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The Physiologist

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

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AMERICAN PHYSIOLOGICAL SOCIETY ENDOWMENT FUND

Established in 1977 to

Support programs for the development of physiologists and physiology

Encourage communication with other disciplines of science and the public

Foster scientific and cultural relations with other parts of the world

The following individuals have been honored with contributions.

The illustration above is a miniature reproduction of a bronze plaque being cast to hang in the APS Bethesda Office. Not shown are the individual shingles at the bottom of the plaque bearing the name of each living or deceased physiologist or other individual in whose memory the Endowment Fund is maintained. To date, the names of John F. Perkins, Jr. and Caroline tum-Suden have been so honored.

The APS Endowment Fund was established to encourage tax deductible contributions or bequests to the Society at any time and in any amount, for specific or general purposes. Upon request, the Society will provide to a donor or institution contributing a memorial gift a replica of the plaque bearing the name of the individual living or deceased in whose honor the gift was made. The family of, or the individual being honored by a donation to the fund will be advised formally of the donors name, unless the contributor specifically requests that the donation be anonymous.

Donations to the APS Endowment Fund or queries should be addressed to the fund at 9650 Rockville Pike, Bethesda, Maryland 20014.

The following recently-received contribution is gratefully acknowledged:

In memory of C. H. Best by an anonymous donor.

FEDERATION MEETING – SATELLITE SYMPOSIUM

REGULATION OF PROTEIN DEGRADATION IN HEART AND SKELETAL MUSCLE

APRIL 5 and 6, 1979

Howard Morgan and Kern Wildenthal have organized this satellite symposium to be held in the auditorium of the University of Texas Health Science Center at Dallas, 5323 Harry Hines Blvd. The symposium will be held on Thursday and Friday, April 5 and 6, 1979 with a dinner and lecture being planned at the Faculty Club on Friday evening, April 6.

The Thursday session will run from 1:30 to 5:00 and the Friday session from 9:00 to Noon. These sessions will tend to act as a "bridge" between the two cluster society meetings that characterize the 1979 Federation Spring Meeting. The first cluster meets from 8:30 AM Monday, April 2 through 5:00 PM Thursday, April 5 and includes the American Society of Biological Chemists, American Society of Pharmacology and Experimental Therapeutics and American Institute of Nutrition.

APS will meet in the second "cluster" that begins Friday, April 6 at 2:00 PM and runs until 4:30 PM on Tuesday, April 10. In addition to APS this "cluster" will include the American Association of Pathologists, the American Association of Immunologists and two guest societies, the Biomedical Engineering Society and the Society for Experimental Biology and Medicine.

The program for the symposium is:

1. Alan J. Barrett, Cambridge, England
   "Tissue proteinases: general considerations"

2. John W. C. Bird, New Brunswick, N.J.
   "Proteinases in cardiac and skeletal muscle"

3. Roger T. Dean, London, England
   "Mechanisms and regulation of protein degradation: general principles"

4. Howard E. Morgan, Hershey, Penn.
   "Regulation of protein turnover in heart"

5. Kern Wildenthal, Dallas, Texas
   "Role of lysosomes in cardiac protein degradation"

6. Richard A. Lockshin, Jamaica, N.Y.
   "Regulation of protein degradation in insect muscle"

7. Alfred L. Goldberg, Boston, Mass.
   "Mechanisms controlling protein degradation in adult and embryonic muscle"

8. David J. Millward, London, England
   "Protein turnover in skeletal muscle during hypertrophy"

9. Vernon R. Young, Boston, Mass.
   "Muscle protein turnover in healthy and diseased human beings"

63rd ANNUAL MEETING

FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

APRIL 1-10, 1979 DALLAS, TEXAS

The first FASEB "Stretch Meeting" will be held April 1-10, 1979 in Dallas, Texas. The ten day format will bring all FASEB Societies to one location meeting in two clusters, with exhibits open to span a portion of the time each cluster is holding scientific sessions.

First Cluster of Societies
- American Society of Biological Chemists (ASBC)
- American Society of Pharmacology & Experimental Therapeutics (ASPET)
- American Institute of Nutrition (AIN)

These Societies will meet Monday morning, **April 2** through Thursday afternoon, **April 5.**

Second Cluster of Societies
- American Physiological Society (APS)
- American Association of Pathologists (AAP)
- American Association of Immunologists (AAI)

GUEST SOCIETIES
- Biomedical Engineering Society (BMES)
- Society for Experimental Biology and Medicine (SEBM)

These Societies will meet from Friday afternoon, **April 6** through Tuesday afternoon, **April 10.**

REGISTRATION AND INFORMATION

Opens 2:00 PM Sunday, **April 1,** and open daily through **April 10.**

EXHIBITS

Exhibits will be open: Wednesday, **April 4** through Noon Sunday **April 8.**

DEADLINE FOR RECEIPT OF ABSTRACTS

Friday, December 15, 1978 – ASBC
Tuesday, December 19, 1978 – AAP & AAI
Tuesday, January 2, 1979 – APS, ASPET, AIN, BMES & SEBM

FASEB DIRECTORY OF MEMBERS

The 1977-78 FASEB Directory of Members will be distributed to eligible APS members in October.

Regular, Associate and Corresponding members will automatically receive copies. Retired members must request their copies.

COMMITTEE ON NOMINATIONS AND AWARDS

The Committee on Nominations and Awards is anxious to bring to the attention of APS members its continuing mission of promoting worthy physiologist candidates for significant awards. If a member wishes to nominate a member as the Society's candidate to any significant award, they are asked to send the necessary supporting documents to the Committee at the APS address in Bethesda with a covering letter. Allow about 90 days prior to the deadline established for the Award to permit the Committee to evaluate the nominee or nominees.

To date the Committee has limited its activities to the following awards:

Flexner Award, sponsored by the Association of American Medical Colleges
Borden Award, also sponsored by AAMC
National Medal of Science, administered by the National Science Foundation
Alan T. Waterman Award, also administered by NSF

It is the Committee's hope that APS members familiar with other significant awards will come forward with appropriate nominations for such awards so that by its sponsorship, the Society can work to enhance the probability that the recipient will be an APS member.

Current members on the Committee are: Helen F. Cserr, James O. Davis, Harry D. Patton, Donald W. Rennie and the Chairman, Jere Mead.

THE DAVID B. TYLER MEMORIAL FUND

In December 1977, Dr. David B. Tyler, one of this country's most distinguished scientists and administrators, died after a long illness.

In his memory, the David B. Tyler Memorial Fund has been established by the family and friends of the late Professor David B. Tyler in recognition of his service to science and humanity, a lifetime contribution that is beyond the scale of human impermanence. It has been established as a special publicly-donated fund to serve as an endowment for the David B. Tyler Memorial Lectureship at the University of South Florida College of Medicine, an institution that David loved, and came to regard as his real home.

Please join the Tyler family and many of David's friends and colleagues who have already contributed to this fund by sending your tax-deductible check made out to "University of South Florida Foundation, D. B. Tyler Fund." In grateful appreciation, we are,

Andor Szentivanyi, M.D., Chairman of Pharmacology and Therapeutics
C. H. Baker, Ph.D., Chairman of Physiology
Samuel C. Bukantz, M.D., Professor of Internal Medicine

HONORS AND AWARDS

Dr. Knut Schmidt-Nielsen has been elected a Foreign Associate of the French Académie des Sciences, one of the world's most distinguished scientific bodies, in recognition of his work in the field of Comparative Physiology.

This Spring, the National Academy of Sciences honored 60 American scientists and engineers by electing them to membership. APS members **Susumu Hagiwara,** Professor of Physiology, UCLA and **Andrew V. Schally,** Chief, Endocrine and Polypeptides Laboratories, VA Hospital, New Orleans, were recipients of this honor.

Two APS members were recipients of the first Sarasota Medical Awards for Achievement and Excellence. **Dr. Eugene Braunwald,** Professor of Medicine at Harvard Medical School, for his work in cardiovascular hemodynamics which has led to major breakthroughs in the management of cardiac disease, and Nobel Laureate, **Dr. Rosalyn Yalow,** Chief of Nuclear Research Services at the VA Hospital, Bronx, New York for her work in radioimmunoassay, a technique for measuring tiny quantities of substances in the blood and tissues.

Dr. Dan H. Moore, Research Professor of Microbiology and Immunology at Hahnemann Medical College & Hospital, has received an award from the Michigan Cancer Foundation for outstanding contributions to breast cancer research. The Eleanor Warren Award was presented to Dr. Moore at the 11th International Mammary Cancer Meeting in Detroit. Dr. Moore heads the 10-person breast cancer research team at Hahnemann. The Hahnemann team has been studying virus particles from mice and has successfully immunized the animals against cancer, a step toward a possible similar treatment of human breast cancer.

Dr. Harold T. Hammel, Professor of Physiology at Scripps Institution of Oceanography, University of California, San Diego, has been appointed as a foreign scientific member of the famed Max Planck Institute for Physiological and Clinical Research, Bad Nauheim, Federal Republic of Germany. Dr. Hammel returns to the Institute to continue work on the osmotic regulation of body fluids in marine animals and birds. He has been collaborating since 1974 with Dr. Eckhart Simon, Director of MPI's Temperature Laboratory. Their goal: to promote an understanding of the role of the nervous system in regulatory biology.

NO INCREASE IN JOURNAL SUBSCRIPTION PRICES FOR 1979

Since the journals of the Society were reorganized in 1976-77 the number of manuscripts received increased dramatically, i.e., from 1,894 in 1975 to a projected 2,376 in 1978. This increase has been a clear indication that the new arrangement of journals is what the scientific community wants. Although more papers have had to be rejected, the number accepted for publication has also increased. Because of the increase in the number of accepted manuscripts, and improvements in the speed of publishing, the number of pages in the journals has increased from 8439 in 1976 to about 10,250 in 1978.

