and published meritorious original research in physiology, who is presently engaged in physiological work, and who is a resident of North America shall be eligible for proposal for regular membership in the Society.

IF ALIEN: Please attach a letter and 7 copies stating visa status and type of passport and giving evidence of intent to stay in North America.

Duties and Privileges:

1. Hold Elective Office.
2. Vote at Society Meetings.
3. Serve on Committees, Boards and task forces.
4. Serve on Federation Boards and Committees.
5. Sponsor New Members.
6. Orally present or co-author a contributed paper and sponsor a non-member authored paper at the Fall scientific meeting.
7. Orally present or co-author one contributed scientific paper at the annual Federation meeting or sponsor one paper.
8. Receive The Physiologist.
9. Receive Federation Proceedings, Public Affairs Newsletters and annual Membership Directory.
10. Subscribe to handbooks and periodicals published by the Society at membership rates.
11. Register to attend scientific meetings of the Federation and the APS Fall meeting at membership rates.
12. Participate in FASEB Member's Life Insurance Program, Disability Program and in Hospital Protection Plan. (For Residents of the United States, its territories or possessions).
13. Eligible to receive the Daggs Award.
14. Eligible to be selected as Bowditch Lecturer (members under 40 years of age).

FOR CORRESPONDING MEMBERSHIP

Bylaws of the Society:

Article III, Section 3 - Corresponding Members. Any person who has conducted and published meritorious research in physiology, who is presently engaged in physiological work and who resides outside of North America shall be eligible for proposal for corresponding membership in the Society.

Duties and Privileges:

1. Serve on Society Committees, Boards and Task Forces.
2. Serve as one sponsor of new Corresponding Members (One regular member must be sponsor of a new Corresponding Member).
3. Orally present or co-author a contributed paper and sponsor a non-member authored paper at the Fall scientific meeting.
4. Orally present or co-author one contributed scientific paper at the annual Federation meeting or sponsor one paper.
5. Receive The Physiologist.
6. Receive Federation Proceedings, Public Affairs Newsletters and annual Membership Directory.
7. Subscribe to handbooks and periodicals published by the Society at membership rates.
8. Register to attend scientific meetings of the Federation and the APS Fall meeting at member rates.

FOR ASSOCIATE MEMBERSHIP

Bylaws of the Society:

Article III, Section 5 - Associate Members. Persons who are engaged in research in physiology or related fields and/or teaching physiology shall be eligible for proposal for associate membership in the Society provided they are residents of North America. Associate members may later be proposed for regular membership.

Duties and Privileges:

Same as for Regular Members except for the privilege of:

1. Holding Executive Office, or membership on certain committees.
2. Voting at Society Meetings.
3. Sponsoring New Members.
4. Receiving the Daggs Award.
5. Selection as Bowditch Lecturer.
6. Sponsoring papers of which he/she is not an author.

FOR STUDENT MEMBERSHIP

Not all questions on the application form may be appropriate – Please place NA next to any such question.

Bylaws of the Society:

Article III, Section 7 - Student Members. Any student who is actively engaged in physiological work as attested to by two regular members of the Society and who is a resident of North America. No individual may remain in this category for more than five years, without reapplying.

Duties and Privileges:

1. Present one contributed paper at the Fall Scientific meeting with the endorsement of the student's advisor.
2. Receive The Physiologist.
3. Subscribe to Handbooks and Periodicals at member rates.
4. Register to attend scientific meetings of the Federation and the APS Fall meeting at student rates.

Submit original and 7 copies of application and supporting documents.

APPLICANT'S LAST NAME _____

Date _____

THE AMERICAN PHYSIOLOGICAL SOCIETY
9650 Rockville Pike, Bethesda, MD 20014

MEMBERSHIP APPLICATION FOR:

- REGULAR ☐
- CORRESPONDING ☐
- ASSOCIATE ☐
- STUDENT ☐

CURRENT MEMBERSHIP CATEGORY; YEAR ELECTED _____

See Instructions

Name of Applicant: _____
First Middle Last

Mailing Address _____ Birth Date: _____

_____ Citizenship: _____

_____ Country of Permanent Residence:* _____

_____ Telephone No.: _____

*Alien residents of North America attach 8 copies of Alien Registration Card or other evidence of intent to remain in North America.

1. EDUCATIONAL HISTORY

Dates	Degree	Institution	Major Field	Advisor

Doctoral Dissertation Title:
(if any)

Postdoctoral Research Topic:

2. OCCUPATIONAL HISTORY

Present Position:

Prior Positions:

Dates	Title	Institution	Department	Supervisor

SPONSORS

#1. Name: _____

Mailing Address: _____

_____

_____

_____

Telephone No. Zip Code

#2. Name: _____

Mailing Address: _____

_____

_____

_____

Telephone No. Zip Code

I have read the guidelines for applicants and sponsors and this application and attest that the applicant is qualified for membership.

#1 Signature _____ #2 Signature _____

Each sponsor must submit an original and 7 copies of a confidential letter of recommendation to the Society, under separate cover.

(over)

APPLICANT'S LAST NAME _____

3. **DESCRIBE YOUR PHYSIOLOGICAL TEACHING** – What percent of your time/effort is spent in teaching Physiology?_____

Describe in the space provided your teaching of physiology including course descriptions (content, format); supervision of pre-doctoral and post-doctoral students; special contributions (films, textbooks, etc.).

4. **INTEREST IN THE SOCIETY** – List any APS Meetings attended by date and check the appropriate box for any papers.

SPRING (FASEB)			FALL (APS)		
Date	Presented	Coauthor	Date	Presented	Coauthor
_____	☐	☐	_____	☐	☐
_____	☐	☐	_____	☐	☐
_____	☐	☐	_____	☐	☐
_____	☐	☐	_____	☐	☐
_____	☐	☐	_____	☐	☐

List other scientific societies of which candidate is a member:

In the space provided state your interest in wanting to join the Society:

5. **SPECIAL CONSIDERATION** – Include any other contributions (Administrative, university, national service, awards and honors) that may be important to physiology.

6. **DESCRIBE YOUR RESEARCH** – What percent of your time/effort is spent in research?_____

Describe the fundamental physiologic questions in your research and how you have answered these questions. Limit the paragraph to the space provided.

7. **BIBLIOGRAPHY** – Attach a list of your publications under the following categories:
   1. Complete physiological papers, published or accepted for publication.
   2. Physiological abstracts (limit to ½ page).
   3. Other papers not primarily physiological (limit to ½ page).

The entire bibliography should not exceed 2 pages. Give complete titles and journal references with inclusive pagination. Use the bibliographic form found in the Society's journals. List authors in the order in which they appear in the publication.

COUNCIL OF ACADEMIC SOCIETIES BRIEF

ASSOCIATION OF AMERICAN MEDICAL COLLEGES • 1 DUPONT CIRCLE NW • WASHINGTON DC
(202) 828-0400 SPRING, 1980 VOL. 5., NO. 3

The CAS Brief is prepared by the staff of the AAMC Council of Academic Societies and is distributed through the auspices of your member society.

PRESIDENT REVISES FY 1981 BUDGET REQUEST. As reported in the last issue of the Brief (Vol. 5, No. 2), President Carter unveiled in January his FY 1981 budget request which was described at that time by Administration officials as lean and anti-inflationary. In late March, only two months later, the President sent a new budget request to the Congress as part of his latest program to combat inflation. The table below shows the revised figures for areas of primary interest to medical school faculty.

	Actual 1980 Appropriations	Proposed Rescissions	Revised FY 1980	1981 January Budget	Proposed Cuts	Revised FY 1981
NIH	3,443.0*	-43.2	3,399.0	3,581.5	-91.9	3,490.0
ADAMHA	1,184.0	-69.6	1,115.0	1,261.1	-102.3	1,158.8
Capitation	87.7	-81.3	6.4	-	-	-
HPS Loans	16.5	-16.5	-	-	-	-

*Dollars in millions

For NIH and ADAMHA, the revised President's budget request would mean a reduction in constant dollars of 12% and 15% respectively, assuming a 13% inflation rate. Information is not yet available on how these new reductions will specifically effect funding for investigator-initiated grants or research training. However, the January Administration budget for NIH, analyzed by mechanism of support, would have provided funding for approximately 5,000 ROIs and POIs while providing no money for new or competing renewal training grants or for new individual awards. Therefore, these newly-proposed cuts in the FY 1981 budget will further threaten the critically inadequate training budget and will almost certainly mean that NIH will not be able to "stabilize" research grants at 5,000.

HEALTH RESEARCH ACT OF 1980. Since their inception in 1936, the National Institutes of Health have grown and flourished under the authority of 81 lines of simple, direct language permitting the Surgeon General to "encourage, cooperate with..., render assistance to..., make available..., make grants, secure...assistance, admit and treat...patients, and enter into contracts...in the conduct of research" (Section 301, Public Health Service Act). The beauty, simplicity and flexibility of these stipulations have produced a bureaucratic mechanism admired the world around for its successful support of intramural and extramural biomedical research. The Section 301 authority is not limited in time or in dollar amounts so that only two Congressional committees, House and Senate Appropriations, are required to be involved each year in making funds available for NIH support.

On February 13, 1980 Congressman Henry Waxman (D-Ca.), Chairman of the House Subcommittee on Health and the Environment, introduced a bill that would change all this by establishing the NIH in statute, limiting its authority to three years, setting dollar limits on its appropriations and stipulating in 91 pages what was formerly accomplished in 81 lines. Among the many other problems encountered in this bill is the addition of requirements which would divert research funds to administrative activities, require advisory councils to conduct activities which are at odds with other Federal requirements, and change lines of authority at a time when NIH needs to devote all its attention to averting the effects of austerity on research. The Director of NIH and the Secretary of Health and Human Services have expressed their dismay and opposition but the legislation moved with the speed of an express train through hearings (March 3), subcommittee approval (March 18) and then to a scheduled full committee mark-up (April 2) that was narrowly averted by intensive opposition to the measure. The bill (H.R. 6902) is moving too rapidly to permit careful study and improvement. Cynics suggest that its appeal is the tri-ennial Congressional oversight of NIH which will be required. Many CAS societies have joined to urge a "go-slow" approach to enactment of this bill, suggesting that there are many serious flaws, contradictions and ambiguities that should be eliminated before its passage. A number of Washington based groups are asking Representative Harley Staggers (D-W.Va.), Chairman of the House Interstate and Foreign Commerce Committee, to hold additional hearings and discussions to perfect the legislation and to remove the most objectionable of its ill-considered, inappropriate provisions. The postponement of the April 2 mark-up by the full committee hopefully provides an opportunity to hold these discussions and perfect or defer the legislation.

AMERICAN COLLEGE OF SURGEONS PROPOSES CHANGES IN RESIDENCY ACCREDITATIONS. For several years there has been a growing debate about the accreditation system for graduate medical education. The debate is centered around the roles and relationships of residency review committees, the Liaison Committee on Graduate Medical Education (LCGME), and the professional societies which sponsor residency review committees and the LCGME. In February, the American College of Surgeons (ACS) distributed a proposal for a new mechanism to approve and accredit graduate education programs in the surgical specialties. The proposal calls for a self-supporting accreditation system with an independent staff. It recommends that residency review committees be restructured and their sponsorship changed to a specialty board and a specialty society and that the American Medical Association representation in graduate medical education be only through the Liaison Committee on Graduate Medical Education. The residency review committees would function essentially independently from the LCGME which would play only an advisory role and be an appeals body.

In March, the Graduate Medical Education Committee of the Council of Medical Specialty Societies (CMSS) held meetings in conjunction with the CMSS Spring meeting. Agreement was reached amongst the societies (including the ACS) on twelve points which incorporate the ACS proposals for independent financing and staffing and residency review committee reorganization but retain a closer relationship between the residency review committees and the LCGME. The Graduate Medical Education Committee's report will be on the CMSS agenda at its July meeting. It presumably will then be distributed to other sponsors of residency review committees and the LCGME for consideration.

CAS INTERIM MEETING HELD

The CAS Interim Meeting was held at the Washington Hilton Hotel on March 18-19, 1980. Sixty-four individuals from 50 of the 69 member societies were present to participate in discussion groups, followed by a plenary session at which Senator Richard S. Schweiker (R-Pa.) delivered the keynote address. The next CAS meeting will be held in Washington at the Washington Hilton on October 26-27, 1980.

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THE PHYSIOLOGY TEACHER

ARTERIAL PRESSURE ANALOG

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The functional complexity of the cardiovascular system is the result of the interplay of a relatively small number of physical principles used by the nervous and hormonal systems to achieve circulatory homeostasis. Failing to appreciate the significance of those principles, students tend to overcome the difficulty of mastering the function of the cardiovascular system by memorizing facts and thereby not acquiring a sound understanding of the mechanisms involved. The simple analog described in this paper will allow students to explore some of the physical aspects of the cardiovascular system and provide them with a means to visualize and conceptualize these basic principles. The opportunity to visualize the physical operation of the hydraulic analog facilitates understanding and motivates the students. This, in our opinion, is a major advantage over computer simulation.

Our aim was to reduce the analog to the simplest functional components necessary to simulate the behavior of arterial pressure in response to changes in heart rate, stroke volume, arterial compliance and peripheral resistance. While emphasizing the causal relationships between the various physical determinants and their specific effects on the arterial pulse, we did not aim to build a model based on the allometric relationships between body weight and the different cardiovascualr variables in a given animal. The analog cannot therefore be used to simulate quantitatively left ventricular and arterial function *in a specific animal.* This limitation should not be considered detrimental to the teaching of left ventricular and arterial function. Indeed, we have found that the contrast between the living animal and the analog only enhances the student's understanding.

We have successfully used this analog in graduate physiology laboratories as well as first year veterinary medicine physiology labs. The model was designed to provide "hands-on" experience for the students in order to familiarize them with fundamental hemodynamic principles. The students have enthusiastically accepted the analog as an excellent learning device because it gives them a dynamic, concrete grasp of such difficult concepts as compliance, total peripheral resistance, etc.

The statistical analyses included in the paper are relevant in that they describe the functional validity of the analog. The exercises described herein may be used without the mathematical formulae for undergraduate labs, but we suggest including these formulae for graduate courses in the biophysics of the cardiovascular system.

This paper includes a description of the analog, detailed enough so as to permit easy reconstruction, followed by a series of exercises illustrating the physical determinants of arterial pressure. For each exercise the recorded raw data and their mathematical relationships are shown and their physiological significance is discussed.

DESCRIPTION OF THE MODEL

The principle of operation is based on electronic pulsing of fluid (distilled water) through an open hydraulic system, a schematic of which is illustrated in Figure 1. A rubber balloon (RB) which is enclosed in an airtight 100 ml round bottom flask (F) functions as the left ventricle. The ventricle receives fluid from the fluid reservoir (FR) and ejects it into the vascular system. A check valve (V), composed of a teflon ball contained in a nylon cylinder prevents backflow. The Starling Resistor (SR), which is composed of a latex Penrose tube enclosed in a glass cylinder is used to simulate the compliance of the aorta and large arteries. The SR is not used as a variable resistor, as its name implies. Due to its relatively large diameter (12.5 mm) it offers no effective resistance to flow in the hydraulic system, but serves as an excellent compliance vessel. The true resistance vessels (arterioles) are represented by glass capillary tubes which are arranged in parallel (R1, R2, and R3). S1, S2, and S3 are solenoid valves which will be described subsequently. All components are connected with 1/4" ID tygon tubing.

The Hydraulic Component

Appendix 1 provides a detailed list of materials for the construction of the hydraulic system. An elevated fluid reservoir provides a constant hydrostatic pressure head to the ventricle. A three-way solenoid valve (S1) is electronically activated to regulate ventricular filling (diastole) and ejection ("aortic" systole). During diastole, fluid flows from the FR into the rubber

balloon. The elastic tension which is developed in the rubber wall during filling provides the driving pressure for systolic ejection. "Aortic" systole begins with the opening of S1 and ends when ejection pressure falls below aortic pressure. At this time, the teflon ball will occlude the lumen of the check valve, thus preventing backflow. It should be noted that deenergizing valve S1 terminates "ventricular systole" and starts ventricular filling. This event is controlled electronically and does not in general coincide with the closing of the check valve, which is necessary for preventing backflow and simulating the dicrotic notch. The left ventricle of the analog cannot generate pressure on its own, so this pressure is provided by an elevated fluid reservoir. An increase in stroke volume could therefore be simulated by an increase in the elevation of the fluid reservoir, but it can also be simulated by increasing ejection time. At a constant heart rate, increasing the stroke volume will result in a shortening of filling time, but within a reasonable range, this does not become a limiting factor in increasing stroke volume.

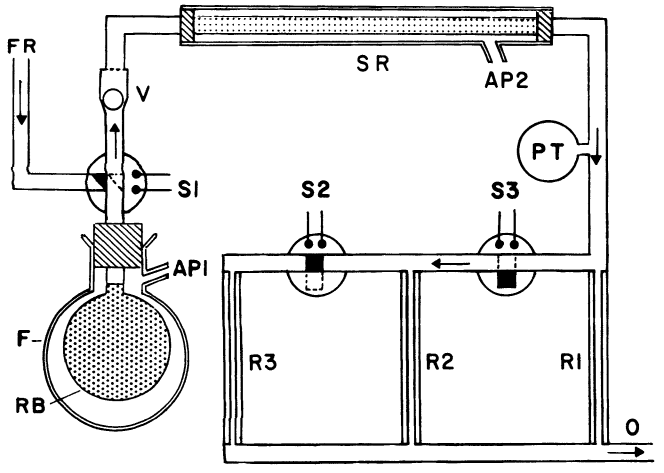


Fig. 1. The Hydraulic Component of the Left Ventricular and Arterial Function Analog. Arrows indicate direction of fluid flow.

LEGEND

AP1 ..... Air port for ventricular volume control

AP2 ..... Air port for compliance control

F ..... Round bottom flask

FR ..... Fluid reservoir

O ..... Outflow vessel

PT ..... Pressure transducer

R1, R2, R3 ..... Glass capillary tubes

S1, S2, S3 ..... Solenoid valves

SR ..... Starling resistor

V ..... Check valve

The Starling Resistor serves as a variable compliance vessel. As air is removed from the glass cylinder via AP2, the latex tube expands and becomes less compliant. If the tube is expanded to such an extent that its walls rest against those of the surrounding glass cylinder, the compliance of the system is essentially equal to zero. A 10 ml syringe is used to inject or withdraw air from AP2. A stopcock is placed between the syringe and AP2 to maintain an airtight system. Pulse pressure changes associated with progressive arteriosclerosis may be simulated using this technique (see Exercise #4).