Despite the many more pages that have been published, and despite inflation, the journals have operated in the black. As a result, subscription prices for 1979 will not be raised on any of the Society journals. In addition, a new option is available. The five individual journals of the *American Journal of Physiology* can be purchased together for $160 per year, a savings of $40 on the price of the journals if they were purchased separately. Subscription to the consolidated *American Journal of Physiology* is still the best buy at $125 per year, but the new "package" offers another option for those who prefer the specialty journals bound separately. (Members may purchase any of the journals at half price.) Another special feature offered in 1979 is a 40-year cumulative index to the *Journal of Neurophysiology.* This index to volumes 1 through 40 will be distributed as Part 2 of the January 1979 issue of the journal. The price to nonsubscribers will be $25.

The Publications Committee continues to welcome suggestions for improving the publications program. The publications of the Society are prospering and the Publications Committee is eager to ensure that the journals and books reflect the changing needs of the membership.

Publications Committee

A. P. Fishman, *Chairman*
R. W. Berliner
R. M. Berne

FORTY-YEAR CUMULATIVE INDEX TO THE JOURNAL OF NEUROPHYSIOLOGY

Several years ago the Publications Committee of the American Physiological Society recognized that cumulative author and subject indexes to the research journals of the Society would increase their usefulness. Two indexes were published in 1976, one to the *American Journal of Physiology* (1952-1975) and the other to the *Journal of Applied Physiology* (1948-1975). Now the series is continued with the publication of a cumulative index to volumes 1-40 (1938-1977) of the *Journal of Neurophysiology.*

The author index includes author's names for each article, complete article title, volume number, and initial page number of each article. Co-authors are listed alphabetically with a *see* reference to the first author. This part of the index has been prepared from the cumulative tables of contents from each of the 40 volumes.

The subject index was prepared by Constantine J. Gillespie of the National Institutes of Health Library. Manual indexing was selected to insure uniform treatment of research reported during the 40 years covered by the indexed volumes. Main headings are printed in bold face and secondary headings in regular type. Cross references (*see* and *see also*) are included. Brenda B. Rauner coordinated production of the index, which involved the computer and composition facilities at Science Press, printing at Lancaster Press, and copy editing and proof reading at the Society editorial office. Copy editors and proof readers were Yvette W. Gordon, Joan Osleeb, and Kathleen B. Rotondo. Stephen R. Geiger served as advisor on the project.

The cumulative index will be distributed to 1979 subscribers to the *Journal of Neurophysiology* without additional charge. Copies of the index may be purchased separately from the Subscription Office, American Physiological Society, 9650 Rockville Pike, Bethesda, MD 20014 for $25.00 per copy, postpaid.

Publications Committee

Alfred P. Fishman, *Chairman*
Robert W. Berliner
Robert M. Berne

ERROR IN LIST OF SPECIAL INTEREST GROUPS

In the June 1978 issue of *The Physiologist,* on page 26, we printed a list of currently organized Specialty Interest Groups. Because of an administrative error, the Task Force on Cardiac Mechanics and the Task Force on Cell Physiology were among those included. These two have not as yet been formally constituted.

On the other hand, the Circulation Group was inadvertently omitted. Louis Tobian is the Chairman of the Steering Committee for this Special Interest Group.

We apologize for any inconvenience caused by these errors.

TRANSFERS TO RETIRED MEMBER

It is apparent from correspondence received in the Bethesda Office that there is general unfamiliarity with the procedures that should be followed in requesting transfer from an active membership category to Retired Member. Article III, Section 6 of the Society Bylaws states: "A Regular or Associate Member who has reached the age of 65 years and/or is retired from regular employment may, upon application to Council, be granted retired member status."

Normally, a member requesting transfer to retired status should be in good standing, having paid all current dues at the time application for the transfer is made. Since dues are payable in advance of July 1, most requests for retirement should occur before the start of the new dues year, prior to Council's Spring meeting and the transfer would become effective with the beginning of the next dues year that starts on July 1. However, on occasion, requests for transfer are received shortly after the start of the dues year on July 1. In these latter cases, the requestor is normally asked to pay one half the current year's dues to compensate the Society for charges and assessments made for each active member on July 1. The subsequent transfer to Retired Member then becomes effective following Council's Fall Meeting, on January 1.

Members must make specific application in writing to request transfer to retired status. Merely requesting a change of address to a new title such as Professor Emeritus does not meet the Bylaw requirement for an application to Council for retired member status.

As a Retired Member, individuals are exempt from the payment of dues and may participate in Society business without vote; contribute or sponsor papers at the Spring and Fall Meetings of the Society; receive *The Physiologist* and, if specifically requested, the annual Directory of Members; subscribe to Society journals and *Federation Proceedings* at member rates; and, attend the annual Federation Meeting and the Society Fall Meeting at special registration rates.

Any questions regarding transfer to retired status should be directed by phone or in writing to the Office of the Executive Secretary. The telephone number is (301) 530-7164.

NOTICE CONCERNING TRAVEL TO THE INTERNATIONAL PHYSIOLOGICAL CONGRESS

Based on approval expressed at the 116th Business Meeting of the Society, August 18, 1976, Council decided that a voluntary assessment of $2.00 would be included in the annual dues for three years to provide additional funds for support of travel grants for North American physiologists to attend the International Physiological Congress to be held in Budapest in 1980.

This program has been quite successful with approximately three fourths of the members responding. If this extent of subscription continues, about $15,000 should be available to add to the approximately equal amount arising from interest on U.S. National Committee funds. In addition, government and private funding organizations will be solicited for grant and contract support for Congress travel.

As in the past, the U.S. National Committee for the IUPS of the National Research Council will publicize the call for applications for travel to the 1980 Congress approximately one year in advance (Summer or Fall 1979) and will establish mechanisms for evaluation of applications.

THE UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM (UNOLS) OPPORTUNITIES FOR BIOLOGICAL RESEARCH ON THE RESEARCH VESSEL ALPHA HELIX

UNOLS is an association of Institutions for the coordination and support of university oceanographic facilities. Research Vessel ALPHA HELIX has been designated as a UNOLS National Oceanographic Facility and is available for use by any qualified scientist or investigator. The vessel was designed and equipped to carry on experimental biological and biochemical research in areas where research facilities are not readily available. In addition, hydrographic and trawl winches provide basic oceanographic capability.

ALPHA HELIX built in 1966 under a grant from the National Science Foundation, is operated by Scripps Institution of Oceanography. It is 133 ft. long with living quarters for a scientific party of 12, which includes a resident technician, at least one visiting scientist designated by the host country in whose waters the ship is operating, and 9-10 U.S. sponsored investigators.

Use of ALPHA HELIX is available to the scientific community in accordance with guidelines set forth by the ALPHA HELIX Review Committee. A potential user must submit a proposal for shiptime to the Committee at least two years in advance of the desired cruise time. In addition, he or she must simultaneously submit a proposal to NSF or other funding agency to obtain support for the research program. Non-funded research projects may be accommodated only on a space-available, non-interference basis.

A successful ALPHA HELIX cruise requires substantial advance planning. Participants must work closely with the HELIX Review Committee, the HELIX Program Office at Scripps, and the research funding agency. Where necessary, they must arrange advance visits to planned work areas to assure that local permissions and arrangements for scientific work are in order. Also, Scripps must obtain ship clearances for all work in foreign waters. These negotiations are necessarily involved and time consuming.

The Review Committee meets annually to consider proposals for ALPHA HELIX use. *The next deadline for receipt of ship use proposals is 1 March 1979.* Proposal instructions and further information should be requested from: UNOLS Office, Woods Hole Oceanographic Institution.

General research areas are selected and announced well in advance on the basis of interest expressed by the scientific community and anticipated success in obtaining research support by potential participants.

1979-1980 ALPHA HELIX is scheduled to conduct programs in the south Equatorial Pacific. The Committee seeks additional proposals for work in the area during 1980. Some ancillary programs may also be accommodated in 1979.

1980-1981 (Tentative) After a transit from Australia, the vessel may spend the austral summer working in the Antarctic area. Additional proposals for work in this area are also sought by the Committee.

1981 and Beyond (Tentative) The ship will leave the high Southern Latitudes in early 1981. Expression of interest in general research areas for this period are welcome to help determine the areas to be visited.

For further information call the UNOLS office, (617) 548-1400, extension 352, or write to: UNOLS Office, c/o Woods Hole Oceanographic Institution, Woods Hole, MA 02543.

URATE AND P-AMINOHIPPURATE TRANSPORT BY ISOLATED, PERFUSED REPTILIAN RENAL TUBULES*

William H. Dantzler
Department of Physiology
University of Arizona, Tucson

Introduction

Urate and p-aminohippurate (PAH) are both secreted by the renal tubules of snakes *in vivo* (3,4,6). However, clearance, stopflow, and kidney slice studies (4,5,6) suggested that the transport processes for these two substances might differ. During the past few years, we have examined the transport of both these organic acids in isolated, perfused segments of snake renal tubules in order to define more precisely the similarities and dissimilarities and to characterize the transport steps at the peritubular and luminal sides within an intact epithelium (7,8,9,10,11,12,13). In the present paper, I shall discuss some results of these studies to illustrate our current concepts of the nature of these transport processes.

We used garter snakes of the genus *Thamnophis.* We teased segments of the tubules from the kidneys without the aid of enzymatic agents and perfused them *in vitro* by a method essentially the same as that originally described by Burg and his colleagues (1) (Fig. 1). These experiments were all performed at 25°C. In most cases, perfusion and bathing solutions were bicarbonate buffered Ringers containing 3mM potassium and 150mM sodium, gassed with 95% O_2–5% CO_2, and maintained at pH 7.6. The tubules were perfused at rates between about 1 and 7nl min^{-1}, although the rate was generally maintained between 2 and 4nl min^{-1}.

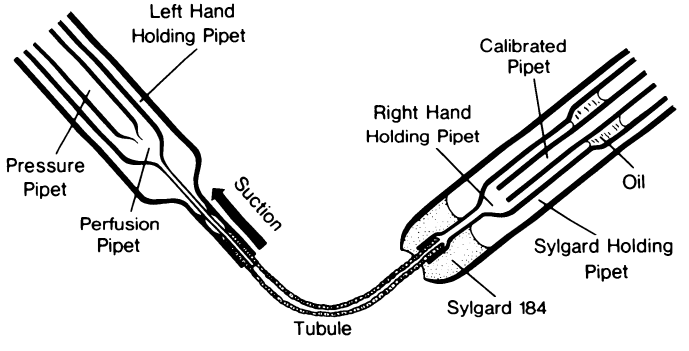


Fig. 1. Diagram of method for perfusing isolated renal tubules.

We have divided the proximal tubule into two anatomical portions on the basis of differences in PAH transport (8). One segment extends from a narrow neck portion next to the glomerulus through a series of convolutions occurring at the first bend in the proximal tubule. We have termed this segment the proximal-proximal tubule. The other segment consists of the remainder of the proximal tubule. We have termed this portion the distal-proximal tubule.

General Aspects of Transepithelial Transport

PAH transport from bath to lumen occurs primarily in the distal-proximal tubule (Table 1) (8). When tubules were perfused without any PAH in the initial perfusate and 2 x 10^{-5} mol/l PAH in the bathing medium, the mean ratio of the concentration of PAH in the collected tubule fluid to that in the bath (TF/B ratio) was less than 1.0 in the proximal portion of the proximal tubule and about 6.0 in the distal portion of the proximal tubule (Table 1). This indicates that PAH is transported from bath to lumen against a concentration gradient in the distal-proximal tubule but not in the proximal-proximal tubule. Moreover, net transepithelial PAH transport was about five times as great in the distal-proximal tubule as in the proximal-proximal tubule (Table 1). These findings are similar to those observed in rabbit proximal tubules where significant PAH transport occurs primarily in the pars recta (14). All other PAH studies reported here have involved distal-proximal tubules only.

Table 1. PAH Transport

	TF/B	Net Transport mol mm^{-1} min^{-1} x 10^{-15}
Proximal-proximal tubule	0.85 ± 0.19(7)	45.3 ± 9.92(7)
Distal-proximal tubule	6.02 ± 0.61(23)	249.9 ± 35.60(23)

Values are means ± SE. Figures in parentheses indicate number of tubules. These data have been published previously (8).

In contrast to PAH transport, urate transport occurs against a concentration gradient from bath to lumen throughout the proximal tubule. When tubules were perfused without any urate in the initial perfusate and 2 x 10^{-5} mol/l urate in the bathing medium, the mean TF/B ratio was about 2.0 (2.12 ± 0.21, n = 23; mean ± SE) in both segments. No differences in net transepithelial transport of urate were noted in the two segments. Accordingly, data from both segments of the proximal tubule were combined in the studies on urate reported here. These findings on urate differ from those observed in isolated rabbit tubules where urate secretion apparently occurs only in the pars recta (2).

When net transepithelial transport was studied at different perfusion rates in single tubules, net urate transport varied with flow rate but net PAH transport did not (7,8). These data suggest that backdiffusion from lumen to bath is marked for urate but not for PAH.

In order to determine if the transepithelial transport processes saturated, we varied the PAH concentration in the bath over a 100-fold range (0.2 x 10^{-5} mol/l to 20 x 10^{-5} mol/l) in one series of experiments and the urate concentration over a 200-fold range (0.2 x 10^{-5} mol/l to 40 x 10^{-5} mol/l) in a separate series of experiments (7,8). Since urate transport varies with flow rate, the urate studies were performed at a constant flow rate of 4 nl/min. The results are shown in Fig. 2. Both the PAH and urate transport systems tended to saturate. However, that for PAH appeared to saturate at a bath concentration of about 6 x 10^{-5} mol/l while that for urate did not completely saturate at 40 x 10^{-5} mol/l. From these saturation curves, it can be seen that the bath concentration at which all other secretion studies were per-

*Taken from the introductory remarks given at the session on Renal Transport of Organic Substances at the 1977 Federation Meetings.

formed (2×10^{-5} mol/l) was below that required for a maximum rate of transport. The apparent K_m for PAH, determined from these data, is 0.01 mmol/l; that for urate is 0.6 mmol/l. Thus, the apparent K_m for the urate transport system, although quite low, is almost two orders of magnitude greater than that for the PAH transport system.

When urate at a concentration of 40×10^{-5} mol/l was added to a bath containing PAH at a concentration of 2×10^{-5} mol/l, there was absolutely no effect on net transepithelial PAH transport (8). These data, which correspond to those obtained with clearance techniques (6), kidney slices (6), and nonperfused renal tubules (8), indicate that urate and PAH do not compete for transport sites.

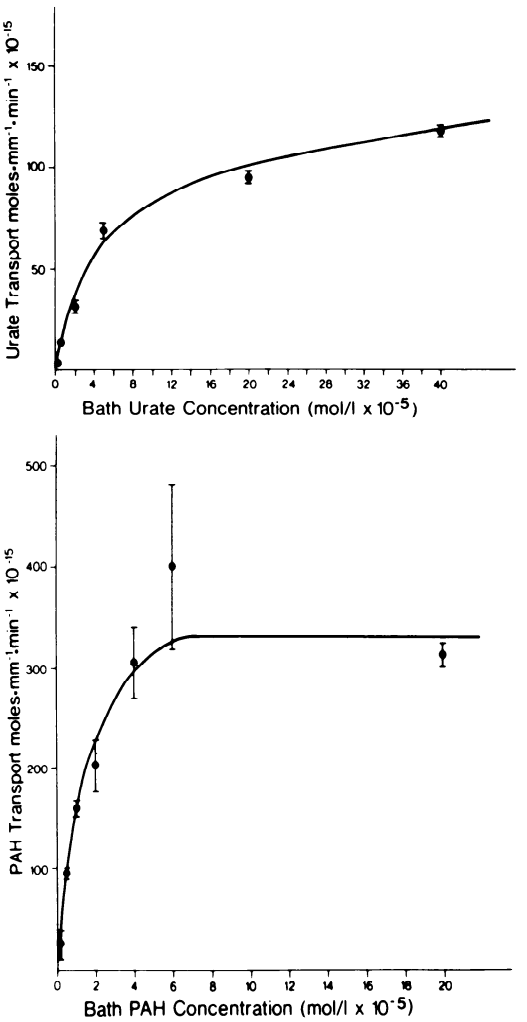


Fig. 2. Saturation curves for net transepithelial urate and PAH transport. Values are from 4 to 6 tubules at each point. Vertical lines indicate SE. Curves were fitted by eye. These data have been published previously (7,8).

Intracellular Concentrations

For a number of tubules, the concentration of PAH or urate in the tubule cell water was measured during the secretion studies (7,8). For each distal-proximal tubule segment, the PAH concentration in the cells during the secretion studies was greater than that in the collected tubule fluid or the bath (Fig. 3). For both proximal tubule segments, the urate concentration in the cells during the secretion studies was greater than that in the collected tubule fluid or the bath (Fig. 3). Since no significant amounts of urate or PAH accumulated in the cell water during studies of efflux from lumen to bath (7,8), there was no evidence for significant binding of the organic acids within the tissue. Therefore, the data shown are compatible with active uptake of the organic acid on the peritubular border of the cells and passive movement into the lumen.

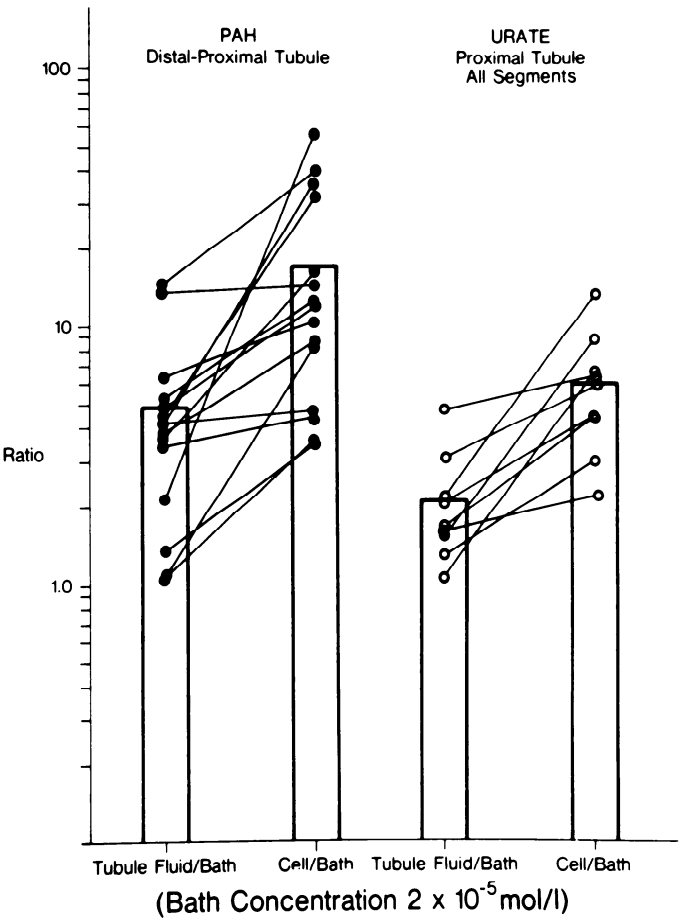


Fig. 3. Comparison of concentration of organic acid in tubule fluid in cell water during the secretion of the organic acid by each perfused tubule. Each pair of points connected by a line represents a separate tubule. Open bars indicate means. These data have been published previously (7,8).