Total peripheral resistance is electronically controlled by directing flow through one, two, or all three of the glass capillary tubes (R1, R2, R3) with solenoid valves S2 and S3. When S3 is open, fluid flows through R1 and R2, which provides a medium value of peripheral resistance. To achieve high resistance, S3 is closed and fluid is directed through R1 only. Low peripheral resistance may be obtained by opening both S2 and S3 and directing flow through all three resistance vessels.

A standard Statham blood pressure transducer (PT) is used to record pressure in the system. [NOTE: The driving pressure is the difference in pressure between two points in the vascular system. Both the driving pressure and pulse pressure are *differences* in pressure, the former being spatially and the latter temporally determined. It follows that in a closed cardiovascular system, two pressure transducers must be used to record driving pressure. However, in a system which is open to atmospheric pressure, driving pressure can be recorded with only one transducer as long as atmospheric pressure remains constant and is arbitrarily set to zero. This is the case in the analog and therefore all recorded values are driving pressures (as well as intravascular pressures)]. All recordings illustrated in this paper were made on a Gould-Brush Model 2200 Recorder. High frequency components in the pulse wave were eliminated by placing a capillary tube between the hydraulic system and the PT.

Detailed descriptions of the behavior of the model in this paper show mean pressures within a range of 0 to 100 mm Hg. It should be noted that the high pressure was obtained when the bottom of the FR (an 18 liter Nalgene carboy) was at a height of 1.5 meters above the level of the rubber balloon. Higher pressures that are more characteristic of an adult human cardiovascular system may be obtained by raising the level of the FR even higher.

The Electronic Pacemaker

The pacemaker circuit is illustrated in Figure 2.

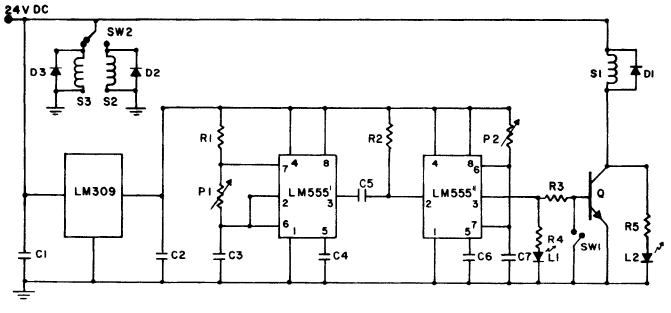


Fig. 2. Electronic Pacemaker Circuit.

LEGEND

C1 ..... 2000 μF

C2 ..... 47 μF

C3, C7 ..... 1 μF

C4, C6 ..... 0.01 μF

C5 ..... 100 pF

D1, D2, D3 ..... 1N4003

L1, L2 ..... LEDS (MSL 100)

LM309 ..... +5VDC Voltage Regulator

LM555' ..... Timer IC for frequency

LM555'' ..... Timer IC for pulse width

P1, P2 ..... 500 K Ω Helipot potentiometer

Q HP7C4

R1 ..... 500 H Ω

R2 ..... 100 K Ω

R3 ..... 100 Ω

R4 ..... 560 Ω

R5 ..... 1 K Ω

S1, S2, S3 ..... 24 VDC Solenoid valves (C&H Sales Co.* SV7912 Part #)

SW1 ..... Switch for peripheral runoff

SW2 ..... 3-way (SPDT) switch for peripheral resistance ("ON-NONE-ON")

*C&H Sales Co.
2176 E. Colorado Blvd.
Pasadena, CA 91107

The circuit consists of two IC Timers (LM555) which control the opening and closing of solenoid valve S1. LM555' is used in an astable operation and determines the heart rate which may be altered between 64 and 200 beats/min by adjusting the variable resistor P1. LM555'' regulates the pulse width which determines the ratio between systole and diastole (duty cycle). P2 alters this ratio to produce a ten-fold change in systolic time which results in a ten-fold change in stroke volume of the ventricle (V_{ST}). Light emitting diodes L1 and L2 serve as visual indicators of the duration of ventricular ejection and filling respectively. Switch SW1 allows manual control of solenoid valve S1 and is used to produce peripheral runoff curves. When this switch is closed, the left ventricle is isolated from the arterial system and the arterial fluid "bleeds-off." The SPDT Switch SW2 operates in an "ON-NONE-ON" fashion and allows manual control of solenoid valves S2 and S3, which are used to adjust peripheral resistance. Valve S3 is normally open and valve S2 is normally closed. The voltage regulator LM309 provides +5VDC to the timing circuit.

EXERCISES

Fig. 3 shows typical pulse waveforms produced by the analog. The following exercises have been designed so as to progressively familiarize the students with the effects of the physical determinants of arterial pressure on the pulse waveform: peripheral resistance (Exercise No. 1), compliance (Exercise No. 2), time constant (Exercise No. 3).

Discussion of the results and the illustrations should enable the student to master the material even if the model is not available. In Exercises No. 4 and 5 the concepts of compliance, peripheral resistance and time constant are applied to the analysis of the pulse waveform. Finally, Exercises No. 6 and 7 illustrate the effect of changes in left ventricular function (stroke volume, heart rate) on pulse pressure.

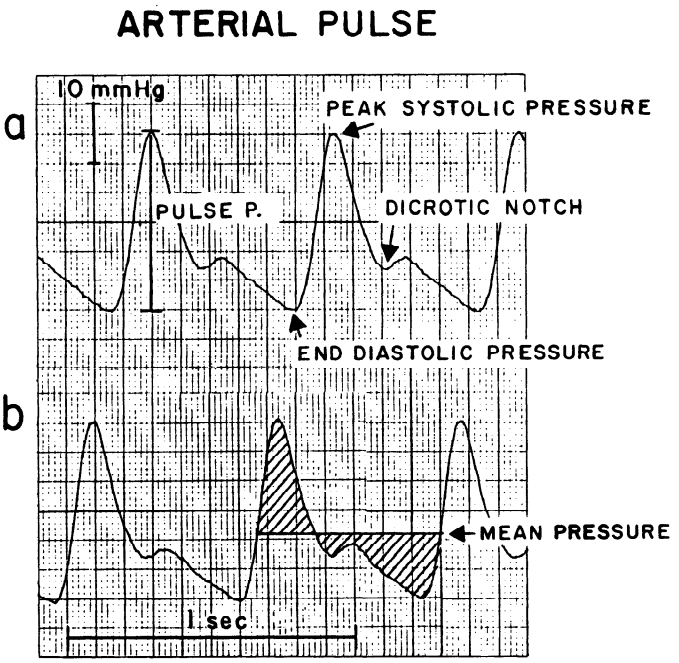


Fig. 3. a) Pulse Waves as Recorded from the Model
b) Geometric Representation of Mean Pressure

Exercise No. 1: The Pressure-Flow Relationship

This exercise is an introduction to some fundamental properties of fluid dynamics and the partitioning of energy for flow. The heart converts chemical energy into mechanical energy which is then transmitted to the blood and the vascular system. When mechanical energy is added to a fluid in a hydraulic system, it reappears as potential energy (pressure, which has dimensions of energy per volume of fluid), kinetic energy, which manifests as flow, and heat due to the frictional losses of energy caused by the resistance to flow. This partitioning of energy is determined by the geometry of the vascular system, the viscosity of blood and the flow pattern (laminar and/or turbulent). In a rigid hydraulic system, the pressure-flow relationship will be linear and will intercept at the origin if flow is laminar and nonpulsatile (Poiseuille's Law).

Experimental determinations of flow are made by collecting the fluid from the outflow vessel "O" during a 60 sec period at various mean pressures. The volume of fluid collected per minute is either directly measured in a graduated cylinder or weighed on a balance, the volume in ml being equivalent to the gram-weight of the water. Since flow is measured over a one minute time interval, the mean pressure over this same time period is the driving pressure, which is used to establish the pressure-flow relationship. Flow is changed by systematically increasing stroke volume but keeping heart rate and peripheral resistance constant.

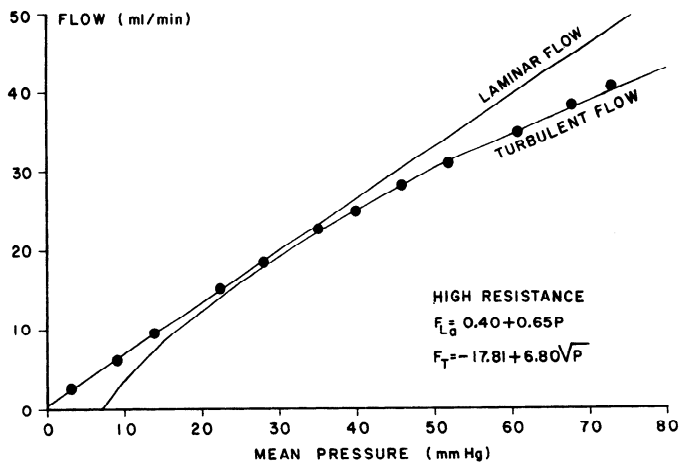


Fig. 4. Flow as a Function of Pressure for Low and High Peripheral Resistance. The equations describe the best fit of the pressure-flow data for low (F_L) and high (F_H) resistance.

Figure 4 illustrates the pressure-flow relationships derived from these data for low and high peripheral resistance. Both relationships are curvilinear and pass through the origin. The equations shown in Figure 4 represent the best fit of the experimental data as obtained by regression analysis. The coefficients of determination are $r^2 = 0.999$ for flow at low resistance (F_L) and $r^2 = 0.998$ for flow at high pressure (F_H). Both equations are power functions. Close inspection of the equations reveals that the contribution of the last term of each (power term) becomes negligible at low mean pressure. As a result, the pressure-flow relationships for both approximate a linear function between 0 and 30 mm Hg. Notice that above 30 mm Hg the linear relationship no longer holds: The slope of the curve decreases, reflecting a smaller increase in flow for the same pressure increment.

An analysis of the shape of the pressure-flow curves leads to the following physical explanation about flow patterns in the model. In a rigid hydraulic system, the pressure-flow relationship would be linear and would intercept at the origin if flow is laminar and nonpulsatile (Poiseuille's Law). A deviation from linearity in the pressure-flow relationship indicates a change in flow pattern. In particular, if the curvilinear portion is due to turbulent flow, then flow should be proportional to the square root of pressure within this range. Figure 5 shows the predicted pressure-flow curves for laminar (F_{La}) and turbulent flow (F_T) in the high resistance condition.

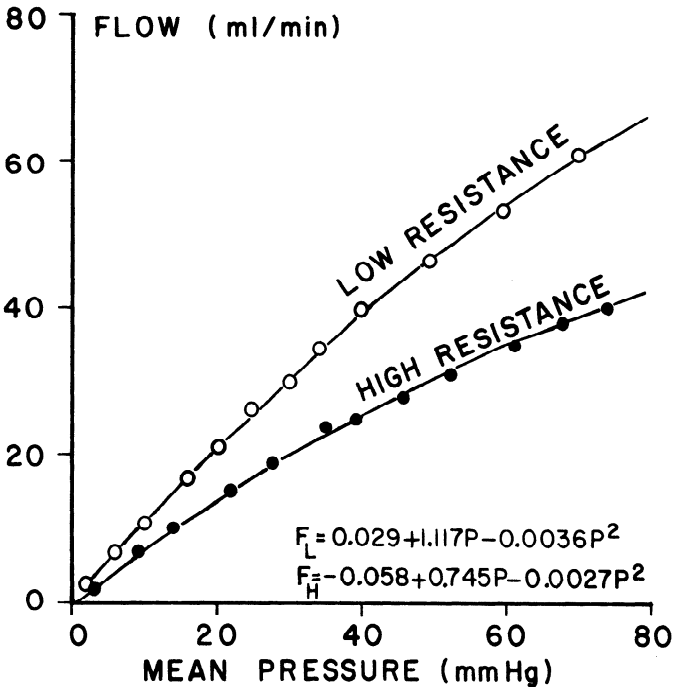


Fig. 5 Predicted Pressure-Flow Curves for Laminar and Turbulent Flow. Experimental pressure-flow values (black dots) recorded from the model fit the laminar flow line below 30 mm Hg (F_{La}) and the turbulent flow curve above 30 mm Hg (F_T).

At pressures below 30 mm Hg the pulsatile flow does not significantly alter the linearity of the relationship and the experimental points fall on the predicted laminar flow line, and above 30 mm Hg the points fit the turbulent flow curve. The coefficients of determination are $r^2 = 0.996$ (N=7) for F_{La} and $r^2 = 0.997$ (N=6) for F_T. In summary, the behavior of the model can be described by equations which are consistent with principles of fluid dynamics.

How do these results compare with what might be expected in a living vascular system? Given the location of the pressure transducer in the model, the recorded data describe the pressure-flow relationship in the rigid portion of the hydraulic system, i.e., the glass capillary tubes (arterioles) and Tygon tubing. In a living organism, the vasculature is both distensible and collapsible. Therefore, one might expect the pressure-flow relationship in a living cardiovascualr system to be different. Contrary to the behavior of the model, flow in a distensible system will show *greater* increases at high pressure for a given pressure increment. The collapsibility of living vessels requires a minimum intravascular pressure to maintain patency. As a consequence, the pressure-flow curve does not pass through the origin but intercepts the pressure axis at the critical closing pressure. In addition, both laminar and turbulent flow are observed in living vascular systems. Under normal conditions laminar flow predominates, however, in abnormal conditions such as severe anemia, turbulent flow may become significant due to a decrease in viscosity of blood and an increase in velocity of flow caused by an increase in cardiac output.

Peripheral Resistance

Poiseuille's Law describes the relationship between pressure and laminar flow:

$$F = P_d \frac{\pi}{8} \frac{r^4}{\ell} \frac{1}{\eta} \qquad (1)$$

where F = flow

P_d = driving pressure

r = radius of vessel

ℓ = length of vessel

η = viscosity

By analogy with Ohm's Law, this equation may be reduced to:

$$F = P_d \cdot \frac{1}{R} \qquad (2)$$

where R = resistance to flow.

From this equation, peripheral resistance is defined as:

$$R = \frac{P_d}{F} . \qquad (3)$$

In a rigid tube the pressure-flow relationship becomes linear (assuming constant viscosity) and the slope represents the reciprocal of the resistance to flow. Note that this is true only when the relation is linear; with a curvilinear relation the slope is no longer the reciprocal of the resistance to flow.

Exercise No. 2: Pressure-Volume Relationship

In the foregoing treatment the influence of the rigid portion of the hydraulic system upon flow and pressure has been considered and only mean pressure has been taken into account. However, instantaneous changes in pressure and flow depend upon compliance (C), a property of the distensible portion of the hydraulic system. The compliance of the arterial system is the property which enables it to convert kinetic energy of the circulatory fluid to potential energy of the vascular wall, which is then used to propel blood during diastole. The combination of compliance and resistance is responsible for converting pulsatile blood flow into continuous flow.

Compliance is defined as the ratio of a change in volume to a change in pressure. For infinitesimally small changes, compliance is defined as:

$$C = \frac{dV}{dP} . \qquad (4)$$

High compliance means that a large volume change produces a small change in pressure. Conversely, in a low compliance system a small volume of fluid is stored under high pressure.

The compliance of a system can be determined from the pressure-volume (P-V) curve of that system. By definition, C is the slope of the P-V curve. Experimentally, the P-V curve is obtained by injecting known volumes of fluid into the Starling Resistor and recording the corresponding pressure changes. Fluid is injected into the Starling Resistor and runoff is prevented by clamping the final outflow vessel "0" (See Figure 1). This yields a P-V relationship for all of the vascular components of the model. However, since most of the vasculature downstream of the Starling Resistor is rigid, the compliance of the system reduces to that of the Starling Resistor. Figure 6 shows the results of this procedure for low and high compliance. For low compliance the relationship is linear over the entire pressure range. In the high compliance condition, the relationship is only linear from 0-100 mm Hg, which is within the normal range of operation of the model.

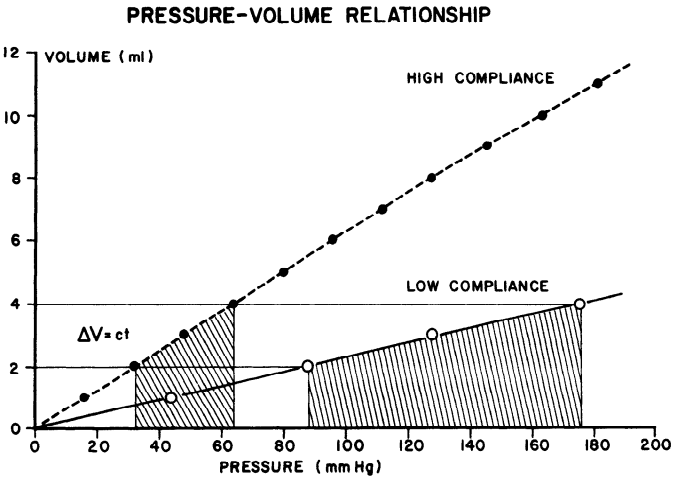


Fig. 6 The Pressure-Volume Relationship for Low and High Compliance. Note that a given volume change (ΔV) produces a large pressure change in the low compliance condition but only a small pressure change in a system with high compliance.

Exercise No. 3: Arterial Pressure Changes During Diastole

During diastole, there is no flow into the Starling Resistor. Assuming that laminar flow predominates, changes in arterial pressure during this time are determined by compliance (C) and the instantaneous outflow or peripheral runoff (P/R):

$$\frac{dP}{dt} = -\frac{P}{R} \cdot \frac{1}{C} = \frac{-1}{RC} \cdot P. \qquad (5)$$

Integration of equation (5) leads to:

$$P(t) = P_0 \cdot e^{-t/RC} \qquad (6)$$

where P_0 = arterial pressure at the closing of the unidirectional valve. Equation (6) describes the shape of the runoff curve as an exponential decay, the rate of which is determined by the time coefficient -1/RC. The product RC is called the *time constant* of the system and has units of seconds. Note that as the value of RC increases, the exponent decreases and consequently, the rate of decline of the exponential function decreases as described by equation (6).

Figure 7 shows a recorded runoff curve for high peripheral resistance.

In order to test whether this curve can be expressed by equation (6), 21 data points were read off the curve and submitted to an analysis of regression using various mathematical relations as statistical models. The graph above the recording shows that the experimental data points conform best to an exponential curve, the coefficient of determination being $r^2 = 0.999$.

Regression analysis shows that the shape of the runoff curve is consistent with equation (6). Is there also consistency between the estimated regression coefficient, the previously determined resistance to flow (Exercise No. 1), and compliance?

Consider the estimated equation in Figure 7:

$$P = 60e^{-0.255t} \qquad (7)$$

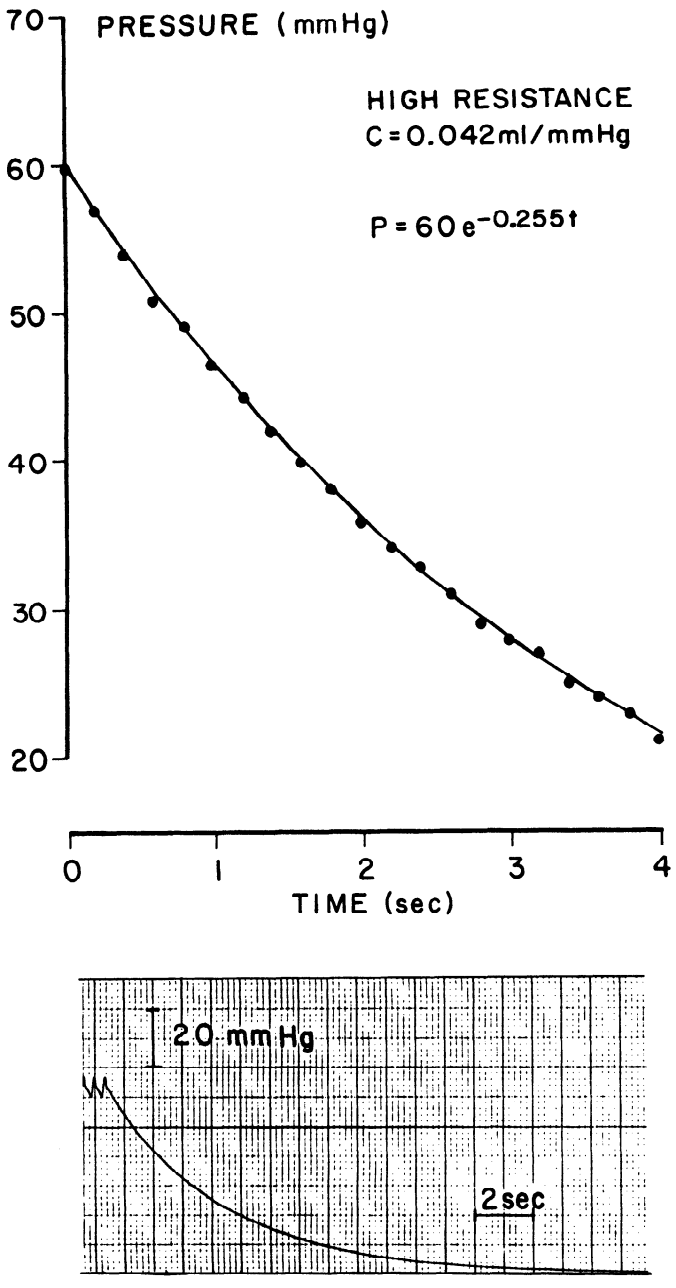


Fig. 7 Arterial Pressure Changes During Peripheral Runoff. Top: Exponential fit of recorded pressure-time data. Bottom: Recording of runoff from the model.

Notice that the time coefficient is equal to the reciprocal of the time constant of the hydraulic system (from equation (6)):

$$-0.255 = -\frac{1}{RC} . \qquad (8)$$

If the behavior of the model is consistent, it should be possible to predict the time coefficient from *independently derived values of R and C.* This is easily accomplished by taking:

(1) A value for C from the slope of P-V curve of Fig. 6, since:

$$\frac{dV}{dP} = C, \text{and} \qquad (9)$$

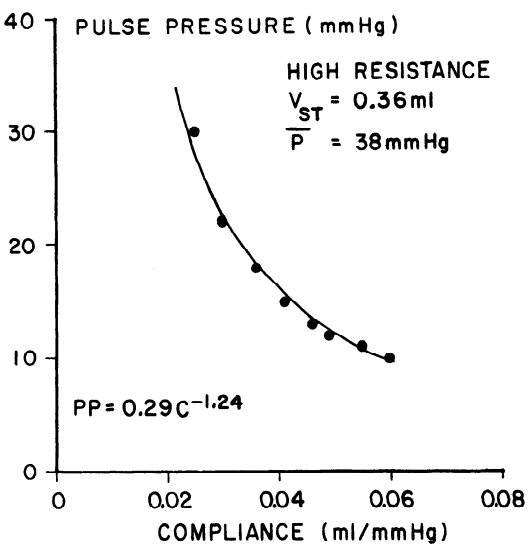
(2) A value for R from the slope of the linear portion of the Pressure-Flow curve of Figure 5, since:

$$\frac{dF}{dP} = \frac{1}{R} . \qquad (10)$$

Therefore, the absolute value of the ratio of (10) to (9) should be equal to the time coefficient which has been estimated by regression analysis of the runoff curve. With this method, we find $1/RC = .258$ sec, an agreement within 1.2% of the $1/RC$ estimated by regression analysis. The remarkable consistency within the experimental data demonstrates that the behavior of the model conforms to equation (6) and that, neglecting the dicrotic notch, peripheral resistance and compliance are the main determinants of the shape of the runoff curve.

What is the significance of the shape of the runoff curve and the time constant in the cardiovascular system? The time constant RC determines the rate of pressure decline during diastole. If RC = 1 sec then arterial pressure drops to 37% of its initial value in 1 sec, regardless of the level of initial pressure and the actural values of R and C, as long as their product is equal to 1 sec. Therefore, with respect to the time constant, resistance to flow and compliance play symmetrical roles: An increase in one can be compensated for by a decrease in the other in order to maintain the same time constant. However, the particular effects of C and R on pulse waveform and hemodynamic variables are different as illustrated in Exercises No. 4 and No. 5. Notice that by increasing one variable while holding the other constant, the time constant of the hydraulic system increases.

Exercise No. 4: Effect of Compliance on Pulse and Mean Pressure



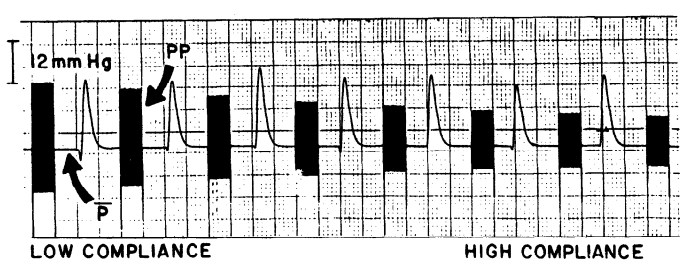


Fig. 8 Effect of Compliance on Pulse and Mean Pressure. ($\bar{P}$ ≙ mean pressure, PP ≙ pulse pressure in mm Hg). The recording was made at a slow paper speed and shows the progressive changes in pulse pressure and mean pressure as compliance is gradually increased.

Figure 8 illustrates the effect of compliance on pulse and mean pressure. In the actual recording reproduced at the bottom, the height of each dark rectangle represents pulse pressure and the horizontal lines between the rectangles indicate mean pressure. The transient changes in mean pressure are due to the technique used to alter compliance: Pressure in the air space surrounding the Penrose tube changes when air is injected to increase compliance. The sudden increase in pressure pushes fluid out of the Penrose tube until pressure has returned to its mean level. Note that the recording was made at a very slow paper speed, such that individual pulse waves cannot be resolved.

As compliance is increased from left to right on the recording, pulse pressure decreases but mean pressure remains constant. This phenomenon continues in the face of an almost threefold increase in compliance. The decline in pulse pressure is due to the decrease in peak systolic pressure and the concomitant increase in diastolic pressure as illustrated by the recording. The decrease in peak systolic pressure is caused by the reduced stiffness of the Penrose tube, whereas the increase in diastolic pressure is due to the greater time constant RC. Indeed, the time necessary to reach end diastolic pressure increases with compliance, but, since the actual time for runoff (diastole) is imposed by the pacemaker, diastolic pressure does not have sufficient time to drop to the former level and consequently remains higher. Therefore, compliance alters peak systolic and end diastolic pressure in opposite ways and by different mechanisms.

The graph depicted in Figure 8 shows the relationship between compliance and pulse pressure at constant peripheral resistance, stroke volume and heart rate. The best fit curve ($r^2 = 0.991$) corresponds to a power function with a negative exponent.

Changes in compliance do not result in changes in mean pressure. This feature differentiates the hemodynamic consequences of a change in compliance from those of a change in peripheral resistance. As compliance is altered, the time distribution of pressure is affected in such a way that the higher diastolic pressure is compensated for by a lower systolic pressure. As a result, the mean pressure remains the same and mean flow over a cardiac cycle is not affected.

EFFECT OF PERIPHERAL RESISTANCE ON MEAN AND PULSE PRESSURE

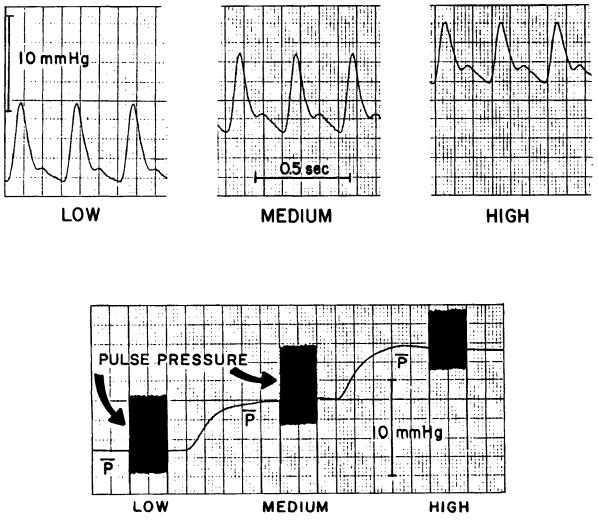


Fig. 9 Effect of Peripheral Resistance on Mean and Pulse Pressure.

Exercise No. 5: Effect of Peripheral Resistance on Mean and Pulse Pressure

Figure 9 shows the effect of peripheral resistance on pulse and mean pressure at constant compliance, heart rate and duty cycle. With increasing peripheral resistance, mean pressure increases and pulse pressure tends to decrease.

Mean pressure is the driving pressure for runoff; its level depends on cardiac output (left ventricular function) and peripheral resistance. When a steady cardiac output suddenly encounters a higher peripheral resistance, inflow to the Starling Resistor exceeds the now reduced outflow. Consequently fluid is retained in the Starling Resistor and due to the compliance, mean pressure will rise until a level is reached where runoff again balances cardiac output.

In contrast to the rising mean pressure, pulse pressure declines at high peripheral resistance. Since both peak systolic and end diastolic pressures increase, the reduction in pulse pressure is due to a larger increase in diastolic than in peak systolic pressure. Indeed, as peripheral resistance changes from low (61 mm Hgfiml^{-1}fisec) to high (92 mm Hgfiml^{-1}fisec), end diastolic pressure rises by 11.2 mm Hg and peak systolic pressure by 8.4 mm Hg. Clinically a higher diastolic pressure is interpreted as reflecting an increased peripheral resistance.

With an increase in peripheral resistance the time constant of runoff increases, the rate of decline in diastolic pressure is slower and consequently the diastolic pressure reached at the end of the cardiac cycle is higher. Table 1 summarizes the results of Exercises No. 4 and No. 5.

TABLE I

Hemodynamic Variable	Increase in Compliance (R is held Constant)	Increase in Peripheral Resistance (C is held Constant)
Peak systolic pressure	decreases	increases
End diastolic pressure	increases	increases
Pulse pressure	decreases	decreases
Mean pressure	remains constant	increases

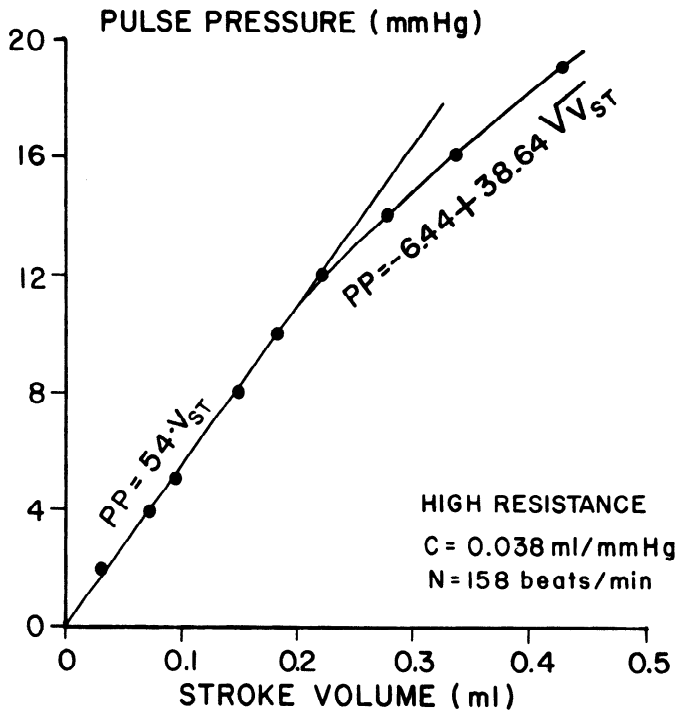
EFFECT OF LEFT VENTRICULAR FUNCTION ON PULSE PRESSURE

Left ventricular function in conjunction with venous return determines cardiac output, which is the mean rate of inflow to the arterial system over an entire cardiac cycle. Since the hydraulic model is an open system, venous return is not a limiting factor of cardiac output as long as the pressure head produced by the fluid reservoir remains sufficiently high. Cardiac output (CO) is the product of stroke volume (V_{ST}) times heart rate (HR). A change in CO will therefore reflect a change in V_{ST} or HR or both. The resulting change in *mean pressure* cannot be used to distinguish a change in V_{ST} from a change in HR since mean pressure is only determined by CO and peripheral resistance. However, the concomitant change in *pulse pressure* will allow us to recognize whether CO has been altered by a change in V_{ST} or HR, as shown in Exercises 6 and 7.

Exercise No. 6: Effect of Stroke Volume on Pulse Pressure

Figure 10 shows the change in pulse pressure as stroke volume is progressively increased. During this experiment peripheral

resistance is high, compliance and heart rate are constant. Stroke volume is increased by prolonging systolic time (inflow time); it is indirectly measured by dividing flow by heart rate. The recording was done with slow paper speed, so that individual pulse waves are not resolved during the change in stroke volume. The recording shows that as stroke volume is increased pulse pressure becomes larger. The mathematical relationship between the two variables is depicted in the graph above the recording. When stroke volume varies from 0 to 0.2 ml, pulse pressure increases linearly, the regression line going through the origin. Beyond this range there is a significant deviation from linearity, pulse pressure increasing less for the same increment in stroke volume. For this portion of the graph, regression analysis indicates that a square root function is the best fit ($r^2 = 0.999$).



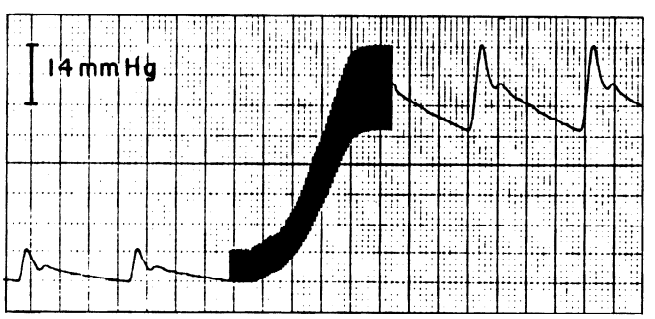


Fig. 10 Effect of Stroke Volume on Pulse Pressure. Top: Best fit of experimental data. Bottom: Pressure change observed during a progressive increase in stroke volume. Note that paper speed has been decreased in the middle of the recording.

What is the physical meaning of the slope of the stroke volume — — pulse pressure curve? Since changes in pressure (P_{sys}-P_{dias}) are plotted against changes in volume ($V_{end\ diastolic}$ - $V_{end\ systolic}$), the slope has dimensions of volume elasticity, which is the reciprocal of compliance. Neglecting the outflow during the phase of rapid increase in pressure, stroke volume represents the change in volume of the Starling Resistor. Compliance computed from the linear portion of the curve is equal to 0.018 ml/mm Hg, about half the value of the actual compliance of the S.R. (C = 0.038 ml/mm Hg). Compliance of the S.R. determined from the stroke volume — — pulse pressure curve tends to be lower than compliance determined from the pressure-volume curve, because neglecting outflow leads to an underestimate of the actual compliance. If this underestimate is only due to runoff this considerable discrepancy would indicate that runoff cannot be neglected in computing compliance. In fact the entire difference cannot be attributed to runoff: Under the dynamic conditions of pulsatile flow a new phenomenon occurs.

Due to the inertia of the column of fluid in the S.R., the rapidly inflowing fluid cannot instantaneously move the entire column and transient local bulging occurs at the proximal end of the Penrose tube. The inflowing fluid is not uniformly stored throughout the tube and only the compliance of the transiently bulged segment is effective in determining the rise in systolic pressure. The compliance of a cylindric tube is directly proportional to its length:

$$C = \frac{\Delta V}{\Delta P} = \frac{\pi \ell (r_2^2 - r_1^2)}{\Delta P} \qquad (11)$$

where ℓ = length of tube

r_1 = initial radius of the tube

r_2 = final radius of tube.

Therefore, the *effective compliance* is necessarily smaller than the compliance of the whole tube determined under static conditions.

The existence of effective compliance can also be directly demonstrated by rapidly injecting known volumes of fluid into the clamped S.R. The more rapid the injection, the steeper the rise in pressure and the larger the initial overshooting. When equilibrium is reached following the rapid injection, one can again measure the *actual compliance* of the Penrose tube.

As stroke volume increases, the effective compliance approaches the actual compliance as a larger and larger segment is recruited to store the fluid. Compliance corresponding to the curvilinear portion of the graph in Fig. 10 is given by the inverse of the first derivative:

$$\frac{dV}{dP} = 0.52(V_{ST})^{0.5}. \qquad (12)$$

For a stroke volume of 0.5 ml the effective compliance is 0.037 ml/mm Hg, a value close to the actual compliance of 0.038 ml/mm Hg.