Apparent Membrane and Transepithelial Permeabilities

The apparent permeability of the luminal membrane of the tubules to the organic acids was determined from the net transepithelial transport of the organic acid and the concentration difference between the cells and the lumen (7,8). The apparent permeability of the peritubular membrane to the organic acids was determined from the efflux of the organic acids from tubules with oil-filled lumens (9,10).

For PAH, the apparent permeability of the luminal membrane was $3.50 \pm 0.91 \times 10^{-5}$ cm s^{-1} (mean ± SE for 15 tubules) and the apparent permeability of the peritubular membrane was $0.50 \pm 0.07 \times 10^{-5}$ cm s^{-1} (mean ± SE for five tubules). A luminal membrane permeability about seven times that of the peritubular membrane is compatible with the concept of active uptake into the cells on the peritubular membrane and passive movement into the lumen.

In the case of urate, the apparent permeability of the luminal membrane was only $0.75 \pm 0.26 \times 10^{-5}$ cm s^{-1} (mean

± SE for nine tubules) while the apparent permeability of the peritubular membrane was 3.10 ± 0.61 x 10^{-5} cm s^{-1} (mean ± SE for five tubules). A low luminal membrane permeability and a peritubular membrane permeability four times as great suggest an inefficient system if urate transported into the cells at the peritubular membrane is simply to move passively into the lumen and not back into the bath.

The apparent transepithelial permeabilities for both PAH and urate can be calculated from the measured luminal and peritubular membrane permeabilities. The calculated transepithelial permeability for PAH (0.44 x 10^{-5} cm s^{-1}) is about the same as that determined directly from efflux from the lumen (0.67 ± 0.17 x 10^{-5} cm s^{-1}; mean ± SE for nine tubules), suggesting that the transepithelial efflux crosses the cells. Indeed, when the tubules were perfused with a solution containing 7 x 10^{-5} mol/l PAH while no PAH was present in the bath, the measured efflux from lumen to bath (29.28 ± 7.76 x 10^{-15} mol mm^{-1} min^{-1}; mean ± SE for nine tubules) was almost identical with that predicted from the individual membrane permeabilities (28.5 x 10^{-15} mol mm^{-1} min^{-1}) (10). In the case of urate, however, the calculated transepithelial permeability (0.60 x 10^{-5} cm s^{-1}) is about one-fourth of that determined directly from the transepithelial efflux (2.42 ± 1.09 x 10^{-5} cm s^{-1}; mean ± SE for seven tubules (10). This suggests that a large fraction of urate can move passively between the cells and that this is the region in which most of the backleak occurs.

Initial Transport Models

Our initial cellular models for transport of PAH and urate by snake proximal renal tubules are shown in Fig. 4. Both PAH and urate appear to be transported against a concentration gradient into the cells at the peritubular side. Such transport also appears to be against an electrical gradient if we assume that the inside of the cells is negative compared to the bath and that the organic acids move as anions. These organic acids then appear to move passively down an electrochemical gradient into the tubule lumen. In the case of PAH, the luminal membrane permeability seven times the peritubular membrane permeability is compatible with this pattern of transport. In the case of urate, the peritubular membrane permeability is four times the luminal membrane permeability. This would be an inefficient system for transepithelial transport from bath to lumen, and the situation may be more complicated than this. Moreover, there is a significant backleak of urate from lumen to bath, and this may occur largely between the cells. This is indicated by a broken arrow and a question mark.

Further Analysis of Peritubular and Luminal Transport Steps

Now I shall consider the steps at the peritubular and luminal membranes in more detail. I shall discuss the results of some studies which help to define, in a preliminary way, the nature of these transport steps.

1. *Transport step at the peritubular side of the cells.* It is not yet certain whether this step, which is against an electrochemical gradient, is a primary transport step or is coupled to the transport of some other substance, such as an inorganic ion. We have studied the effects of some inorganic ions on both PAH and urate transport (9,11,12,13).

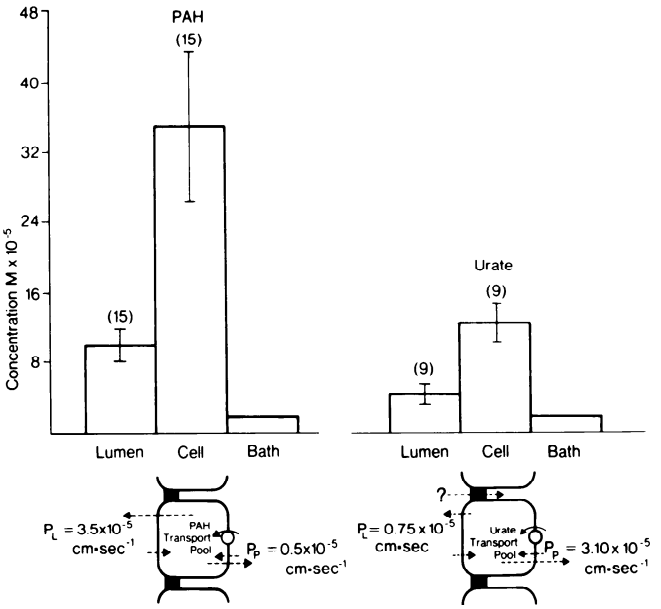


Fig. 4. Initial models for PAH and urate transport by snake proximal renal tubules. Model for PAH applies to distal-proximal tubule only. Model for urate applies to entire proximal tubule. Circles and solid arrows indicate active transport. Broken arrows indicate passive fluxes. Bars in upper part of figure indicate mean PAH and urate concentrations in bath, cell water, and tubule fluid at end of perfusion period. Vertical lines indicate SE. Figures in parentheses indicate number of tubules. Apparent PAH and urate permeabilities for luminal membrane (P_L) and peritubular membrane (P_P) are also shown. Figure is redrawn with additions from models published previously (7,8).

In the case of both organic acids, the removal of potassium from the bathing medium led to a reduction in net transepithelial transport to about 30% of control ($p<0.001$). This depression was reversible even after 60 min when potassium was restored to the bathing medium. The cell water concentration of the organic acids during perfusion in potassium-free medium was measured at the time of maximum depression of transepithelial transport. This is shown for urate in Fig. 5, in which the model for transport in the absence of potassium is compared with the control model in the presence of potassium. At the time of maximum depression of urate transport, the concentration of urate in the cell water was less than that in the bath but greater than that in the tubule lumen. These findings suggest that, in the absence of potassium, active transport is eliminated and urate moves from bath to lumen by a purely passive process as shown in the model. The apparent transepithelial permeability for urate (1.95 ± 0.39 x 10^{-5} cm sec^{-1}; mean ± SE for 11 tubules) (13), calculated assuming passive diffusion from bath to lumen, was not different from that determined from the passive efflux from lumen to bath. Thus, removal of potassium from the bathing medium does not appear to alter the transepithelial permeability for urate and it appears likely that some urate moves between the cells. This is indicated by the broken arrow and question mark.

A similar model for PAH transport in potassium-free medium is shown in Fig. 6. At the time of maximum depression of PAH transport, the transepithelial transport from bath to lumen was still against a concentration gradient, and the PAH concentration in the cell water, although well below the control level shown, was still greater than that in bath or lumen. This is compatible with a depression, but not complete elimination, of the transport system as shown in the model. As can be seen, the apparent luminal and peritubular

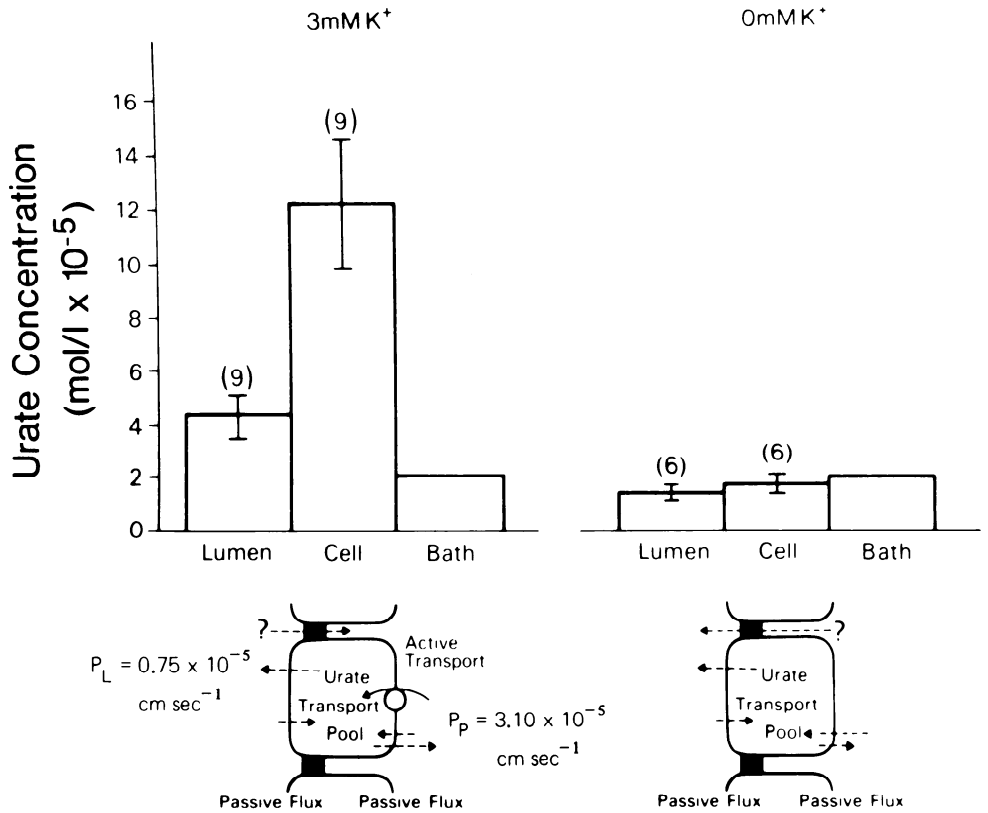


Fig. 5. Models for urate transport across snake proximal renal tubules in bathing media containing 3 mmol/l or 0 mmol/l potassium. Legend for symbols is same as for Fig. 4. Size of circles indicates relative effectiveness of active transport step at peritubular membrane. Models have been published previously (7,9,11).

membrane permeabilities in potassium-free medium were unchanged from the control values. These findings are also compatible with the model shown. Moreover, the lack of an increase in the peritubular membrane permeability indicates that the reduced intracellular PAH concentration did not result from a more rapid leak of PAH back into the bath across the peritubular membrane. Although the dependence of the uphill transport step at the peritubular side of the cells on the presence of potassium in the bathing medium is apparent for both urate and PAH, the mechanism involved in this dependence is not yet clear.