In summary, this experiment shows that the dynamic behavior of a system cannot always be predicted from the static properties of its components, because under dymamic conditions new phenomena may come into play.

Exercise No. 7: Effect of Heart Rate on Pulse Pressure

Figure 11 shows the change in pulse pressure as heart rate is continuously increased from 64 to 200 beats per minute. During this experiment peripheral resistance is high, compliance and

stroke volume being held constant. The recording was done with slow paper speed, so that individual pulse waves are not resolved during the change in heart rate.

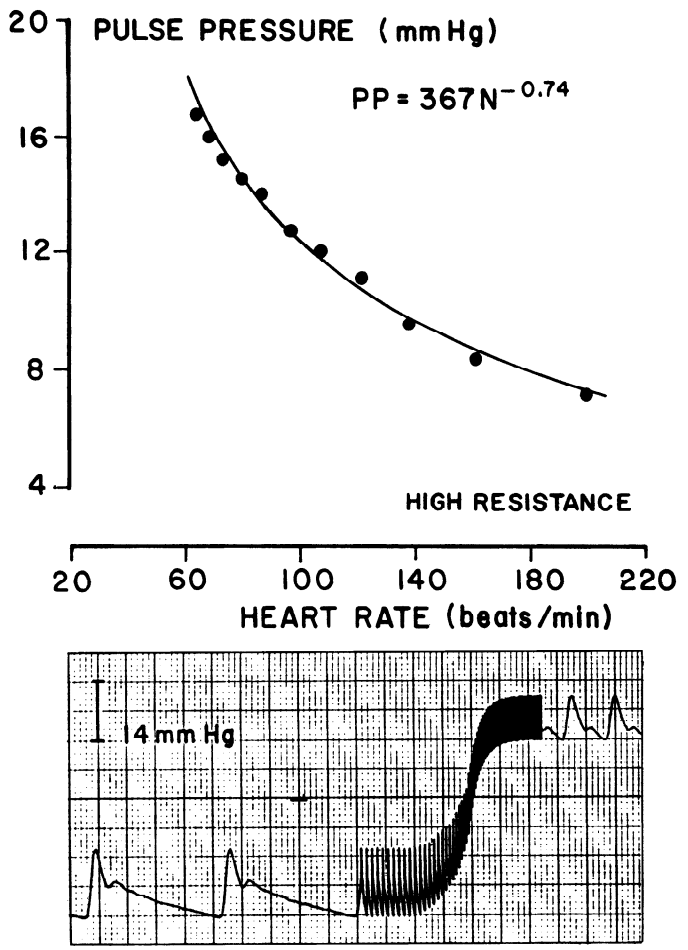


Fig. 11 Effect of Heart Rate on Pulse Pressure. Note that paper speed has been decreased during the change in heart-rate.

The recording shows that with increasing heart rate both peak systolic and end diastolic pressures increase. But since end diastolic pressure increases more, pulse pressure actually decreases according to the power function represented above the recording. Peak systolic pressure is higher because of the increased inflow (CO) into the Starling Resistor. Diastolic pressure increases because the actual time for runoff is shortened as heart rate increases. Notice that in this case the time constant for runoff does not change; this is contrary to what happens when compliance or peripheral resistance are altered. The opposite effects of stroke volume and heart rate on pulse pressure show that it could remain constant or even increase when both heart rate (chronotropic effect) and stroke volume (inotropic effect) are increased.

CONCLUSION

In each of the foregoing exercises, the student's attention is focused on only one variable at a time, thereby introducing the basic biophysics of the cardiovascular system. More complex situations simulating the actual behavior of the cardiovascular system can be demonstrated by changing several variables simultaneously, which leads to many new possibilities for exploring both normal and pathological behavior of the left ventricle and arterial system.

Appendix 1

Materials for Construction of
The Hydraulic Component

Component	Qty.	Description
Fluid reservoir	1	10-liter Naglene carboy
Left Ventricle	1	Small toy balloon
	1	100 ml round bottom flask with port (1/4" ID)
	1	Rubber stopper
Check valve	1	Teflon ball (5/16" dia) (Small Parts Co.* #BT-5)
	1 in²	Nylon mesh (Small Parts Co. #CMN-2000)
	1	Nylon housing (tube connector 1/4" dia to 1/2" dia).
Starling Resistor	1	12"x1" dia. Latex wound drain
	1	12"x 1" dia. glass cylinder with port
	2	Rubber stoppers
Resistance vessels	4-6 in. lengths	Capillary tubing
Misc.	6 ft.	Tygon tubing (1/4" ID)
	3 ft.	Amber tubing (1/4" ID)
	1	Statham Pressure transducer
	24" x 15"	Plywood (3/4") Frame
	24" x 12"	Plywood (3/4") Base
	3	Stopcocks
	3	Connector tubes

*Small Parts Inc.
6901 N. E. Third Avenue
Miami, FL 33138

BÁRÁNY

Robert Bárány (1876-1936) ear specialist of Vienna. In 1906 Bárány advanced a theory of vestibular nystagmus. He received the Nobel prize in 1914 for his work on the physiology and pathology of the vestibular apparatus.

Bárány's Sign: The nystagmus produced following injection of warm or cold water into the external auditory meatus, which varies with the pathology of the internal ear.

From: *The Origin of Medical Terms.* Henry A. Skinner. Williams & Wilkins, Baltimore, 1961.

NEURAL CONTROL OF OVULATION*

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Ovulation is the pivotal point in the reproductive cycle. Is is not an isolated event but requires synchrony of numerous steps including preparation and maturation of the follicle(s) destined to ovulate, steroid hormone secretion by the ovary, and neuroendocrinological changes resulting in gonadotropin secretion. This presentation will focus on the ultimate signal to the ovary that results in the release of the ovum: the preovulatory surge of luteinizing hormone (LH).

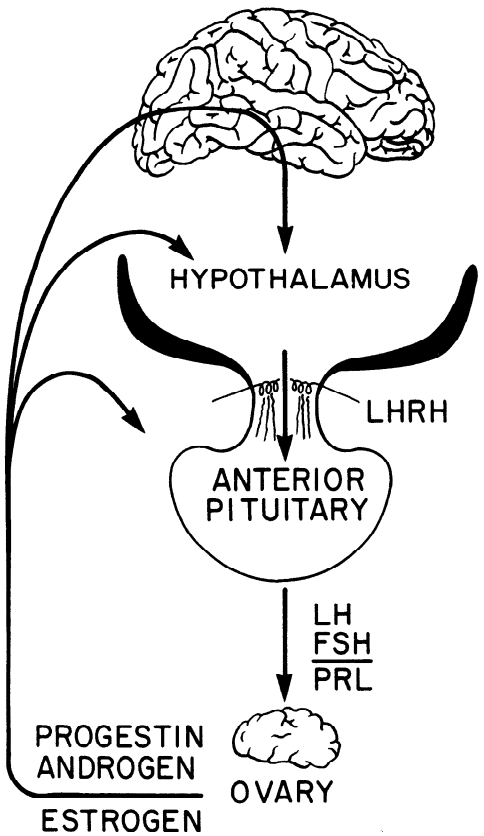


Fig. 1 Diagram of several feedback loops involved in the hypothalamo-pituitary-ovarian axis.

The components of the system are shown in Fig. 1. Neurosecretory neurons of the hypothalamus produce luteinizing hormone releasing hormone (LHRH) which is released into the hypophyseal portal system resulting in the release of LH from gonadotrophs in the anterior pituitary. LHRH is required in the normal, physiologic release of LH. The ovary in response to stimulation by the gonadotropic hormones LH and follicle stimulating hormone (FSH) and also prolactin secretes steroid hormones. These hormones, estrogens, androgens and progestins, have in addition to their various effects in peripheral tissues the important function of feedback regulation of gonadotropic hormone secretion. The issue becomes complex due to the multiple sites of steroid feedback interaction: extrahypothalamic CNS areas (which in turn influence hypothalamic activity), the hypothalamus and the pituitary.

In this system the ultimate trigger that results in ovulation is a massive but brief outpouring of LH from the pituitary - commonly referred to as the LH surge. The events thought to be responsible for that surge can be reduced to two questions that have intrigued or confounded reproductive neuroendocrinologists for the last few years. Is the LH surge the result of increased LHRH secretion or an increased pituitary response or sensitivity to LHRH? Or perhaps more realistically, what are the relative contributions of these two proposed phenomena to an increase in LH secretion and what mechanisms are involved in their control (Fig. 2)? The following is a review of some of the past work that led to these questions and a discussion of some present studies and possible resolutions.

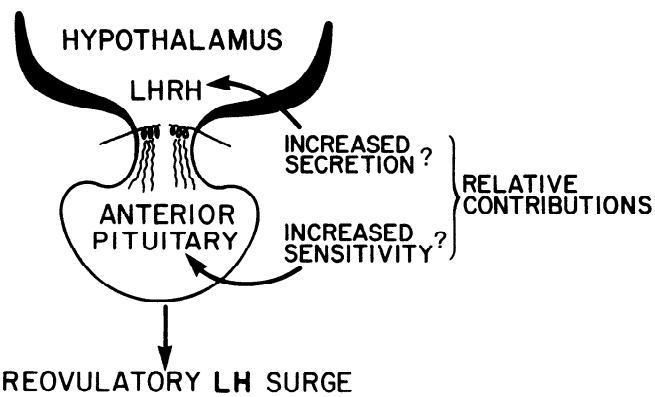


Fig. 2 Diagram of potential contributors to a system producing a surge of LH secretion resulting in ovulation.

A. LHRH: Localization and Elements of Control

It has long been known that the hypothalamus controls anterior pituitary function and, specifically, that a small region of the medial basal hypothalamus is essential for maintaining basal LH secretion. This basal region includes the median eminence, arcuate nucleus, ventromedial nucleus and part of the anterior hypothalamic area and has been called the hypophysiotropic area (41). Other areas implicated in the control of LH, particularly the surge of LH, are the preoptic area (POA) and the suprachiasmatic nucleus. A combination of lesion and stimulation studies identified the involvement of these structures in the control of ovulation (6), but the link between the hypothalamus and pituitary LH secretion was not identified. It was known, however, that extracts of the hypothalamus, particularly the basal hypothalamic area, when injected into rats resulted in an LH surge and ovula-

*Tutorial Lecture, Fall Meeting of the American Physiological Society, 1978.

tion (25). Finally, in 1971 through intense efforts in many laboratories the isolation and identification of this link was accomplished: LHRH, a decapeptide (8,24).

One of the first problems to be attacked was the localization of LHRH in the brain. The problem itself led to some interesting approaches which have been applied to other peptide-containing neuronal systems (Table 1). Palkovits devised a microdissection procedure for the simple and reproducible removal of hypothalamic nuclei; their LHRH content was then determined by radioimmunoassay (32). The other approach has been immunohistochemistry involving qualitative techniques that can provide information as to the specific cells or even granules within an area that contain LHRH (48).

Table 1:

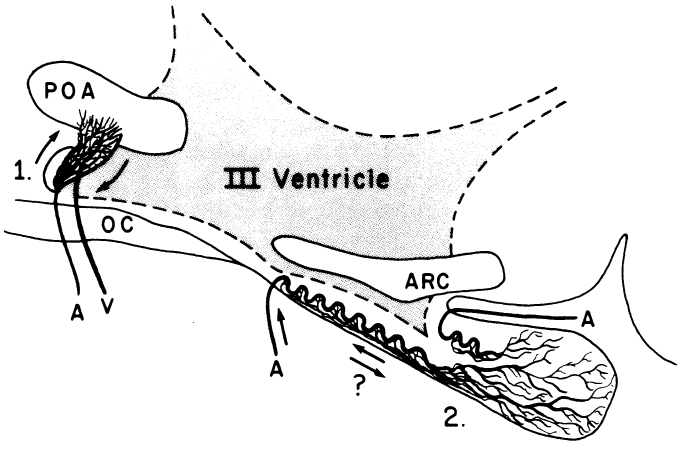
LHRH LOCALIZATION

1) Palkovits Punch +
   Radioimmunoassay

2) Immunohistochemistry
   a) Fluorescent antibody
   b) Peroxidase-anti-peroxidase (PAP)

In the rat, cell bodies of LHRH-containing neurons are found principally in two areas: 1) in the medial POA and anterior hypothalamus, and 2) in the tuberal hypothalamus, principally in the arcuate nucleus and adjacent periventricular nucleus. The distribution of LHRH cell bodies in the hypothalamus of the primate is similar to that found in the rat. The optic chiasm is displaced downward as compared to the rodent brain, but there is a concentration of LHRH-containing neurons in the preoptic and suprachiasmatic areas and the basal hypothalamus (28). These LHRH-containing neurons are part of what is termed the parvicellular neurosecretory system; they are about half the size of the magnocellular secretory neurons producing oxytocin and vasopressin. The median eminence is generally devoid of neuronal cell bodies but contains about 50% of the hypothalamic LHRH due to axonal projections, primarily from the arcuate nucleus. There are also modified ependymal cells, tanycytes, lining the recess of the III ventricle in the median eminence which are reported to contain LHRH (48). These LHRH-containing tanycytes have also been described in another circumventricular organ, the organum vasculosum of the lamina terminalis (OVLT). This component of the hypothalamic circulatory system has recently received much attention and warrants some amplification at this point.

The OVLT is a neurovascular specialization at the rostral end of the III ventricle. It contains neurons, surrounding a neuropil containing glial cells, axon terminals and a capillary network. As shown by Palkovits and co-workers in the rat, this capillary plexus is part of a portal system with distribution primarily to the POA (3) (Fig. 3). Flow in this venous plexus and that draining the POA has been described as bidirectional, implying the possibility of interaction between the two areas. The other portal system in the hypothalamus, the hypophyseal portal system, is of course the essential anatomical link that provides the route of passage for hypothalamic releasing hormones to the anterior pituitary. Recently unidirectional flow dogma has been challenged with anatomical and physiological evidence for retrograde flow to the hypothalamus (7,35). The capillaries here and in the OVLT are fenestrated; furthermore they have an interesting relationship to the III ventricle through tanycytes. Stretching from the floor of the ventricle to the perivascular space of the capillaries of the hypophyseal portal system in the median eminence, tanycytes have an unique potential for communication. There are numerous intriguing and imaginative speculations as to the role played by this communication system with the OVLT at one end and the median eminence at the other in the transport of LHRH; however, none are substantiated as yet.



1. OVLT = Organum vasculosum lamina terminalis

2. Hypophyseal portal system

Fig. 3 Diagram of sagittal view of the hypothalamus and pituitary depicting two circumventricular organs. At the rostral end of the III ventricle, the OVLT has a capillary network which is part of a portal plexus; flow in the venous plexus between the preoptic area (POA) and the OVLT is bidirectional. At a caudal recess of the II ventricle, the other circumventricular organ, the median eminence, contains the capillary plexus which is part of the hypophyseal portal system; there is some evidence for retrograde flow in this venous plexus as well. OC = optic chiasm; ARC = arcuate nucleus; A = artery. [Redrawn from M. Palkovits, In: *Reproductive Endocrinology* (28)].

The release and/or synthesis of LHRH can be affected by neurotransmitters and sex steroids. Catecholaminergic neurotransmitters have been most consistently and convincingly implicated in the control of LHRH secretion. The dopaminergic system is concentrated in the basal hypothalamus with cell bodies in the arcuate nucleus and surrounding area and projections to the median eminence and to the neural lobe. Endings have been described in relation to LHRH secretory neurons and to tanycytes. There is another dopaminergic system within the hypothalamus; from an origin in the posterior hypothalamus these cells project into the dorsal hypothalamic and suprachiasmatic region (45).

In contrast to the dopamine system the noradrenergic system has its origin outside of the hypothalamus, arising primarily from the locus coeruleus, lateral tegmental group and reticular formation in the brainstem, entering the hypothalamus via the medial forebrain bundle and terminating in the preoptic and anterior hypothalamic areas, the median eminence-arcuate region and along the entire periventricular system. Both systems have considerable overlap with areas involved with LHRH production. Morphologic evidence for the potential interaction between dopamine, norepinephrine and LHRH-containing terminals at the median eminence is supported by findings of changes in turnover in catecholaminergic neurons coincident with changes in endocrine status (15). It is important to point out the problem inherent in all neuroendocrine studies which is that both the pituitary and the hypothalamus secrete more than one hormone and that many of the neuronal control systems for these diverse hormones are funneled through the basal hypothalamus to the

median eminence; further, manipulation of one system may affect the operation of another. This caveat should be kept in mind when considering the complex issue of the role of neurotransmitters in LHRH control. To date, however, studies with intraventricular infusion or iontophoretic application of catecholamines seem to point to a stimulatory role for norepinephrine - more of a tone setter - in LHRH secretion involved with the LH surge and a possible inhibitory role for dopamine (45).

The other elements implicated in the control of LHRH are sex steroids, especially estrogens. Steroid concentrating neurons have been localized with autoradiographic and more recently cytosol and nuclear binding techniques. The topography of estrogen binding neurons in the hypothalamus is similar among species: labeling is dense throughout the arcuate nucleus and periventricular area, and the preoptic and anterior hypothalamic areas (26). There is also a great concentration of estradiol binding cells in the anterior pituitary. Neuronal binding to estrogen is also found in extrahypothalamic areas but tends to be more variable between species. Progesterone binding to cytosol receptors from the basal hypothalamic region and anterior pituitary has been reported; interestingly, progesterone binding in these areas requires pretreatment with estrogen (18).

Testosterone binding has been demonstrated in the hypothalamus and pituitary of the female, both rodent and primate (26). The distribution is similar to that found for estradiol. The question as to which steroid is involved in a particular control process is confounded by CNS metabolism of steroids at the site. The standard estrogen-androgen relationship involves the aromatization of either androstenedione or testosterone to biologically active estrogens. Testosterone can also be reduced at the 5α position to dihydrotestosterone which although a potent androgen is non-aromatizable. In the rat hypothalamus the distribution pattern of estrogen-concentrating neurons is roughly an anterior group and a basal group. Selmanoff *et al.* (39) have reported that the preoptic and anterior hypothalamic areas exhibited the highest level of aromatase activity. The highest level of 5α reductase activity was found in the lateral hypothalamus. The importance of this discrete anatomical localization in steroid action on the hypothalamus is yet to be established.