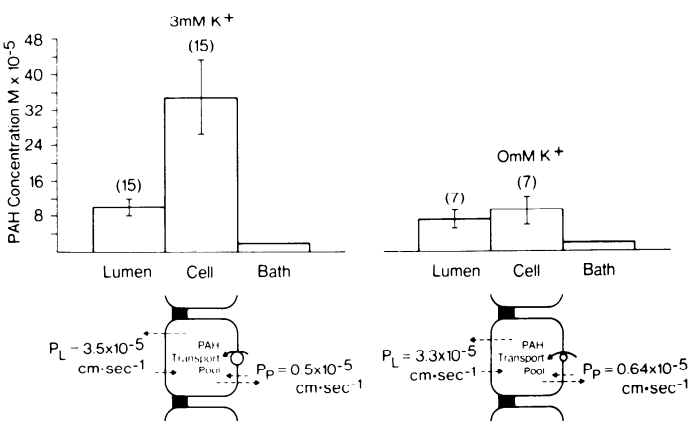
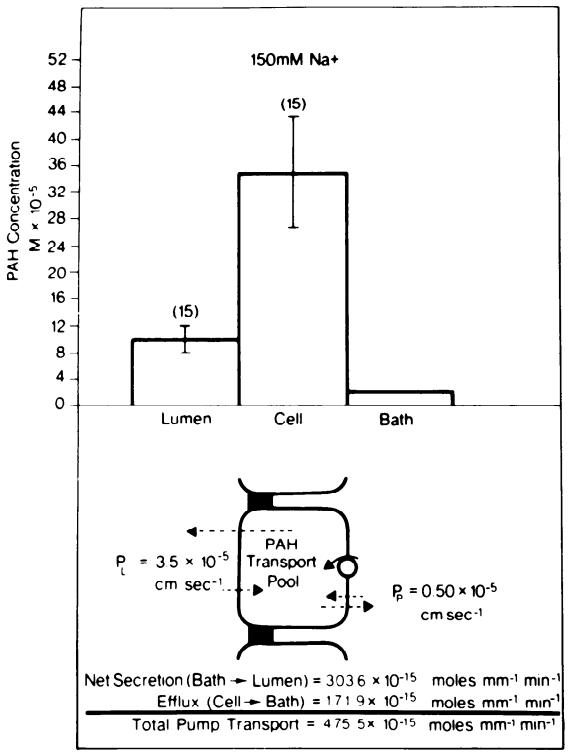


Fig. 6. Models for PAH transport across snake distal-proximal renal tubules in bathing media containing 3 mmol/l or 0 mmol/l potassium. Legend for symbols is same as for Fig. 4. Size of circles indicates relative effectiveness of active transport step at peritubular membrane. Models have been published previously (7,9,11).

In the case of urate transport, dependence on the presence of potassium cannot be related secondarily to the transport of sodium. Nor can the transport of urate into the cells be dependent on any form of coupled transport involving sodium. Replacing all the sodium in both the bathing medium and perfusion fluid with choline had no effect on the net transepithelial transport of urate (13).

However, this is not the case for PAH. Replacing all the sodium in the bathing medium with choline led to a depression of net transepithelial PAH transport to about 20% of control. This effect was reversible even after 50 min. The concentration of PAH in the cell water was measured at the time of maximum depression of transepithelial PAH transport. This is shown in Fig. 7 in which the model for PAH transport in the absence of sodium is compared with the control model in the presence of sodium. In the absence of sodium, PAH transport still occurred from bath to lumen against a slight concentration gradient. At this time the mean concentration of PAH in the cell water was greater than that in the bath or lumen, but it was markedly reduced from the control level. These data suggest that, even in the absence of sodium, transport occurs from bath to lumen by a process of active uptake into the cells at the peritubular membrane and passive movement into the lumen. The apparent permeability of the luminal membrane was not different from the control value. However, the apparent permeability of the peritubular membrane was double the control value. This change was statistically significant ($p<0.02$). If we calculate the efflux across this membrane that could occur at steady-state and compare it with the control value, we can see that, although it is less than the control value, it makes up more than 50% of the estimated minimum total transport compared to about 36% in the con-



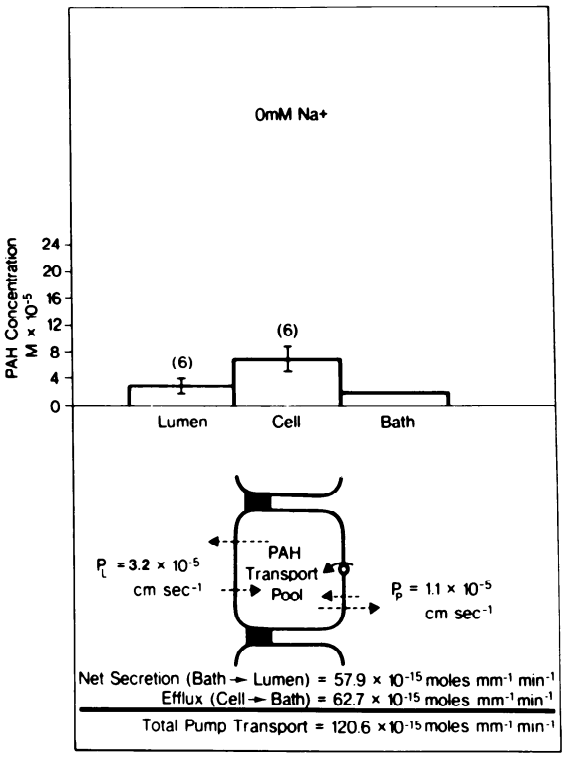


Fig. 7. Models for PAH transport across snake distal-proximal renal tubules in bathing media containing 150 mmol/l or 0 mM/l sodium. Legend for symbols is same as in Fig. 4. Size of circles indicates relative effectiveness of active transport step. Measured values for net PAH secretion and estimates of PAH efflux from cells to bath and of total pump transport are shown at bottom of figure. Models have been published previously (12).

trol situation. It appears that the rate of active transport is reduced in sodium-free medium, but that the increased permeability of the peritubular membrane leads to an even lower net rate of transport and intracellular PAH concentration than would be observed otherwise.

2. *Transport step at the luminal side of the cells.* This step, which is down an electrochemical gradient, may still be mediated in some fashion. However, it does not appear that the transport of sodium influences this transport step for either urate or PAH. As noted earlier, replacing all the sodium in both the bathing medium and perfusion fluid with choline had no effect on the net transepithelial transport of urate (13). Replacing the sodium in the perfusion fluid alone with choline had no effect on net transepithelial transport of PAH (12). However, in these PAH experiments, sodium in the bathing medium may have diffused into the lumen so rapidly that the sodium concentration in the lumen was always too high to cause a reduction in PAH transport. Replacing the sodium in the bath as well as the perfusate with choline caused a marked decrease in net transepithelial transport. Since removal of sodium from the bathing medium alone markedly depresses net transepithelial transport, it was impossible to determine if there was an additonal effect on net transepithelial transport of removing sodium from the perfusate. However, the apparent permeability of the luminal membrane to PAH when sodium was absent from both the perfusate and bathing medium was unchanged from the control value (about 3.2 x 10^{-5} cm sec $^{-1}$), indicating that sodium does not influence PAH transport across this membrane (12).

If the movement of these organic acids from cells to lumen across the luminal membrane is mediated in some fashion, such mediated steps might be inhibited by pharmacologic agents which are known to inhibit organic acid transport. Therefore, we examined the effect of probenecid in the lumen on PAH and urate transport. As can be seen in Fig. 8, 0.1 mmol/l probenecid in the lumen rapidly and reversibly inhibited net transepithelial PAH transport. However, it had no effect on net transepithelial urate transport. The effect, or lack of effect, at the luminal membrane can be seen more quantitatively from the apparent permeabilities (Table 2). The apparent permeability of the luminal membrane to PAH was markedly reduced in the presence of 0.1 mmol/l probenecid while that to urate was not affected. These data suggest that the movement of PAH across the luminal membrane is, indeed, mediated in some fashion and that such mediated transport is inhibited by the same inhibitor which inhibits transport from the peritubular side. On the other hand, urate movement across the luminal membrane is not inhibited by the same inhibitor which inhibits transport from the peritubular side and may be a completely passive process.

Table 2. Effects of Substrates and Probenecid in Lumen on Luminal Membrane Permeability (P_L)

	P_L cm sec^{-1} x 10^{-5}	
	PAH	Urate
Control	3.50 ± 0.91(15)	0.75 ± 0.18(12)
Probenecid in Lumen 0.1 mmol/l	0.73 ± 0.09(6)	0.65 ± 0.09(4)

Values are means ± SE. Figures in parentheses indicate number of tubules. Control data have been published previously (7,8).

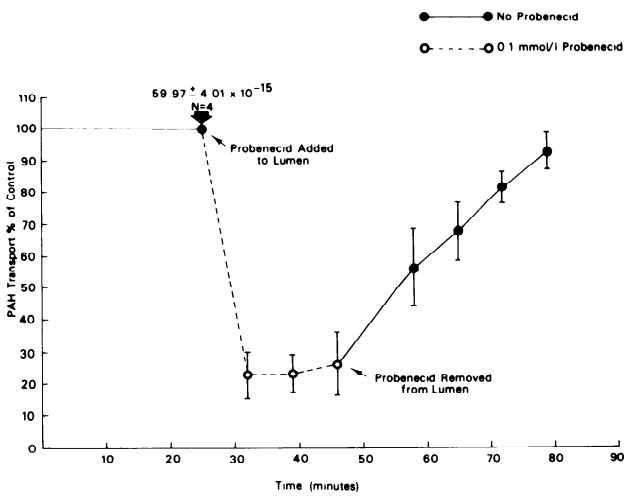


Fig. 8. Effect of probenecid in lumen on net transepithelial transport of PAH. At end of 25 min, perfusion fluid was changed from one containing no probenecid to one containing 0.1 mmol/l probenecid. After tubules had been perfused with fluid containing probenecid for three periods, the perfusate was again changed to one that was free of probenecid. Values for PAH transport are shown as percents of mean control value for each tubule for first 25 min. Absolute mean rate of PAH transport for all tubules for first 25 min is shown in mol mm^{-1} min^{-1} ± SE. Vertical lines indicate SE.

Since the movement of PAH out of the cells across the luminal membrane is inhibited by low concentrations of probenecid, it appeared likely that under these circumstances the cell water concentration of PAH would increase to a concentration higher than that observed during control transport. However, the concentration of PAH attained in the cells with probenecid in the lumen was strikingly less than that observed under control conditons (Table 3). There is no evidence of significant cellular binding in the control cells and these differences appear to be real. Therefore, these data suggest that when PAH movement out of the cells across the luminal membrane is inhibited there may be some form of feedback which reduces uptake at the peritubular side. This may be an electrical phenomenon resulting from restriction to the movement of anions across the luminal membrane or it may be a more specific control mechanism.

Table 3. PAH Concentration in Cell Water $[PAH]_{Cell}$

	$[PAH]_{Cell}$ mol/l x 10^{-5}
Control	34.81 ± 8.33(15)
Probenecid in Lumen 0.1 mmol/l	6.53 ± 0.67(6)

Values are means ± SE. Figures in parentheses indicate number of tubules. Control data have been published previously (8).

Current Transport Models

Our current tentative cellular models for PAH and urate transport are summarized in Fig. 9. 1) Both PAH and urate appear to be transported against an electrochemical gradient into the cells across the peritubular membrane. In both cases this step is dependent on the presence of potassium in the bathing medium. In the case of PAH, this step also requires the presence of sodium. However, the absence of sodium both depresses the uptake of PAH and increases the backleak of PAH from the cells. It is not clear whether this uptake step is coupled in some direct fashion to sodium movement. However, I am inclined to view the transport step for PAH as a primary one with the effect of sodium being a secondary effect. In any case, sodium is not required for urate uptake at the peritubular side. 2) PAH apparently moves from cell to lumen down an electrochemical gradient by some mediated step. Interference with this step also appears to reduce PAH uptake across the peritubular membrane. Urate movement from cell to lumen is not readily inhibited by probenecid and may be completely passive. 3) Urate transport is characterized by a significant backleak from lumen to bath, which may occur between the cells, and PAH transport is not.

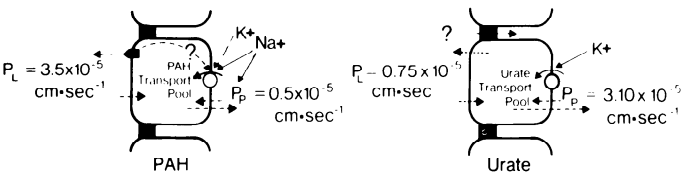


Fig. 9. Current models for PAH and urate transport by snake proximal renal tubules. Model for PAH applies to distal-proximal tubule only. Model for urate applies to entire proximal tubule. Most of legend for symbols is same as for Fig. 4. Arrows from Na^+ and K^+ indicate sites of effects. Thick solid arrow on top of broken arrow indicates mediated movement for PAH across luminal membrane. Broken arrow with question mark leading from luminal to peritubular PAH transport steps indicates possible feedback.

ACKNOWLEDGEMENTS

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REPORT OF THE NATIONAL HEART, LUNG, AND BLOOD ADVISORY COUNCIL

The report of the National Heart, Lung, and Blood Advisory Council of the National Institutes of Health is an independent report from the Council to the President and the Congress describing in non-technical language the recent progress of the program objectives of the National Heart, Lung, and Blood Institute. The Report highlights the gratifying decline in mortality from cardiovascular diseases as strong evidence that basic and clinical biomedical research, when applied to the prevention and control of disease through demonstration, education, and technical assistance programs, brings relief from human suffering and a reduction in the demands on medical care. The Council recommends to the President and the Congress that expanded federal support be given for research into the basic biological processes of the heart, blood vessels, lungs and blood.

The Report is available from the Public Inquiries and Reports Branch, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, Maryland 20014.

AN INVENTORY OF PROGRAMS IN SCIENCE AND MATHEMATICS FOR WOMEN

a project of
The Office of Opportunities in Science of
The American Association for the Advancement of Science
supported by
The National Science Foundation

This inventory will be concerned with efforts made between 1966 and the present to improve the natural science and mathematics education of girls and women in the United States and to increase their participation in mathematics and science-related careers. For purposes of this project, natural science will include the biological and physical sciences, interdisciplinary and problem-centered efforts in these fields, applied sciences, and engineering. Only medical and health fields will be excluded. All levels of science and mathematics education will be surveyed.

The kinds of efforts to be incorporated will include provision of career information, improvement of mathematics or science counseling, innovations in science and mathematics curricula directed toward women, new methods of teaching science and mathematics to women, recruitment of women into science education programs, assistance to women with degrees to reenter the workforce, major institutional changes involving some combination of all these approaches, and research studies related to the participation of women in science. Features of special interest to minority and handicapped women will be highlighted.

The inventory, which will be widely distributed, is expected to be useful to the National Science Foundation and to other organizations for planning and policy purposes. In a preface to the inventory proper, a short analytical section will interpret and make use of the insight and information accumulated in the process of compiling the inventory.

The inventory will be compiled by the staff of the Office of Opportunities in Science and will be completed in late spring 1979. An analogous effort resulted in the 1976 publication of *Programs in Science for Minority Students 1960-1975,* which included 325 entries. An inventory of science education programs for handicapped students is also underway.

The staff members of this project welcome suggestions of programs that might be included in the inventory. Please forward names and addresses of institutions and persons who should be contacted to:

Dr. Michele L. Aldrich
Inventory of Women's Programs, OOS-AAAS
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Telephone inquiries can be called to (202) 467-5431
(TTY (202) 467-4497)

THE DEPARTMENT OF PHYSIOLOGY
UNIVERSITY OF SASKATCHEWAN

L. B. Jaques

The Canadian Prairies were the last large area of settlement in North America. This occurred in the first decade of the 20th century to constitute the Northern Frontier of settlement and development. The University of Saskatchewan similarly represented the last of the state supported universities recognized and established before World War I. Its character, program, successes, and problems have then reflected to a considerable degree, those of sister universities in the American midwest and farther west, modified by an extreme climate and Canadian culture and social practices. The province of Saskatchewan was established in 1905 and the legislature passed an act in April 1907 establishing the University of Saskatchewan. The organization of the university proceeded sufficiently rapidly that the first students were admitted in September 1909. The campus is situated on the South Saskatchewan River and is large enough to accommodate a large College of Agriculture, College of Veterinary Medicine, the Colleges in the Health Sciences – Medicine, Pharmacy and Nursing etc., and the colleges of Arts and Science, Law, Education, etc. As stated by Professor Carlyle King (The First 50 Years) McLelland the Stewart Limited 1959, Toronto "that this impressive establishment of higher learning in a northern latitude of a prairie region has come to *be,* within 50 years, is a miracle. . . . . The University has grown spectacularly out of the soil of the Province, from the sweat and toil of those who have made the grain to grow in this soil". The first faculties established were those of Arts and Science, Agriculture and Law.

The beginnings of the College of Medicine was the establishment in 1926 of a School of Medical Sciences under the wing of the College of Arts and Science and the establishment of the departments of Physiology and Anatomy. For 30 years the students of Saskatchewan took their Arts and pre-clinical training in the School of Medical Sciences, completing their medical training by spending the clinical years at other medical schools. With the building of the University Hospital on campus in 1956, the full medical course was instituted. From the beginning, physiology has been a University subject with the department teaching all students of colleges requiring the subject. The initial students were in the College of Arts and Science at the University and nursing students in schools attached to the Saskatoon city hospitals (St. Paul's, Saskatoon City Hospital). Physiology was one of the required subjects for the four year course in pharmacy from 1921. All pharmacy students were required to take physiology from 1936. The first university course for medical clinical laboratory technicians was organized and established for the students in 1945. Other groups of students who had programs organized more recently were those from the schools of Physical Education and Physiotherapy. Veterinary physiology has been the responsibility of a separate department of physiology in the College of Veterinary Medicine since its opening in 1965.