Another facet of estrogen metabolism occurring within the hypothalamus is the enzymatic hydroxylation at carbon-2 to form catecholestrogens, which may serve as biochemical links between estrogens and catecholamines (14,33). The possibility of a role for catecholestrogens in neuroendocrine mechanisms has generated much interest. The enzyme catechol-O-methyl transferase (COMT) is required for the metabolism and inactivation of both norepinephrine and 2-hydroxyestradiol; in this regard catecholestrogens compete effectively with catecholamines for the active site of COMT (5). It has been postulated that this could result in an increase in norepinephrine available for altering LHRH release. Another possibility relates to the observation that catecholestrogens compete for the estrogen receptor (14). In this case, catecholestrogens could act as antiestrogens preventing endogenous estrogens form having a feedback action on the hypothalamus and putiutary. Again, these intriguing speculations have not been thoroughly investigated.

B. Preovulatory LHRH Secretion

These then are the elements of the hypothalamus. How do they work together to regulate the secretion of LHRH that results in the preovulatory surge of LH?

In the menstrual cycle the preovulatory surge of LH results in ovulation some 12-24 hr. after the peak. Th secretory pattern of LH throughout the cycle is controlled by estrogen-negative and -positive feedback loops. The preovulatory surge is the consequence primarily of a positive feedback action of estradiol. The effective stimulus is the strength-duration pattern in serum estradiol concentration which accompanies follicular maturation late in the follicular phase of the menstrual cycle (19,47).

The same positive feedback action of estradiol is operational in the rat estrous cycle. The preovulatory surge of LH results in ovulation some 12 hr. after the peak. The effective stimulus for the initiation of the LH surge is the strength-duration pattern in serum estradiol concentration which accompanies follicular maturation during diestrus-2 and proestrus. Experimental evidence for this estrogen requirement comes from studies in which antibodies to estradiol were administered on the morning of diestrus-2. Such treatment prevented ovulation (12). Ovarian removal on the morning of diestrus-2 abolishes the proestrous LH surge (38). Ovariectomy followed immediately by implanting Silastic capsules containing estradiol restored the surge as shown in the work of Legan and Karsch (22).

This estrogen-induced LH surge has been clearly demonstrated in the monkey (20). Implantation of estradiol-containing capsules early in the menstrual cycle when estradiol levels are normally quite low results in the induction of an LH surge; the full LH response is dependent on the duration of the estrogen treatment. In the primate, the positive feedback becomes manifest when a physiological increase in serum estradiol is sustained for approximately 36 hr. In the first few hours of treatment, a negative feedback action on LH secretion can be demonstrated. It must be emphasized that the appropriate strength of the estrogen stimulus is important; the most effective estradiol concentration is generally similar to that found in the late follicular stages of the cycle. These strength-duration characteristics of the positive feedback action of estrogen on the initiation of the LH surge have also been described in women (47).

Based on this phenomenon of estrogen induced LH surges and on the information presented earlier that receptors for estrogen are present in both the hypothalamus and the pituitary, the question posed in Fig. 2 can be expanded to include the effect of estrogen on the relative roles of an increase in LHRH secretion and an increase in pituitary responsiveness in the surge of LH. Taking the hypothalamus first, what is the experimental evidence that LHRH is actually involved in the LH surge? One test of the obligatory role for LHRH is the effect of eliminating or at least severely limiting LHRH secretion. Arimura *et al.* (4) have shown in rates that injection of antibody to LHRH on the morning of proestrus prevents the LH surge that normally occurs in the afternoon and blocks ovulation. Abrupt suppression of serum LH concentration has also been noted in ovariectomized rhesus monkeys following a single i.v. injection of antiserum to LHRH (21).

Another, somewhat indirect, indicator for the involvement of LHRH in the preovulatory surge of LH is an increase in LHRH secretion in relation to the LH surge. The simple approach would be to measure LHRH concentrations in blood prior to and during the surge. The first obvious problem with this is that LHRH has a very short trip through hypophyseal portal vessels before it reaches its target organ. This is an effective design for maintaining LHRH concentrations at the level of the pituitary; but, by the time it reaches peripheral circulation, LHRH with a half-life of 3-5 min. is at an extremely low concentration and is perhaps metabolically altered. These factors make simple peripheral measurements difficult and to some extent meaningless. The place to measure LHRH serum concentration, of course, is in the hypophyseal portal system. Surgical approaches were developed,

but the anesthetic agents used not only quieted CNS firing in general, they quieted the neurons secreting LHRH. Recently, it was determined that Althesin induces analgesia but does not completely block LHRH secretion. Using this anesthetic agent, Sarkar *et al.* (37) found in the rat that the concentration of LHRH is pituitary stalk plasma is low throughout the cycle but rises dramatically in the early afternoon of proestrus just preceding and coincident with the LH surge as determined in other animals.

LHRH concentration has also been measured in hypophyseal stalk plasma of monkeys. In studies by Neill *et al.* (30) LH in peripheral plasma and LHRH in pituitary stalk plasma were found to be low during the early follicular phase of the cycle. In another group of monkeys estradiol was injected during the mid follicular phase of the cycle in order to achieve a positive feedback-type LH surge. In these monkeys both the LH in peripheral plasma and the LHRH in pituitary stalk plasma was high. These findings show a correlation between increased LH secretion and increased LHRH secretion. They also suggest that the stimulatory effects of estrogen on LH secretion are accomplished, at least in part, by evoking an increase in hypothalamic LHRH secretion.

As to the specific hypothalamic area that can influence the secretion of LHRH, stimulation of the POA results in LH secretion and ovulation in many nonprimates (6). In earlier studies in the rat, we showed that there was a quantitative relationship between the amount of POA tissue activated by electrochemical stimulation and the amount of LH released by the pituitary (42). What we were unable to measure at that time was LHRH in the portal blood. Is there a similar quantitative relationship between the neural area stimulated and the amount of LHRH secreted? This has been shown now to be true. Using electrical stimulation of the POA of male rats, Fink and Jamieson (13) have shown that increasing the current strength results in a corresponding increase in the concentration of LHRH in pituitary stalk plasma. Using electrochemical stimulation of the preoptic area of proestrous rats, Eskay *et al.* (11) have found the increase in LHRH in hypophyseal portal plasma occurs within the first 30 min.

As the POA seemed to be important in the control of the preovulatory LH surge, it was of interest to know what would happen to LH secretion if the neural connections between the POA and the hypothalamus were interrupted. For these experiments a small bayonet-shaped knife was designed to be fixed on a holder of a stereotaxic instrument (17). This knife, known as the Halász knife, made possible a whole range of discrete cuts and tract interruptions in the hypothalamus. A frontal cut (also called anterior or retrochiasmatic) interrupts neural connections between the POA and the rest of the hypothalamus. Rats with such cuts no longer ovulate. Basal LH secretion is unaffected, but the cyclic LH surge is absent. An anterior cut performed within 5 min. after electrochemical stimulation of the preoptic area eliminates the expected LH surge (42).

The relationship between the neural signal resulting in LHRH secretion and estrogen positive feedback has been the subject of many ingenious studies. In one such approach Neill induced a LH surge in ovariectomized rats with a standard estrogen-positive feedback treatment. He found that a Halász cut which separated the POA from the medial basal hypothalamus blocked the positive feedback effect of estrogen on LH secretion in these animals suggesting that the estrogen was working through the POA (29). Recently Goodman approached the question of site of positive feedback effect of estrogen on LH secretion a bit differently (16). In these studies estradiol was implanted into discrete areas of the rat brain, and peripheral LH concentrations were determined. The possibility of transport of estradiol from the site of implantation to the anterior pituitary was assessed by monitoring pituitary estradiol concentrations. Goodman found that: 1) high pitutiary estradiol concentrations alone cannot stimulate LH surges, 2) the medial basal hypothalamus is *not* the site of the positive feedback action of estradiol, and 3) estradiol can act at the level of the POA to induce LH release.

In the primate hypothalamus the site of positive feedback is not clear. Studies from two separate laboratories involving Halász cuts, lesions and stimulations in the rhesus monkey have yielded conficiting results (21, 31, 40). However, a guarded conclusion at this point might be that the preoptic area of the primate brain has a reduced role in the control of cyclic LH secretion.

C. Pituitary Response to LHRH

Up to this point in the discussion, the pituitary has been treated conveniently as a passive tissue that responds to a given LHRH signal in a constant manner regardless of prior hormonal conditions. There is predictability with the pituitary in that in a given hormonal state it responds to a pulse of LHRH in a dose-response fashion *in vivo* and *in vitro*. But the degree of effect elicited by a given LHRH stimulus changes along with a changing hormonal environment. In the human the responsiveness of the pituitary to LHRH increases profoundly going from the early follicular stage to mid-cycle at a time when the normal, spontaneous LH surge would be occurring (46). This period also corresponds to the time of increasing levels of serum estradiol. This same phenomenon has been described in numerous studies in rats (2, 9). Maximal pituitary responsiveness to LHRH corresponds to the time of the rat estrous cycle in which the LH surge normally occurs. It also corresponds to the time of maximal estradiol secretion.

Another interesting twist in pituitary response is the self-priming effect of LHRH. Although it was first suspected in studies in which LHRH was administered as a constant infusion as opposed to a pulse, it is most clearly seen when two identical LHRH pulses are administered separated by a 30 min. to 2 hr. interval; the second pulse causes a greater release of LH than the first. This priming response has been found to vary with the stage of the reproductive cycle and *in vivo* is most clearly demonstrated during the late follicular stages in humans (46) and on proestrus in rats (1,9). Again, this is the time when the LH surge normally occurs. It would seem, then, that the coincident presence of many of the variables being discussed are found during proestrus only: peak estradiol titers, maximum pituitary responsiveness to an initial pulse of LHRH and the full expression of the primed response.

Under the appropriate conditions, pituitaries from cycling animals can be studied *in vitro* isolated from immediate hypothalamic and ovarian influences but yet retaining their cyclic characteristics (44). In Fig. 4 is shown the LH secretory profile of individual anterior pituitaries removed from rats on the morning of the days of the cycle as indicated and superfused *in vitro*. The LH secretory response to two identical pulses of LHRH *in vitro* is very similar to that seen *in vivo*. The response to the first pulse changes throughout the cycle. The response to the second pulse, or self-priming, is full blown on proestrus. Again, everything seems to come together on this day: peak responsivity to LHRH and self-priming. These *in vitro* studies demonstrate that the self-priming is a pituitary event; the exogenous LHRH does not require recruitment of endogenous LHRH secretion for the effect.

Two questions come to mind with these data. First, what is happening in the pituitary in the 1-2 hr. interval between the two pulses of LHRH; second, how is estrogen affecting the responsiveness and the self-priming?

Concerning the first question, it has been shown that protein synthesis is required for expression of the primed response. This was demonstrated through the use of inhibitors of protein synthesis; such treatment attenuates the response to the second pulse (10,27,34). Although there has been some debate as to the nature of the protein being synthesized, recent evidence seems to indicate that LH synthesis is stimulated during this period. Studies by Rommler *et al.* (36) are consistent with this view; their results in which electron microscopic examination of the cells secreting LH were combined with LH quantitation at various times after consecutive LHRH injections are diagrammed in Fig. 5. Concomitant with an increase in serum LH there is an increase in the extrusion of granules from the gonadotrophs following LHRH exposure. After 30-120 min. observance of the gonadotrophs showed a decrease in granule release and an increase in new granule synthesis. This corresponds to the observed increase in pituitary LH levels. Between 60-240 min. there was a progressive accumulation of lysosomal structures in the gonadotrophs; the authors correlated this with the measured decrease in pituitary levels. Imagine a second pulse of LHRH at 2 hours, at a time of increased granule activity and LH synthesis. These investigators concluded that the demonstrated accumulation of LH granules following the initial exposure to LHRH is probably sufficient to account for the self-priming response.

The second question concerns the role of steroids, specifically estrogen, in the responsiveness of the gonadotrophs and the LHRH self-priming effect. The pattern of increasing serum estradiol concentrations matches the pattern of increasing pituitary responsiveness prior to the LH surge. Much work has gone into establishing the causality of this relationship, but the situation is not clear. In general, estradiol has a biphasic effect on LH release induced by exogenous LHRH *in vivo* or *in vitro:* an initial negative or inhibitory effect on pituitary LH secretion followed with a 14 hr. or so lag period by an augmentative effect on LH secretion (23,43) (Table 2). The suggestion has been made that the negative effect of estradiol is on the immediate events of the release process; the long term positive effect would involve other events in the gonadotroph. Suggestions for this chronic stimulatory effect include a change in number or binding characteristics of the LHRH receptor or an increase in the amount of LH available for release. This latter possibility could be direct or indirect through the action of LHRH on LH synthesis.

Trying to integrate what is known, guessed at or unknown concerning hypothalamic and pituitary events brings us back to the original set of questions regarding relative roles and the LH surge as seen in Fig. 2. First, the increase in LHRH secretion: I

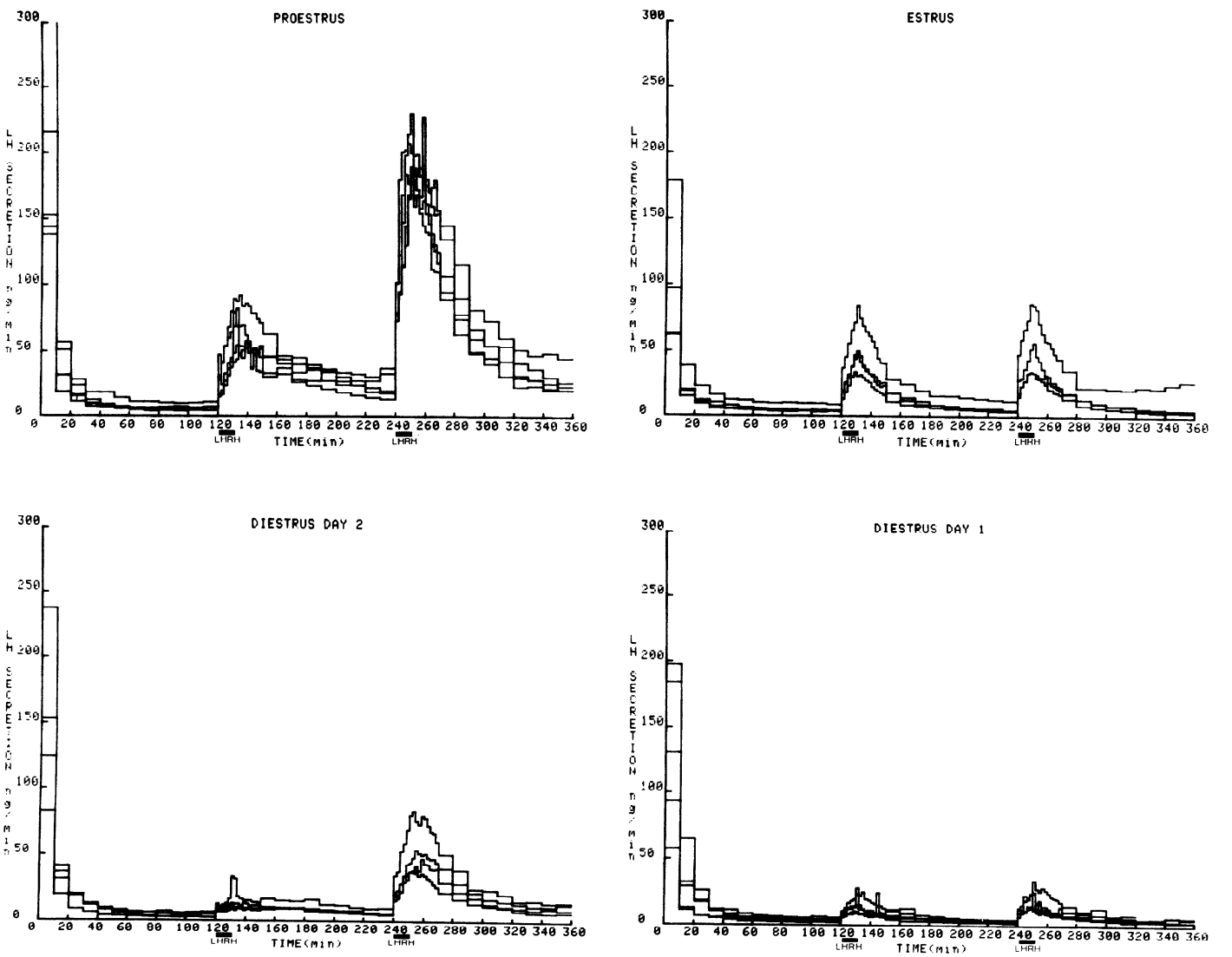


Fig. 4 *In vitro* superfusion of quartered anterior pituitaries obtained by decapitation on the morning of the indicated days of the estrous cycle. At 120 min. and at 240 min. LHRH, 100 ng/ml, was pulsed for 10 min. as indicated by the solid bars. Each line represents the results of an individual superfusion. (From Waring, D. and J. Turgeon, Endocrinology *106:* in press, 1980).

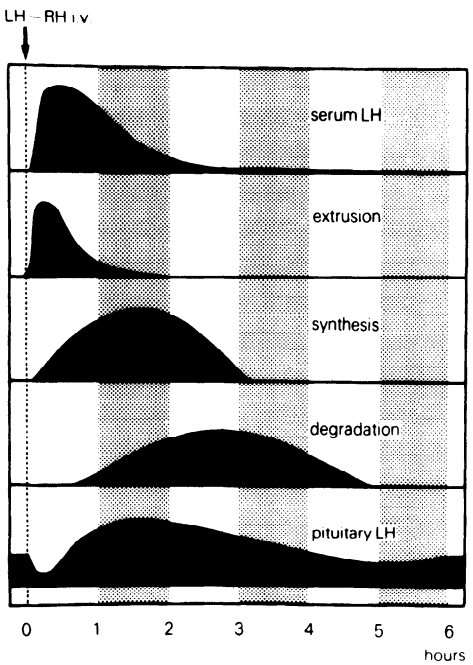


Fig. 5 Diagram of granule extrusion, synthesis and degradation in gonadotrophs and LH concentrations in the pituitary and serum following LHRH injection in female rats. [From Rommler *et al.* (36)].

Table 2:

BIPHASIC EFFECT OF ESTRADIOL

Estradiol Treatment In Vivo or In Vitro	Effect on LHRH Induced LH Release
2 - 4 hr.	Inhibitory
14 - 24 hr.	Stimulatory

have reviewed the evidence that substantiates that LHRH secretion does indeed increase prior to the LH surge. Further, this increase in LHRH secretion has been related to a positive feedback effect of estradiol acting, at least in part, at the hypothalamic level. As far as the mechanism of action of estradiol or the involvement of catecholamines in this process, we are still dealing with a black box. Secondly, the increase in responsivity to LHRH: I have presented evidence that substantiates that the capacity of the pituitary to respond to LHRH does indeed increase prior to the preovulatory surge. This coupled with the appearance of the self-priming effect would ensure that small increases in LHRH secretion would result in dramatic increases in LH secretion. The events in the pituitary of the preovulatory female, then, provide for signal amplification. Finally, trying to assign the specific role for estrogen in the pituitary release of the preovulatory LH surge makes me uncomfortable at the present but excited about future investigations into the nature of the involvement of this steroid in the events concerned with the synthesis and release of LH.

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ADVANCES IN OCULOMOTOR AND VESTIBULAR PHYSIOLOGY

The New York Academy of Sciences and the Barany Society will sponsor a Conference on "Advances in Oculomotor and Vestibular Physiology," September 22-24, 1980 at the Barbizon-Plaza Hotel, New York City. The Conference will consolidate recent information on the central vestibular and oculomotor systems. This includes studies of how pathways within the CNS are utilized for oculomotor processing, how signal processing takes place in the vestibulo-ocular reflex arc, and how the vestibular nuclei are controlled by the visual and body postural systems. Clinical research will be presented that utilizes modern techniques of signal processing or multimodal interactions for diagnosis of disease of the central vestibular and oculomotor systems.

The Conference will be chaired by Dr. Bernard Cohen, Dept. of Neurology, Mount Sinai School of Medicine. For further information, contact: Conference Dept., The New York Academy of Sciences, 2 East 63rd St., New York, NY 10021.

SIMPLE MODEL OF THE CIRCULATION*

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Models of the cardiovascular system provide a useful test of our understanding of the system. They are also useful for teaching and for examining hypotheses before animal experiments are begun. Guyton and his colleagues produced a major systems analysis of the circulation and extensively discussed its value (Guyton et al., 1972, 1973). A simpler version designed by Dickinson and Ahmed is distributed by McMaster University as MACMAN, designed for teaching purposes.

Levy (1979) has recently discussed the concepts underlying Guyton's model and has clearly stated the interactions of the various factors. He does not however discuss how to solve the derived equations, and like Guyton's model, his analysis takes the static circulation (cardiac output of zero) as its starting point. This approach has the disadvantage that mean circulatory pressure is difficult to measure in animals and impossible to measure in humans. This paper therefore takes a slightly different approach although the concepts used are those developed by Guyton et al. and by Levy.

BASIC CONCEPTS

This approach to modelling the circulation is based on the following concepts:

1. A model must be simple enough to be readily understood, yet capable of further expansion to allow more aspects of the circulation to be modelled. This further development must involve expansion of existing components and not addition of new components. For example, the model can be simplified by considering arteriolar resistance as a single unit. Later expansion can involve incorporation of individual organ arteriolar resistances but the appropriate sum of these must equal the combined arteriolar resistance as used in the simpler model. If this criterion for simplification is not met, the simple model will fail to produce realistic results and will therefore be unsatisfactory.
2. To produce a model which fulfills the first criterion, I suggest the following are the minimum essential components: an arterial compartment, separated by an arteriolar resistance (R_A) from a capillary compartment, separated by a post-capillary resistance (R_C) from a venous compartment, separated by a post-venous resistance (R_V) from a right atrial compartment. The right atrial compartment leads to a cardiac pump and pulmonary compartment with a pulmonary arterial resistance (R_P). This model resembles the model of Levy (1979) except that the capacitance or venous compartment is separated from the right atrium, and therefore venous pressure is not equal to right atrial pressure.
3. The model must accurately define relationships between the compartments but it cannot attempt to define cause-effect relationships. This problem was discussed by Levy (1979). As the equations developed later demonstrate, any cardiovascular variable is both a cause and an effect since the circulation is a circle and further, there is no mathematical definition of the terms cause and effect.
4. The simple model attempts only to define steady-state relationships. Under these conditions, venous return equals cardiac output equals total organ blood flow. Thus as Levy (1979) pointed out, attempts to explain changes in cardiac output as a consequence of changes in venous return present a circuitous argument and must be avoided.
5. Cardiovascular variables may be classified into two types -semi-independent variables and dependent variables. These variables are shown in Figure 1. The semi-independent variables are those that are at least partly determined by outside factors, although they may also be modified by homeostatic mechanisms within the circulation. These semi-independent variables can be considered as made up of three components:

VARIABLE = BASAL COMPONENT +/- EXTERNAL COMPONENT +/- INTERNAL COMPONENT

The basal component is the value at rest during the control situation and may be determined by local, nervous and humoral factors present during the control period. This component must be assigned an initial value. The external component represents the effect the user wishes to model. It may represent altered nervous or humoral factors (e.g. a drug infusion) and its value must be put in by the user. The internal component represents the effects of the cardiovascular homeostatic reflexes, for example the baroreceptor reflex, which modify the variable as a consequence of the change in some cardiovascular parameter (e.g. arterial pressure). Its value must be calculated by the model.

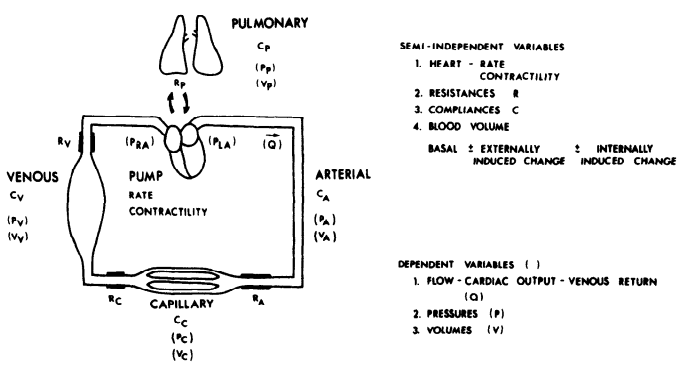

Fig. 1 The cardiovascular variables used in this simple model classified into semi-independent and dependent groups.

Dependent variables are those which are determined wholly within the circulation and which cannot be modified directly by outside influences. They must therefore always be calculated within the model. For example, arterial pressure is a dependent variable since it can be changed only through changes in arteriolar resistance or cardiac output; external factors cannot change arterial pressure directly.

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6. Three sets of fundamental equations are involved in a description of the circulation. These were clearly defined by Levy (1979):
a) Cardiac - determination of cardiac output as a function of preload, afterload, contractility and heart rate.
b) Relationships between the pressure drops between the compartments, the resistances and flow.

PRESSURE DROP = FLOW . RESISTANCE

c) Relationships between pressure, volume and compliance in each compartment

PRESSURE = VOLUME/COMPLIANCE

Each of these equations involves at least one semi-independent variable and two dependent variables. Given the starting values for the semi-independent variables the model must calculate values for all dependent variables and then modify the semi-independent variables in accordance with known homeostatic feed-back mechanisms. The resultant values must simulataneously satisfy the three sets of equations.

OUTLINE OF THE MODEL

The equations used for this simple model are shown in Figure 2. The capacitance vessels (venous compartment) have been taken as the starting point for the solution for two reasons. First, it is conceptually simple since these vessels are the reservoir which supplies the pump which distributes blood, under pressure, to the organs. Secondly, venous compliance is less subject to measurement errors than are the other compliances because it is relatively large. For the first iteration (Fig. 2), venous volume is assumed to equal total blood volume and venous pressure is then calculated from this volume and venous compliance.

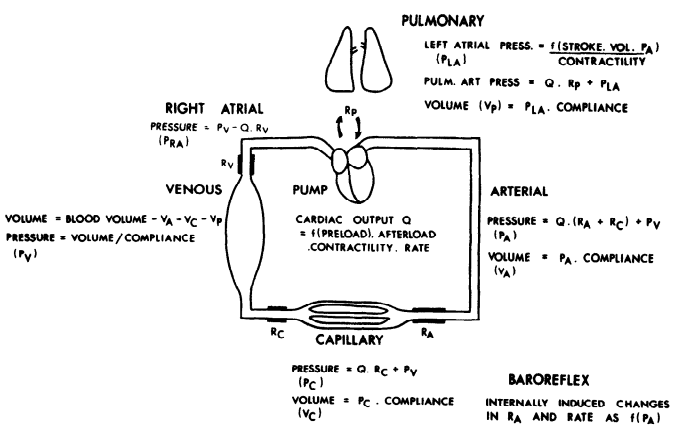

Fig. 2. The relationships between the variables shown as simple equations.

The blood in the capacitance vessels reaches the right atrium by flowing along vessels with a small resistance - the post-venous resistance (R_V). Thus right atrial pressure is equal to venous pressure minus the pressure drop across this resistance. This equation relates preload (right atrial pressure in this simple model) to both venous pressure and flow and this interrelationship is necessary to model relationships between afterload and preload (see below).

Cardiac output (Q) depends on preload, afterload (mean arterial pressure in this simple model), contractility and heart rate (Levy, 1979). An equation can be derived from the Frank-Starling relationship (Greenway & Innes, 1979):

STROKE WORK = f (RIGHT ATRIAL PRESSURE)

Incorporating heart rate (HR) and contractility (C):

MINUTE WORK = f (RIGHT ATRIAL PRESSURE).HR.C

Since total minute work of the heart is approximately equal to cardiac output multiplied by arterial minus right atrial pressures:

CARDIA OUTPUT = f(RIGHT ATRIAL PRESSURE).HR.C/(P_A-P_{RA})

This equation cannot be solved since (P_A-P_{RA}) - the systemic pressure drop - depends on peripheral resistance and cardia output. Hence we have cardiac output on both sides of the equation, and it must be rearranged:

(CARDIAC OUTPUT)^2 = f(RIGHT ATRIAL PRESSURE).HR. C/R_T

where R_T is the total peripheral resistance. Cardiac output is the square root of this calculation. Experimentally determined values for this equation in anesthetized cats have been given (Greenway & Innes, 1979). This value of cardiac output (Q) is now fed back into the equation for right atrial pressure and a revised value for Q is obtained. This process is repeated until both equations are satisfied as shown when right atrial pressure does not change by more than 1% on reiteration.

It is now possible to calculate values for the arterial and capillary compartments using the equation in Figure 2. Then left atrial pressure is calculated from the Frank-Starling relationship between left ventricular stroke work and left atrial pressure. An approximate equation for this relationship in the cat is calculated from the data of Sonnenblick & Downing (1963) but further work is required to define this relationship more precisely. Pulmonary arterial pressure and pulmonary venous volume can now be calculated.

At this point, after the first iteration, estmates for all the variables have been obtained based on the premise that venous volume equals total blood volume. The process is now re-iterated correcting venous volume for the other compartment volumes, and the equations are considered to be solved when venous volume does not change by more than 1% on reiteration.

The circulation is now in a steady state but no corrections have been made for internal homeostatic mechanisms. In this simple model, only the arterial baroreceptor reflex is incorporated. Arteriolar resistance and heart rate are now corrected by a value proportional to arterial pressure and the equations are again solved. The experimental data verifying these equations for the baroreceptor reflex in anesthetized cats is in preparation for publication.

The user can make any desired changes in any combination of the semi-independent variables to model the effects of hemorrhage, drug infusions etc. and the equations are again solved without and then with the baroreceptor reflex.

The program to carry out the above procedures is given as a flow-chart in Figure 3 and a listing of the program in BASIC-11 (Digital Equipment Corporation) is given in the appendix. The program requires less than 4K words of memory. The values for the semi-independent variables, for the Frank-Starling relationships and for the baroreceptor equations are calculated from experimental data for cats anaesthetized with chloralose or pentobarbital and the pressure-volume relationships in the compartments are assumed to be linear. The accuracy of these values can be improved as better experimental data becomes available. Appropriate experimental data for other species or man can be substituted as required by the user. A sample of the print out for the control values is given in Table 1. After each set of changes in the semi-independent variables made by the user, a similar printout is produced with the new values for all the variables.

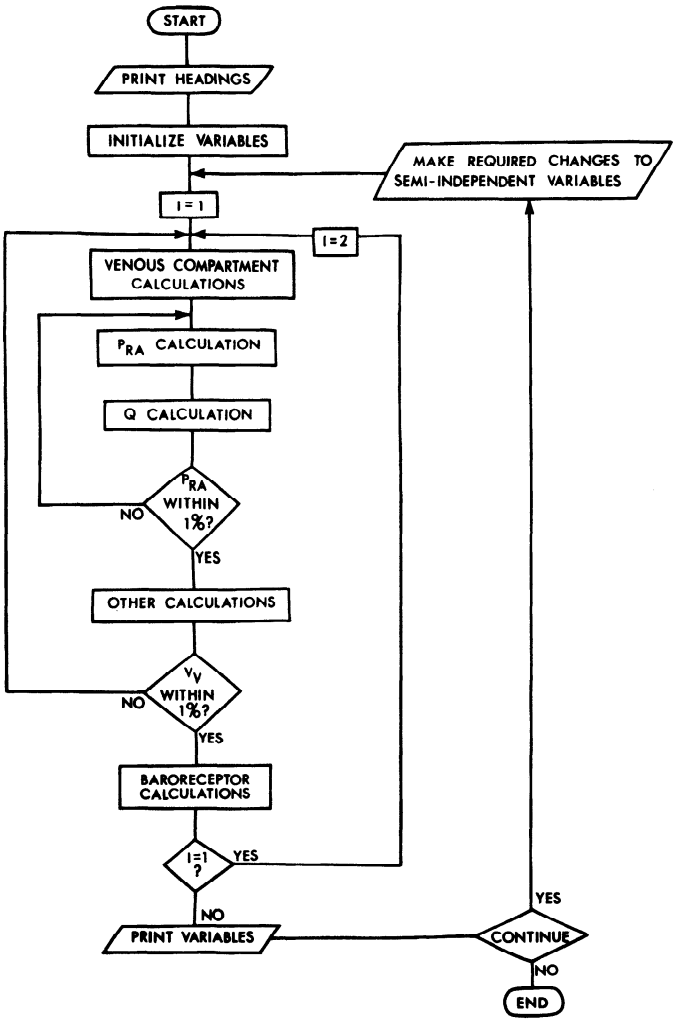

Fig. 3 Flow chart of the BASIC program given in the appendix and used to solve the relationships shown in Figure 2.

TABLE 1. An example of the program print out showing the initializing values for the semi-independent variables for the anesthetized cat, the resulting calculated dependent variables and the effects of the baroreceptor reflex.

MODEL OF CARDIOVASCULAR SYSTEM OF CAT
Version 2 28-OCT-79 02:28:57

		WITHOUT	and WITH BAROREFLEX
SEMI-INDEPENDENT VARIABLES			
1. BLOOD VOLUME ml/kg	=	52	
2. COMPLIANCES ml/kg.mm Hg			
Arterial	=	0.040	
Capillary	=	0.13	
Venous	=	4.0	
Pulmonary	=	0.71	
3. RESISTANCES mm Hg.kg.min/ml			
Arteriolar	=	0.780	0.751
Post-capillary	=	0.0900	
Post-venous	=	0.0500	
Pulmonary	=	0.0400	
4. HEART			
Heart rate / min	=	220	216
Contractility normal=1	=	1.00	
DEPENDENT VARIABLES			
1. FLOWS ml/kg.min			
Cardiac output	=	134	135
Stroke volume	=	0.61	0.62
2. PRESSURES mm Hg			
Arterial	=	126	123
Capillary	=	21.1	21.3
Venous	=	9.1	9.1
Pulm. Art.	=	16.8	16.8
Right Atrial	=	2.3	2.3
Left Atrial	=	11.4	11.4
3. VOLUMES ml/kg			
Arterial	=	5.0	4.9
Capillary	=	2.7	2.8
Venous	=	36.1	36.3
Pulmonary	=	8.1	8.1

failure (contractility 40% of normal and blood volume increased 15%). This is shown in figure 5. Thus changes in afterload will themselves produce changes in preload in a direction which will tend to reduce the change in cardiac output. However this compensatory effect will not reduce the change in cardiac output when the animal is on the flat portion of the ventricular function curve. Thus the model mimicks the effects recently demonstrated in the anesthetized cat (Greeway & Innes, 1979).

USES OF THE MODEL

The model has several uses. It can be used as a simple teaching aid to demonstrate the effects of, for example, changes in arteriolar resistance, venous compliance or cardiac contractility. Complex interactions can also be examined. For example, epinephrine causes arteriolar vasodilatation, venoconstriction and increases in heart rate and contractility (Innes & Nickerson, 1975). The effects of these changes, alone and in combination can be modelled to demonstrate that the combination produces a very large increase in cardiac output with little change in arterial pressure. This is shown in Figure 4. In addition, the model can be used to determine how far unexplained effects of a drug might be produced by known effects. For example, sodium nitroprusside reduces right and left atrial pressures. The model can be used to determine whether the known action of sodium nitroprusside on arteriolar resistance is sufficient to explain this or whether some other action such as venodilatation (increased venous compliance) must also be postulated. The model demonstrates that while the arteriolar vasodilator action of nitroprusside would be expected to produce a small decrease in atrial pressures and a 13% increase in cardiac output in the control situation, this vasodilator action produces a much greater decrease in atrial pressures and a 33% increase in cardiac output in simulated heart

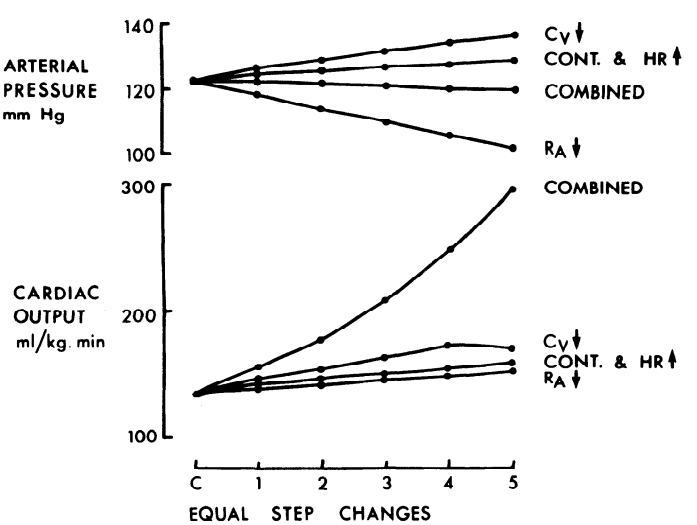

Fig. 4 Model of the actions of epinephrine, individually and combined to demonstrate that the combination results in a very large increase in cardiac output with little change in arterial pressure.