The responsibility of the department for teaching physiology to nursing students has varied. As indicated above, this was an early responsibility for the hospitals in the city of Saskatoon. The University School of Nursing was organized in 1938. The teaching of physiology to nursing students in the hospitals was the responsibility of nursing instructors in the hospitals from 1940 to 1952. Then from 1952 to 1962, the hospital nursing students for the whole province of Saskatchewan spent an initial year at the University for instruction in medical sciences including physiology. This meant an increase of students to about 200 students twice a year for this period. Then in 1962 the teaching of medical sciences to the non-degree nursing students was transferred to new junior colleges (of Applied Arts and Sciences).

Canada entered World War II against Germany in August 1939. In 1941, as a war measure, Canadian Medical Schools were instructed to accelerate their teaching program to one and one third academic years per calendar year. The major problem for Saskatchewan students was that at some medical schools with the shifts in time tabling, they were expected to have taken pharmacology. Pharmacology was then added to the curriculum at Saskatchewan and given by visiting professors from 1943 to 1949. The department was then combined into the department of Physiology and Pharmacology and only in 1969, with new space finally available was it separated into separate departments of physiology and of pharmacology.

The department has occupied different buildings and increased its space with each move, although always fulfilling the corollary of Parkinson's Law that space is never adequate for a unit which has an active function. When President Walter Murray established the departments of Physiology and Anatomy in 1925, there was no visible space available for these new departments. When asked where they could be housed temporarily, he stated "in the green houses". Figure 1 shows a photograph of a class of medical students with Professor John Fiddes, (the second professor of physiology) demonstrating the well-known Langendorff perfusion of the rabbit heart with a kymograph tracing. In 1936 the department was promoted to the end of a hall in a new wing of the Field Husbandry Building. In 1949 the department then moved into its own quarters in the Medical Building that had just been finished. This building was enlarged to a Health Sciences Building in 1969, when the department of Physiology moved into the new space and the department of Pharmacology occupied the space vacated by the joint departments.

The first professor of Physiology of the University of Saskatchewan was D.J.M. Scott, M.A., M.D., Ph.D., appointed in 1925. Dr. Scott was a pupil of Lovett-Evans, University College, London and worked particularly on physiology of nerve. After his premature death in 1930, he was succeeded by John Fiddes, M.B., Ch.B., M.D. Dr. Fiddes was an Aberdonian. Dr. Fiddes had lived a very adventurous life. He had gone to sea as an apprentice on the sailing ship, the Strathdon, at the age of 15 in 1898 and sailed around the Horn and back. He remained in the Merchant Navy and qualified for the rare combination of Master's papers in both sail and steam. At the age of 29 he entered Aberdeen University in 1912 and was completing anatomy and physiology when the First World War broke out. He then returned to the Royal Navy as a Lieutenant in the Royal Naval Reserve. He returned to his medical studies in early 1918 and graduated M.B., Ch.B., at the University of Aberdeen in 1919. After 4 years in general practice in England and Scotland, Dr. Fiddes returned to the University of Aberdeen as Carnegie Teaching Fellow and assistant to Professor McWilliam. He spent three years teaching and instructing in practical physiology, biochemistry and histology and graduated M.D. receiving the thesis gold medal. In 1926 he went to the new institute for medical research in Melbourne,

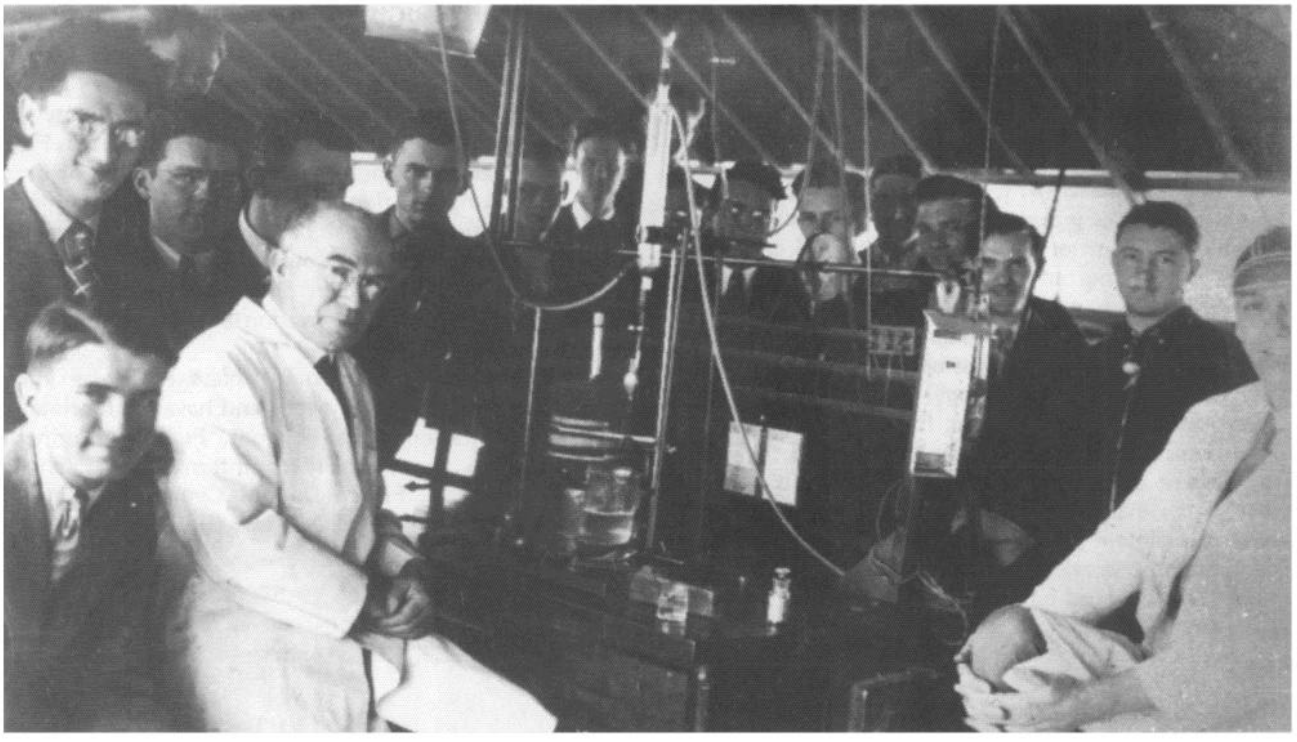

Fig. 1. The Class in Medical Physiology, University of Saskatchewan, with Professor John Fiddes, 1936.

Australia (the Baker Institute) as pathologist. Dr. Fiddes was appointed in succession to Dr. Scott in 1930 as Professor of Physiology at the University of Saskatchewan. In the time between Dr. Fiddes' appointment and arrival in Saskatchewan, the world-wide depression hit and as a result the infant school of medical sciences had a desperate struggle to survive. By 1935 it looked as if it would be necessary to close the school. However, consultation with the graduates assured President Murray that only the existence of the School of Medical Sciences had made it possible for them to pursue their studies in medicine, so the school was kept open on a very much reduced budget. It was fortunate that Dr. Scott, in 1925, in organizing the department, had obtained a good stock of well built sturdy equipment for physiology from W. H. Palmer, of London and this made it possible with a minimum amount of supplies (chiefly frogs) to maintain the teaching program. Dr. Fiddes successfully weathered the severities of drought and the severities of War on the Prairies. He retired in 1946 and was succeeded by Dr. Louis B. Jaques.

Dr. Jaques was a pupil of Dr. Charles Best, University of Toronto. At the age of 35, his main work had been with regard to the development and investigation of heparin. His appointment was planned by President J. S. Thompson to increase the research abilities of the School of Medical Sciences. The staff in the Department was doubled by the appointment of an instructor, G. J. Millar, who was a pupil of Dr. D. Y. Solandt, Professor of Physiological Hygiene, University of Toronto. The department was increased to three by the appointment of Dr. Duncan E. Hutcheon in 1950 as an associate professor of pharmacology. Dr. Hutcheon remained three years. This remained the size of the department till 1967/68, when in preparation for separation into the department of pharmacology, additional appointments were made in pharmacology, Dr. D. D. Johnson and Dr. Robert Hickie. Dr. Jaques stepped down as head of the department of physiology June 30, 1971 and Dr. Millar was appointed as Acting Head of the Department. In January 1972, Dr. Jaques was appointed the first W. S. Lindsay Professor of the College of Medicine. Such appointments are equivalent to distinguished professorship appointments. The professorship is named in honour of the first Dean of the School of Medical Sciences (College of Medicine) with whom Dr. Jaques was associated for many years.

Dr. John W. Phillis was appointed Professor and Head of the Department of Physiology, July 1st, 1973, so the department again was headed by a Neurophysiologist. Dr. Phillis graduated from the University of Sydney in Veterinary Sciences and studied neurophysiology under Dr. R. Curtis at the Australian National University in Canberra in Sir John Eccles' department. He was successively on the staff in Physiology at Monash University, Melbourne, Indiana and the University of Manitoba and has devoted his talents to fundamental problems of identifying and establishing the mode of action of synaptic transmitters in the central nervous sytem.