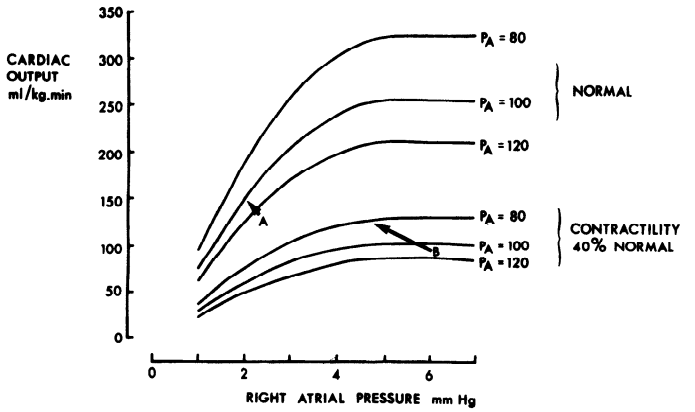

Fig. 5 The graphs show the relationships between cardiac output and right atrial pressure at arterial pressures (P_A) of 80, 100 and 120 mm Hg when contractility is normal and when it is reduced to 40% of normal. Point A represents the control value in the normal cat and the arrow from it shows the effects of reducing arteriolar resistance. Point B represents the control value in a cat with a contractility of 40% normal and with a compensatory increase in blood volume of 15%. The arrow from it shows the effects of reducing arteriolar resistance over the same range as in the normal cat.

As it stands, the model is mainly of value to aid understanding of acute overall cardiovascular responses, particularly cardiac output changes. Further elaboration is required to model individual organ blood flows and compliances, complex states such as valvular heart disease, and long-term changes in the cardiovascular state. Thus the model is much less comprehensive than that produced by Guyton and his colleagues. However, it is simpler, requires much less computer memory and since it is written in BASIC, it is much easier to adapt to various computers and various user requirements.

ACKNOWLEDGEMENTS

I am most grateful to G.D. Scott for his expertise with the computer and to I.R. Innes and Mrs. L. Pratt for technical assistance in obtaining the data on which the model is based.

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APPENDIX

DOCUMENTATION FOR PROGRAM MODEL2.BAS

ABBREVIATIONS USED FOR INPUT CHANGES

BV Blood volume	Initialized at 52 ml/kg		Range 26-150
CA Arterial compliance	0.04 ml/kg.mm Hg		0.01-0.12
CV Venous compliance	4.0		1.0-9.0
CP Pulmonary compliance	0.71		0.2-2.0
RA Arteriolar resistance	0.78 mm Hg.kg.min/ml		0.22-4.0
RC Post-capillary resistance	0.09		0.02-0.2
RV Post-venous resistance	0.05		0.02-0.8
RP Pulmonary resistance	0.04		0.10-0.25
HR Heart rate	220 beats/min		50-300
CC Cardiac contractility	1 arbitrary units		0.1-1.7

VARIABLES - CARDIOVASCULAR

SEMI-INDEPENDENT VARIABLES	*	Init. & input	Changed by Baroreflex
1. BLOOD VOLUME	B$	B(1)	
2. COMPLIANCES			
Arterial	C1$	C1(1)	
Capillary	C2$	C2(1)	
Venous	C3$	C3(1)	
Pulmonary	C4$	C4(1)	
3. RESISTANCES			
Arteriolar	R1$	R1(1)	R1(2)
Post-capillary	R2$	R2(1)	
Post-venous	R3$	R3(1)	
Pulmonary	R4$	R4(1)	
4. HEART			
Rate	H$	H(1)	H(2)
Contractility	F$	F(1)	

DEPENDENT VARIABLES	All Z$	
1. FLOWS		
Cardiac output	Q(1)	Q(2)
Stroke volume	S(1)	S(2)
2. VOLUMES		
Arterial	V1(1)	V1(2)
Capillary	V2(1)	V2(2)
Venous	V3(1)	V3(2)
Pulmonary	V4(1)	V4(2)
3. PRESSURES		
Arterial	P1(1)	P1(2)
Capillary	P2(1)	P2(2)
Venous	P3(1)	P3(2)
Pulmonary art.	P4(1)	P4(1)
Right atrial	P5(1)	P5(2)
Left atrial	P6(1)	P6(2)

Right atrial pressure in Polynom. calculation	P
Right atrial pressure - previous value in loop	P5(9)
L ventricular stroke work	Z
Venous volume - previous value in loop	V3(9)

PROGRAM CONTROL VARIABLES

Loops without baroreceptors	I=1
Loops with baroreceptors	I=2
Abbreviation of variable to be changed	D$
New value of variable to be changed	V
Print using strings	Z$(1-5)
Blank variable to fill asterisk column of printout	Z$
Query to continue running program	A$
Counter to end program if equations not solved	I2, I3

```
10 REM ***MODEL2.BAS***
20 PRINT TAB(10);"MODEL OF CARDIOVASCULAR SYSTEM OF CAT"
30 OPEN "LP:" FOR OUTPUT AS FILE #1 \ PRINT #1 \ PRINT #1 \ PRINT #1
40 PRINT #1,TAB(10);"MODEL OF CARDIOVASCULAR SYSTEM OF CAT"
50 PRINT #1,TAB(25);"Version 2   ";DAT$;"    ";CLK$ \ PRINT #1
60 REM INITIALIZE VALUES
70 I=1 \ B(1)=52 \ C1(1)=.04 \ C2(1)=.13 \ C3(1)=4 \ C4(1)=.71
80 R1(1)=.78 \ R2(1)=.09 \ R3(1)=.05 \ R4(1)=.04 \ H(1)=220 \ F(1)=1
90 GO TO 370
100 REM INPUT CHANGES REQUIRED FOR SECOND RUN
110 PRINT "INPUT ABBREV. OF VARIABLE TO BE CHANGED OR <CR> "; \ INPUT D$
120 IF D$="" GO TO 360 \ GO TO 140
130 PRINT "IMPOSSIBLE VALUE: TRY AGAIN"
140 PRINT "NEW VALUE "; \ INPUT V
150 IF D$<>"BV" GO TO 170
160 IF V<26 GO TO 130 \ IF V>150 GO TO 130 \ B(1)=V \ B$="*" \ GO TO 110
170 IF D$<>"CA" GO TO 190
180 IF V<.01 GO TO 130 \ IF V>.12 GO TO 130 \ C1(1)=V \ C1$="*" \ GO TO 110
190 IF D$<>"CV" GO TO 210
```

```
200 IF V<1 GO TO 130 \ IF V>9 GO TO 130 \ C3(1)=V \ C3$="*" \ GO TO 110
210 IF D$<>"CP" GO TO 230
220 IF V<.2 GO TO 130 \ IF V>2 GO TO 130 \ C4(1)=V \ C4$="*" \ GO TO 110
230 IF D$<>"RA" GO TO 250
240 IF V<.22 GO TO 130 \ IF V>4 GO TO 130 \ R1(1)=V \ R1$="*" \ GO TO 110
250 IF D$<>"RC" GO TO 270
260 IF V<.02 GO TO 130 \ IF V>.2 GO TO 130 \ R2(1)=V \ R2$="*" \ GO TO 110
270 IF D$<>"RV" GO TO 290
280 IF V<.02 GO TO 130 \ IF V>.08 GO TO 130 \ R3(1)=V \ R3$="*" \ GO TO 110
290 IF D$<>"RP" GO TO 310
300 IF V<.01 GO TO 130 \ IF V>.25GO TO 130 \ R4(1)=V \ R4$="*" \ GO TO 110
310 IF D$<>"HR" GO TO 330
320 IF V<50 GO TO 130 \ IF V>300 GO TO 130 \ H(1)=V \ H$="*" \ GO TO 110
330 IF D$<>"CC" GO TO 350
340 IF V<=.1 GO TO 130 \ IF V>1.7 GO TO 130 \ F(1)=V \ F$="*" \ GO TO 110
350 PRINT "INCORRECT ABBREVIATION" \ GO TO 110
360 PRINT #1,CHR$(12) \ I=1
370 REM CALCULATIONS
380 V3(I)=B(1) \ Q(I)=100 \ I2=0
390 REM VOLUME LOOP
400 P3(I)=V3(I)/C3(1) \ I3=0
410 REM RAP-FLOW LOOP
420 P5(9)=P5(I) \ P5(I)=P3(I)-Q(I)*R3(1) \ P5(I)=(P5(I)+P5(9))/2
430 P=P5(I) \ IF P>6 THEN P=6
440 IF P<.21 THEN P=.21
450 Q(I)=SQR((47*P-4.6*P*P-9.4)*H(I)*F(1)/(R1(I)+R2(1)+R3(1)))
460 I3=I3+1 \ IF I3>100 GO TO 1000
470 IF ABS(P5(I)/P5(9)-1)>.01 GO TO 410
480 REM END OF RAP-FLOW LOOP
490 P1(I)=Q(I)*(R1(I)+R2(1))+P3(I) \ V1(I)=P1(I)*C1(1)
500 P2(I)=Q(I)*R2(1)+P3(I) \ V2(I)=P2(I)*C2(1)
510 S(I)=Q(I)/H(I)
520 Z=P1(I)*S(I) \ P6(I)=(-.029*Z+1.76000E-03*Z*Z+3.25)/F(1)
530 P4(I)=Q(I)*R4(1)+P6(I)
540 V4(I)=P6(I)*C4(1) \ V3(9)=V3(I) \ V3(I)=B(1)-V1(I)-V2(I)-V4(I)
550 I2=I2+1 \ IF I2>100 GO TO 1000
560 IF ABS(V3(I)/V3(9)-1)<.01 THEN PRINT  \ GO TO 580
570 V3(I)=(V3(I)+V3(9))/2 \ GO TO 390
580 IF I=2 GO TO 610 \ I=2
590 REM BAROREFLEX CALCULATION
600 R1(2)=R1(1)+(.6-5.00000E-03*P1(1)) \ H(2)=H(1)+(36-.315*P1(1)) \ GO TO 370
610 REM PRINT VALUES FOR RUN
620 PRINT #1,TAB(39);"WITHOUT  and  WITH BAROREFLEX"
630 PRINT #1,"SEMI-INDEPENDENT VARIABLES" \ PRINT #1
640 Z$(1)="'LLLLLLLLLLLLLLLLLLLLLLLLLLLLLL 'L = ####          ####"
650 Z$(2)="'LLLLLLLLLLLLLLLLLLLLLLLLLLLLLL 'L =  ###.#         ###.#"
660 Z$(3)="'LLLLLLLLLLLLLLLLLLLLLLLLLLLLLL 'L =   ##.##         ##.##"
670 Z$(4)="'LLLLLLLLLLLLLLLLLLLLLLLLLLLLLL 'L =   ##.###        ##.###"
680 Z$(5)="'LLLLLLLLLLLLLLLLLLLLLLLLLLLLLL 'L =  ##.####       ##.####"
690 PRINT #1,USING Z$(1),"1. BLOOD VOLUME ml/kg",B$,B(1)
700 PRINT #1,"2. COMPLIANCES ml/kg.mm Hg"
710 PRINT #1,USING Z$(4),"    Arterial",C1$,C1(1)
720 PRINT #1,USING Z$(3),"    Capillary",C2$,C2(1)
730 PRINT #1,USING Z$(2),"    Venous",C3$,C3(1)
740 PRINT #1,USING Z$(3),"    Pulmonary",C4$,C4(1)
750 PRINT #1,"3. RESISTANCES mm Hg.kg.min/ml"
760 PRINT #1,USING Z$(4),"    Arteriolar",R1$,R1(1),R1(2)
770 PRINT #1,USING Z$(5),"    Post-capillary",R2$,R2(1)
780 PRINT #1,USING Z$(5),"    Post-venous",R3$,R3(1)
790 PRINT #1,USING Z$(5),"    Pulmonary",R4$,R4(1)
800 PRINT #1,"4. HEART"
810 PRINT #1,USING Z$(1),"    Heart rate / min",H$,H(1),H(2)
820 PRINT #1,USING Z$(3),"    Contractility normal=1",F$,F(1)
830 PRINT #1 \ PRINT #1,"DEPENDENT VARIABLES" \ PRINT #1
840 PRINT #1,"1. FLOWS ml/kg.min"
850 PRINT #1,USING Z$(1),"    Cardiac output",Z$,Q(1),Q(2)
860 PRINT #1,USING Z$(3),"    Stroke volume",Z$,S(1),S(2)
870 PRINT #1,"2. PRESSURES mm Hg"
880 PRINT #1,USING Z$(1),"    Arterial",Z$,P1(1),P1(2)
890 PRINT #1,USING Z$(2),"    Capillary",Z$,P2(1),P2(2)
900 PRINT #1,USING Z$(2),"    Venous",Z$,P3(1),P3(2)
910 PRINT #1,USING Z$(2),"    Pulm. Art.",Z$,P4(1),P4(2)
920 PRINT #1,USING Z$(2),"    Right Atrial",Z$,P5(1),P5(2)
930 PRINT #1,USING Z$(2),"    Left Atrial",Z$,P6(1),P6(2)
940 PRINT #1,"3. VOLUMES ml/kg"
950 PRINT #1,USING Z$(2),"    Arterial",Z$,V1(1),V1(2)
960 PRINT #1,USING Z$(2),"    Capillary",Z$,V2(1),V2(2)
970 PRINT #1,USING Z$(2),"    Venous",Z$,V3(1),V3(2)
980 PRINT #1,USING Z$(2),"    Pulmonary",Z$,V4(1),V4(2)
990 PRINT "MORE CHANGES (Y) "; \ INPUT A$ \ IF A$="Y" GO TO 100 \ GO TO 1010
1000 PRINT "THIS COMBINATION OF VALUES RESULTS IN DEATH"
1010 END
```

ARTHRITIS FOUNDATION

The Arthritis Foundation offers a limited number of fellowship awards and research grants for men and women in the medical sciences and clinical disciplines related to arthritis. Applications for these awards must be received by September 1 for postdoctoral and senior fellowships; and by November 1 for Allied Health Professionals fellowships and grants. To obtain an application form, write to:

Research Department
Arthritis Foundation
3400 Peachtree Rd., NE
Atlanta, Georgia 30326

These applications will be for awards which commence July 1, 1981.

USING RUMMY TO TEACH CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY

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Introduction

Games are an effective method for students to have fun while learning (2), and the interaction of students and concepts serves to develop proficiency in logic and problem solving. A card game based on rummy has been described in general terms as an aid in the teaching of cardiovascular physiology (1), and the present paper will detail rules and lists of cards for cardiovacular and respiratory rummy that have proved to be successful for first and second year osteopathic medical students.

As in the game from which this was modeled, the object is to lay down (meld) the five cards in one's hand by combining cards to form one pair, three-of-a-kind, or five-of-a-kind. The major difference from gin rummy is that each of the 52 cards which comprise the deck in physiological rummy describes a physiological principle or measurable parameter, or an endogenous or exogenous factor which affects physiological mechanisms. Rather than matching suits or face value of cards, or forming numerical straights, the players must form combinations of cards which demonstrate a clear relationship in a cause and effect manner. Whether a player wins points depends upon how well he/she can justify his combinations of cards and the order in which he declares them to the other players in the group. Thus, the players themselves are the referees of their game; this is an important factor in the success of the exercise since it forces the students to actively call upon their knowledge of physiology rather than passively call upon a faculty member for judgement.

Rules

One player in a group of five or six is selected dealer. He shuffles the deck and deals 5 cards face down to each player including himself. He places the remaining cards in the deck face down in the center of the table, removes the top card, and places it face up beside the deck. All players take their cards and play begins to the immediate left of the dealer.

This player may choose the card beside the deck or he may select the top card on the deck, depending upon potential combinations he may have in his present hand. Upon selecting a card, he must discard one card, placing it face up beside the deck as in the start of play (all discards should remain visible to all players as *any one* of these cards can be chosen in a player's turn).

At this point, this player may pass play to the next player, or declare "rummy" and lay down the cards which form a two-, three-, or five-card combination. It is imperative that the player lay the cards down in the exact order which he claims demonstrates a proper physiological relationship, and that all cards that *can* be in the sequence be there. A joker may be played in place of any other card in the deck. Following the player's justification of his organization of cards, the other players decide whether or not the order is valid. Should they unanimously approve of the cards laid down, the hand is scored as follows:

one 2-card combination	1 points
one 3-card combination	2 points
5-card combination consisting of one 2-card and one 3-card combination	5 points
5-card combination in a single sequence	7 points

The player then draws the number of cards he played from the deck containing the face-down cards. If the meld is not approved by the other players, each of the others receives one point, the player picks up his cards and play continues. The hand ends when all cards in the down deck are gone. The game ends after one hour's play, and the player with the highest point total is the winner.

Comments

These rules have proved to be the most interesting and productive for our students. Although different institutions and conditions may call for modifications, the following three general principles were employed in the evolution of our rules. We feel that these principles are central to the success of the game.

1. The students should be kept playing productively as much as possible during the alloted period. Thus, the game is kept relatively short to prevent loss of interest, and a player is not dropped from the hand because of a misplay or because of laying down cards.
2. Student-student interaction is paramount. It is the interchange between the players that is the basis for the learning experience and which forces the student to formalize and solidify his own concepts of physiological principles. The instructor should resist the temptation to intervene and render a judgement. It is better to let an occasional misplayed hand slip by for credit than to have the students become dependent upon the instructor for decisions.
3. Point-scoring is encouraged. This is why players are allowed to pick up any one card from the discard pile rather than the last discard only, and why jokers are in the deck. Also, direction of change of a physiological parameter is not listed on the card (e.g., cardiac output, up), but rather no indication of change is mentioned for three reasons: (a) it forces the student to have his logic clearly defined when he lays down the hand for justification; he cannot rely upon the cards to do it for him, (by) it allows more physiological parameters to be included in the 52 card deck, and (c) it encorages scoring by allowing the student to declare which way he wants the change to occur, rather than depending upon the "luck of the draw" to get the proper card.

List Of Cards

We have found the following lists of cards to cover the two physiological systems adequately, and to provide the students maximum opportunity to form meaningful physiological relationships.

REFERENCES

1. France, V.M., Cardiovascular Physiology for First-year Medical Students: Teaching and Learning Through Games. *The Physiologist* 21(5): 26-27. 1978.
2. Short, A.H., Teaching Physiology by Games and Models. *The Physiologist* 22(3): 27-29. 1979.

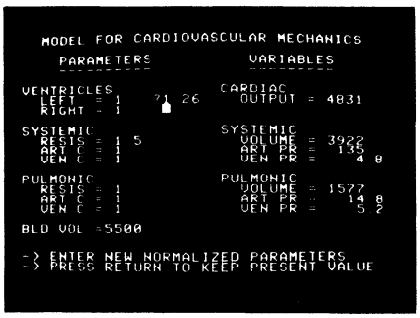
CARDIOVASCULAR CARDS	RESPIRATORY CARDS
Arteriolar vasomotion	Acidosis
Arteriovenous oxygen difference	Airway resistance
Autonomic nervous system (two cards)	Alkalosis
Baroceptors	Alveoli
Blood flow distribution	Anemia
Capillary filtration	Aortic valve stenosis
Capillary pressure	Arterial oxygen content
Cardiac output	Asthma
Cardiac work	Atelectasis
Cardiovascular center	Carbon dioxide
Central venous pressure	Carbon monoxide
End diastolic volume	Carbonic anhydrase
End systolic ventricular volume	Carotid bodies
Exercise	Colloid osmotic pressure
Heart rate	Dead space
Hemorrhage	Emphysema
Humoral factors (2 cards)	Exercise
Joker (4 cards)	FEV_1
Left ventricular failure	Hemoglobin
Local pH and P_{CO2}	Hyperventilation
Lymphatic flow	Hypoventilation
Medullary chemoreceptor	Hypoxia
Muscle blood flow	Intrapleural pressure
Muscle pump	Joker (4)
Myocardial contractility	Medullary control center
Peripheral chemoreceptors	Oxyhemoglobin dissociation
Plasma pH and P_{CO2}	PCO_2
Plasma P_{02}	pH
Positional change	Plasma bicarbonate
Pulmonary arterial pressure	Pneumothorax
Pulmonary edema	PO_2
Pulmonary vascular resistance	Pulmonary complicance
Renal arteriolar constriction	Pulmonary edema
Respiratory center	Pulmonary fibrosis
Right ventricular failure	Pulmonary vascular shunt
SA node	Pulmonary vasoconstriction
Stroke volume	Regional perfusion differences
Supraventricular arrythmia	Respiratory distress syndrome
Systemic arterial pressure	Surfactant
Systemic edema	Temperature
Total peripheral resistance	Tidal Volume
Valve insufficiency	Venous oxygen content
Valve stenosis	Ventilation
Venous return	Ventilation-perfusion ratio
Venous tone	Ventricular hypertrophy
Ventricular arrythmia	Vital capacity
	2, 3-DPG

MICROCOMPUTERS and PHYSIOLOGICAL SIMULATION

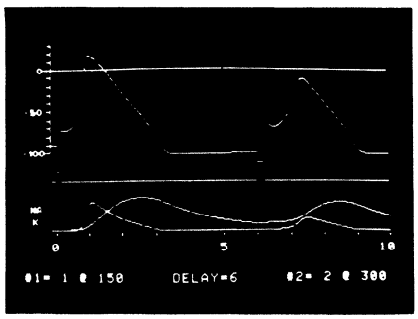
James E. Randall
Indiana University School of Medicine, Bloomington

Foreword by
Arthur C. Guyton
University of Mississippi School of Medicine, Jackson

This book provides microcomputer hardware and programs suited for teaching simulations such as nerve action potential, cardiac action potential, cardiovascular system mechanics, and the glucose tolerance test.



Computed cardiovascular variables for student-selected heart and vascular properties



Demonstration of axon refractory period

Contents:

Representative Teaching Exercises Fully Documented in the Book

Exercises include:

- Plots of compartmental concentrations as a function of the rate constants of first order processes.
- The glucose tolerance test as a function of pancreatic sensitivity and cellular utilization.
- Cardiac output, volume distribution, and pressures for given physical properties of the vessels and the ventricles.
- Central arterial pressure as a function of stroke volume, heart rate, and vascular properties.
- The ECG limb leads as a function of the mean electrical axis of the heart.
- Axon potentials and membrane conductances following paired stimuli.
- Cardiac action potentials and membrane conductances.
- Waveforms as distorted by different time constants of filtering.

February 1980, 240 pp., illus.
Paperbound 06128 $14.50

"Sorely needed for those of us who are just beginning to adapt microprocessors to teaching applications in Physiology. Dr. Randall is eminently qualified to do this special job. He has interacted for several years with his potential readers through his activities in the American Physiological Society."

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"An excellent and up-to-date review of a rapidly advancing field."

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1976, 448 pp., illus.
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BIOCHEMICAL SYSTEMS ANALYSIS: A Study of Function and Design in Molecular Biology

Michael A. Savageau, *The University of Michigan. With a Foreword by* **Robert Rosen,** *Dalhousie University*

"It provides a stimulating account of a subject of increasing importance written by one of the masters in that field. It should be required reading for any biochemists interested in the behavior of metabolic systems."

—*International Journal of Biomedical Computing*

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Principles of Animal Physiology. 2nd Ed. James A. Wilson, Macmillan Publ. Co., Inc., New York, and Collier Macmillan Publ., London, xviii + 891, 1979, $21.95.

In this second edition of *Principles of Animal Physiology* the author has attempted to bring the subject matter up to date and has included many revisions, reorganization of the text, and has added textual material as well as illustrative material - an excellent supplement to the text when explaining complex concepts. The book is divided into three major sections, each a stepping stone to the next. The first section covers background information on animal physiology and related fields such as comparative physiology, cellular physiology, biochemistry and biophysics, as well as concepts underlying physiology and physiological research, followed by discussions of cellular constituents, organization and membranes, and cellular metabolism (157 pages). The second part is devoted to fundamental units of animal systems and contains chapters on biological membranes and transport, potentials of excitable cells, various topics in neurophysiology; function and regulation (383 pages). In the third section, there are discussions on hemostasis and the regulation of circulation, water, nutrition and body temperature, and behavior (296 pages). The theme of regulation is incorporated throughout the book.

As expected in a book of this size and range of topics, some parts are too sparse in content and others too detailed - revealing of course, the author's interests and available information. However, I found all of the topics well presented and well organized. One factor, I believe, is especially helpful, that is, the emphasis on nearly all key terms and concepts. The text is, as the author has written, useful in an introductory course and as a reference - it is not the ultimate treatise.

Two problems do detract from the book's usefulness. The author has stated that any student interested in the course in which the book is used should have a background in "some chemistry, a little physics and mathematics, and some biology ..." I feel that more than a basic knowledge in these subjects is necessary, and a course in biochemistry and, perhaps, a course in biophysics is prerequisite to the understanding of many of the topics. The second problem is far more serious, raising a question about the usefulness of the book. The fault lies in the slipshod manner in which the book has been indexed; some of it so poorly that the reader must be cautious especially when using the book as a reference. For example: Table 1-2 purports to list the animal groups upon which physiological studies have been made. But, in this table lizards and snakes are not listed under Reptilia as having been used in research. However, a number of these animals are listed in the index as well as in the text. And, again, referring to the index, I could not find many of the names of lizards and snakes mentioned in the text despite Tabel 1-2, i.e., iguana, gecko, *Sauromalus,* snake, water snake, *Coluber,* or common or scientific names of other reptiles, i.e. *Alligator,* turtle, marine turtle, green turtle. However, I did find *Python, Chamaeleon,* (incorrectly spelled in the index, but correctly in the text), *Chelonia,* crocodilian, and some others. There are other oversights, but I shall mention just one more: in the section on blood coagulation in mammals, heparin is stated to be a mucopolysaccharide and the reader is referred to Figure 2-26. I defy any student with only "some chemistry" as background (using this text in an introductory course prior to a course in biochemistry) to find in this figure (2-26) that "heparin is a mucopolysaccharide." These examples are given only to make the reader aware of the pitfalls in using this book.

However, the book contains a wealth of information, as stated above, much of it well presented and understandable, and thus the book is of value as a text. The teacher selecting it as a class text, or the student choosing it as a reference handbook should examine it, considering the indexing, availability of the material, and the academic level of the topics. It is to be hoped that Dr. Wilson will take greater care in the cross-references and indexing when writing the 3rd Edition.

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Comparative Mechanisms of Cold Adaptation. L. S. Underwood, L. T. Tieszen, A. B. Callahan, and G. E. Folk, Eds. Academic Press, New York, 1979. 379 pp., illus., index, $24.00

This book is made up of papers presented at a symposium and workshop co-sponsored by the American Institute of Biological Sciences, The Office of Naval Research, and the Ecological Society of America, and presented on 24 August 1977 in East Lansing, Michigan. The editors are widely recognized and respected experts in the field of cold adaptations. The authors' list of contributors to the book is a "Who's Who" in cold adaptation mechanisms.

The purpose of putting the various presentations together in book form is stated by the editors: "We hope this book will not only summarize our current knowledge, but will also be useful to scientists conducting research in this area, to students and others beginning their careers, and to funding agencies considering support for such research."

It is a worthwhile purpose; the editors and contributors accomplished their purpose rather well.

Yousef, in one of the chapters, shows simply and clearly that the pathways of regulatory thermogenesis are different in wild as compared to laboratory rodents. Physiologists (and indeed other biomedical scientists) need periodic reminding that pure bred laboratory strains of animals do not, by and large, respond identically to environmental variables as do wild type animals of the same species.

Musacchia and Deavers in their chapter on thermal balance explore the use of animal models to extend our knowledge of carbohydrate metabolism during depressed states of metabolism. They urge the use of "wild type" varieties in natural habitat conditions to further critical areas of our knowledge.

It is refreshing to read excellent discussions of thermal adaptations in plants in the same volume containing critical evaluations of animal adaptations to cold.

Surprisingly, Wunder had to conclude that, for animals at least, the hormonal aspects of thermogenic responses to cold are still obscure. The one certain aspect of this problem seems to be that thyroid gland and thyroid hormones are somehow necessary to thermogenic responses to the cold.

In my opinion this book is useful for "enrichment" of courses in general mammalian physiology or as a discussion text for a seminar in adaptation to cold. It also should be a vaulable reference for biologists who wish to become familiar with the present state of the art in the physiology of cold exposure quickly and with minimal effort.

The few typographical errors do not detract from the book despite the fact that one stares our from the title page. The trend of putting the proceedings of high quality scientific seminars and symposia into permanent book form after critical, ruthless, and effective editing should be encouraged - especially in these times of ever more outrageous costs for transportation and housing in the face of rapidly diminishing funds for scientific travel.

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Autonomic Pharmacology: Experimental and Clinical Aspects. Michael D. Day. Churchill Livingstone, New York, 1979. 249 pp., illus., index., $15.00

Although the text is prefaced as a primer for undergraduate students, the contents suggest a more sophisticated application. As the book can be read on several levels of understanding, the novitiate of pharmacology will find in the first chapters a thorough, basic introduction to autonomic pharmacology with regards to histroy, anatomy, physiology, and principles of neurohumoral transmission and autonomic regulation in tissues. However, almost no mention is made concerning the autonomic regulation of endocrine systems beyond effects of neurotransmitters on vasculature. Later chapters progress nicely through knowledgeable and concise descriptions of the synthesis, storage, release and metabolism of the neurotransmitters. The student of pharmacology will be delighted with the thorough review (including chemical structures) of drugs affecting the various components of the autonomic nervous system. Clinical uses and dosages of most of the drugs are written in detail and offer an excellent review. The discussion of the pharmacological effects and clinical uses of the autonomic blocking agents is especially well written and instructive. Some readers may find the text's English terminology distracting. Basic and clinical scientists will appreciate the review for its many specific details and discussions of current theories of the autonomic nervous system. The book should make a valuable teaching and learning tool, and be an excellent companion to general pharmacology texts.

Suzanne G. Laychock, Ph.D.
Medical College of Virginia

ADDISON

Thomas Addison (1793-1860) an English physician at Guy's Hospital (a colleague of Bright's). A brilliant lecturer and able diagnostician, he was not a popular practitioner of medicine. He is said to have been the first to employ static electricity in the treatment of spasmodic diseases (1837) and in collaboration with John Morgan wrote the first book in English on the action of poisons in the living body (1829). He described pernicious anemia in 1849.

Addison's principal claim to fame, however, rests on his monograph "On the Constitutional and Local Effects of Disease of the Suprarenal Capsules" published in London, 1855. Addison had referred to the condition in 1849, but even after publication of his monograph the importance of his discovery was not realized. Actually it was the inauguration of the study of internal secretion and the ductless glands. The condition described by Addison was later named by Trousseau "Addison's Disease" and this name has persisted.

From: *The Origin of Medical Terms.* Henry A. Skinner. Williams & Wilkins, Baltimore, 1961.

1980 MEETING OF AMERICAN SOCIETY OF ZOOLOGISTS, AMERICAN MICROSCOPICAL SOCIETY, AMERICAN SOCIETY OF LIMNOLOGY & OCEANOGRAPHY, ANIMAL BEHAVIOR SOCIETY, CANADIAN SOCIETY OF ZOOLOGISTS, ECOLOGICAL SOCIETY OF AMERICA, SOCIETY OF SYSTEMATIC ZOOLOGY, AND WESTERN SOCIETY OF NATURALISTS

SEATTLE CENTER, SEATTLE, WASHINGTON --- DECEMBER 27-30, 1980

PHYSIOLOGY SYMPOSIA

LOCOMOTION AND EXERCISE IN ARTHROPODS (arranged by C. F. Herreid and C. R. Fourtner, SUNY/Buffalo). The symposium will consider "state of the art" studies of arthropod locomotion in air, water and land using research from most of the major taxa. It will include evolutionary overview of arthropod locomotion by R. Hessler (Scripps Inst.); the mechanics of locomotion by R. Bowerman (Univ. Wyoming), C. Spirito (New England Univ.), C. Ellington (Cambridge) and W. Nachtigall (Univ. Saarlandes); muscle biochemistry by B. Sacktor (NIH); neuromuscular interactions by C. Govind (Toronto), C. Fourtner (SUNY/Buffalo) and A. Kammer (Kansas State); circulation and gas exchange during locomotion by J. Wilkens and B. McMahon (Univ. Alberta), P. Miller (Oxford) and C. Kaars (SUNY/Buffalo); temperature regulation by B. Heinrich (Berkeley); swimming, walking and flight energetics by B. Hargreaves (Lehigh), C. Herreid (SUNY/Buffalo) and T. Casey (Rutgers); and a summary and perspectives lecture by J. W. S. Pringle (Oxford).

THE ROLE OF UPTAKE OF ORGANIC SOLUTES IN NUTRITION OF MARINE ORGANISMS (arranged by Grover C. Stephens, Univ. of California, Irvine). The state of the field will be reviewed in the context of potential nutritional contributions to major marine invertebrate groups defined on the basis of habitat. A series of contributions designed to illustrate current activity in the field will be presented. Emphasis will be placed on recent advances in analytical techniques and in the sophistication of interpretation which has characterized the recent rapid development of this field. Such advances include: (1) fluorometric and HPLC analysis of amino acids in the picomole range, (2) preparation of isolated membrane vesicles from invertebrates, (3) kinetic analysis of influx (unstirred layers, interactions with inorganic ion transport, etc), and (4) invertebrate-microbial competition; use of axenic invertebrate systems for study of transepidermal transport. Invited participants include J. Gomme (A. Krogh Inst., Copenhagen), B. Kurelec (Ruder Boskovic Inst., Zagreb), D. Schlichter (Univ. of Cologne), D. Siebers (Biologische Anstalt, Hamburg), E. and A. Southward (Marine Lab, Plymouth) as well as a number of active investigators from various institutions in the United States.

INSECT SYSTEMS - MILESTONES AND NEW HORIZONS IN ENDOCRINOLOGY, PHYSIOLOGY AND DEVELOPMENT (arranged by Lynn Riddiford (Univ. Wash.) and Judy Willis (Univ. Illinois). The program for this symposium which honors Carroll M. Williams includes Insect oogenesis: the origins of ooplasm, W. H. Telfer; Hormonal regulation of vitellogenin synthesis, G. R. Wyatt; Hormonal regulation of vitellogenin uptake, K. G. Davey; Genetic analysis of hormonal control of vitellogenin synthesis J. Postlethwait; Physiological control of prothoracicotropic hormone secretion, H. F. Nijhout; Regulation of insect endocrine glands, L. I. Gilbert; Hormonal regulation of epidermal cell development, L. M. Riddiford; Juvenile hormone: the status of "status quo", J. H. Willis; How antijuvenile hormones work, W. S. Bowers; Structure, evolution and developmental expression of the chorion genes, F. Kafatos; Role of ecdysteroids in insect embryogenesis, J. Hoffman; Hormonal regulation of a pregnancy cycle, B. Stay; Environmental control of hormonal levels, J. deWilde; Hormone action in Drosophila cells, P. Cherbas; Active transport ATPase in the Cecropia midgut, W. R. Harvey; Hormonal control of insect behavior, J. W. Truman; Ecdysteroid metabolism, T. Ohtaki; Future of insect growth regulators, J. Siddall. An evening meal will feature Howard Schneiderman as an after dinner speaker.

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Meeting plans include 16 other symposia, contributed papers (abstract deadline is August 15), special programs, several socials, a job placement service, trips and tours, and an activity room for children. ASZ is sponsoring travel grants for graduate students, and is distributing several free rooms provided by Seattle hotels. In addition, limited travel support will be provided from a National Science Foundation grant to graduate students and postdoctoral fellows participating in the Insect Systems Contributed Paper Sessions. To apply for a Graduate Student/Postdoctoral Fellow Insect Systems Travel Grant, submit a letter of application and a letter of support from the appropriate faculty advisor along with the abstract. For the complete meeting details and forms for submitting an abstract, contact: Mary Wiley, American Society of Zoologists, Box 2739 California Lutheran College, Thousand Oaks, Ca. 91360 (805-492-3585).