The Department of Physiology has served the University of Saskatchewan for over 50 years (1978). In this time it has experienced many changes. These have reflected similar changes in other Universities in North America and changes in the economy of Canada as a whole. Some of the problems have been intensified because of the situation of a new small university growing and developing in a small rural society (a state with a population of only 800,000) with until recently a single economy (wheat farming) and a Depression and a severe drought. The significant features of successive periods for the department can be indicated. Under Dr. Scott the department was established with a skeleton staff and a good stock of quality physiology equipment (manufactured by Palmer & Sons Limited, London). During Dr. Fiddes' tenure, extreme financial stringencies were encountered and at the same time an increased number of teaching responsibilities in terms of small groups of paramedical and Arts students taking physi-

ology. Hence, the teaching program continued on essentially a tutorial basis to small groups. With the end of World War II in 1945/46, there was a tremendous increase in student registration in all these classes so that during Dr. Jaques' Professorship there was a very large student registration but relatively little increase in faculty. As for most departments of physiology in North America, from 1946-1971, the teaching program consisted of lectures to large groups and an extensive class laboratory program dependent on a group of devoted graduate student instructors supported by extramural research grants. After 1971, a marked expansion occurred in faculty with a concomitant decrease in graduate students to provide instructors. Hence, laboratory instruction has been gradually replaced (as in other departments of physiology) by smaller group instruction, computer programming, etc. It is evident then that even for the department of Physiology in this young University, there has been change with each decade and each generation. However, the overall problem for Universities and their Departments to maintain a balance in meeting the immediate demands and support provided by society, while maintaining long term goals, has changed but little.

FULBRIGHT AWARDS IN BIOLOGY

The Council for International Exchange of Scholars is now reviewing applications received during the past few months for the 1979-80 program year. Recommendations will be made to the Board of Foreign Scholarships and to the overseas Fulbright agencies. Meanwhile, the Council has extended some deadlines and is accepting additional applications in Biology until adequate nomination panels can be assembled: **Argentina** (Spanish essential); plant evolution; **Colombia** (Spanish essential) junior lectureships; **Nigeria:** human physiology or cell biology and radiation; **Sri Lanka:** conservation and environment; **Sudan:** physiology.

All awards are for teaching unless otherwise indicated. Applicants must be U.S. citizens and have appropriate educational or professional qualifications. Further information is available from the Council for International Exchange of Scholars, Dept. N, Eleven Dupont Circle, Washington, D.C. 20036. Scholars may register for 1980-81 announcements at any time.

VII INTERNATIONAL CONGRESS OF LYMPHOLOGY

The VII International Congress of Lymphology will be held in Florence, Italy, October 28 - November 2, 1979 at the Palazzo dei Congressi. Two post-graduate courses on Lymphoedemas and Hodgkin disease will be organized. For more information please contact: Organizing Secretariat: O.I.C., Organizzazione Internazionale Congressi, Via dei Bardi 52, 50125 Florence, Italy.

DANFORTH GRADUATE FELLOWSHIPS

The Danforth Graduate Fellowships give financial support and personal encouragement to selected persons who are committed to study for a Ph.D. and to careers in college or university teaching in subject-matter specializations likely to be taught in an undergraduate liberal arts curriculum.

The Program offers approximately 100-110 Fellowships, with 25 percent of the awards expected to go to Blacks, Mexican-Americans, Native Americans (including American Indians, Eskimos, Aleuts, and Native Hawaiians), and Puerto Ricans, and with the remainder of the Fellowships available to persons from any racial or ethnic group.

Applicants may be either college seniors or Ph.D. students. Applicants must be citizens of the United States or give evidence of holding a permanent residence visa. Fellows are expected to study full-time at an accredited university in the United States, beginning in the Fall of 1979. Persons working for a second doctorate and all postdoctoral candidates are ineligible. The Fellowship is for one year. It is renewable, assuming satisfactory progress toward the degree and loyalty to the purposes of the Program, for up to a total of four years. The maximum stipends for Fellows are: Single, or married with no children, $2500; Married, or head of household, with one child, $3500; the stipend is increased by $400 for each additional child.

Write to the Danforth Graduate Fellowship Program, Danforth Foundation, 222 South Central Ave., St. Louis, MO 63105.

VA SCHOLARS PROGRAM

The Veterans Administration is sponsoring a special program to prepare outstanding individuals to assume leadership roles within the health care system. The Program is known as the VA Administrative Scholars Program and is open to all qualified individuals from health and health related professions. Each year five individuals are selected for a 2-4 year scholarship. Financial support will equal present compensation up to the limit of the civil service scale.

Program content is largely determined by the Scholars, who create their own self-directed plans dealing with major health care issues. The Program has been in operation for one year, with five scholars currently in residence. A second class has been selected, and will start in September 1978. Applications are now being solicited for the 1979 program year. Due date is November 1, 1978.

Competition is national in scope, and to date has been very rigorous. Contact Harrison Owen, Veterans Administration, Dept. of Medicine & Surgery, Washington, D.C. 20420 or call (202) 389-3588.

INSTRUCTIONS FOR APPLYING FOR APS MEMBERSHIP

At the April 1977 business meeting the proposed Bylaws Amendment for creating a new membership category for Students was passed. This Bylaw Amendment appears under Section 7 of Article III of the Constitution, printed below.

CURRENT APPLICATION FORMS

Published in each issue, the Physiologist shall 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 returned to the sponsor to 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, 1970.

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.

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. Graduate students in physiology who have completed their preliminary examinations for the doctoral degree provided they are residents of North America. No individual may remain in this category for more than five years.

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.

This Form is Valid Only for 1978

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 _____ Birth Date: _____

Address _____ 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** (Predoctoral students indicate date preliminary examination was passed.)

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: _____ #2. Name: _____

Mailing Address: _____ Mailing Address: _____

_____ _____

_____ _____

_____ _____

Telephone No. Zip Code 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.

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.

Sibley Hoobler to Hy Mayerson:

I am pleased to be added to your list of retired members of the American Physiological Society. I left the Department of Medicine, University of Michigan, one year ago and have transferred to Cleveland where I engage in some part-time physiological research relating to hypertension. This is at the Cleveland Clinic Foundation where I am fortunate enough to have a small laboratory so that I can keep on going. I hope I will continue to be moderately productive. One of my special pleasures has been to audit courses at the University which I had always hoped to take when I was an undergraduate but never quite made it. These have proved very stimulating and enjoyable. As you can see, my beginning retirement has been most happy and I hope it will continue to be so.

Emil Bozler to Edward Adolph:

I always enjoy hearing from my old colleagues in *The Physiologist.* So I follow your kind invitation to report on my activities. Thanks to the friendly attitude of the chairman, and the administration in general, I can continue experimental work and I enjoy it more than ever. Recent events, an honorary doctor of science from this university (Ohio State) and an NIH grant, which will expire when I shall be almost 80 years old, help to maintain my enthusiasm. In this age of increasing specialization, I am probably the only physiologist who works on more than one type of muscle. Successes which I may have had, are largely due to this approach. I feel that vigorous physical and mental activity can prevent, or at least delay, many common ailments of old age.

Albert S. Gordon to Edward:

I began teaching and pursuing research here at New York University in the Fall of 1931. My sponsor for the M.S. and Ph.D. degrees in biology was Dr. Eric Pondor, an international authority on the red blood cell. At present I hold the title of Research Professor Emeritus and am still actively engaged, with approximately ten graduate students and associates, in continuing my studies on the humoral regulation of blood cell production. As you will note my laboratory has been named after me, A. S. Gordon Laboratory of Experimental Hematology (better now than posthumously!).

I give several lectures in a graduate course in basic experimental hematology that I helped to organize several years ago. I might also state that, up to the present time, I have sponsored approximately 85 students for the Ph.D. degree and 102 for the M.S. degree in biology for the 40 years of my academic life at New York University. I am also presently engaged as a Co-Editor of an annual monographic series entitled "The Year in Hematology." It is my intention also to produce a second edition of my 2-volume monograph on "Regulation of Hematopoiesis." I will continue to remain active in research and teaching as long as the opportunities are available and as my mental and physical capacities permit me to do so.

Herbert Elftman to Edward:

Your letter brings back pleasant memories of the sabbatical I enjoyed at Rochester almost a third of a century ago.

Six years ago I retired from Columbia University as Professor Emeritus of Anatomy. Simultaneously my wife achieved similar retirement from the Biology Department of Lehman College of the City University of New York. We both felt that when the whistle blows the game is over and the field should be left unencumbered for the new generation.

We were therefore free to trade the snow and sleet of New York for the friendly fog of the San Francisco Bay region. From our home in Mill Valley our outlook includes Mount Tamalpais, The Diablos, the Berkeley Campus of U.C. and Lick Observatory on Mount Hamilton. We have named our location Snailspace, in honor of its native inhabitants and the way of life they taught us.

My research in muscle physiology continues, but on a more personal basis. The new laboratory is surrounded by redwoods and is designed for EMG, which here means Early Morning Golf. We miss the cultural stimulation of New York City but find enough here to keep occupied.

One benefit of retirement is increased time for travel. We have been around the world three times so far and have visited remote corners of all the continents except Antarctica. One of our central interests has been routes of migration, including the Rhine and the Danube, the Serengeti Plains, oil across Alaska from Prudhoe Bay, Alexander the Great and Genghis Khan across Asia. Most thrilling of all was following Major Powell by raft through the Grand Canyon on the Colorado River.

I hope that you and yours are enjoying yourselves as much as we are.

M. C. Shelesnyak to Edward:

All I'm saying at this writing is that I am at the APS Headquarters, where I spend two days a week examining Society archives and preplanning for our Society Centennial in 1987. But, in view of no formal action by Council as yet, I'll be back in touch before too long.

William E. Stone to Edward:

I am happy to report that my health remains excellent; I chose to go on retirement status in 1976 at age 65 (rather than to hold on until 70) in order to devote more time and effort to research. I am grateful to the Department of Physiology here at the University of Wisconsin for providing adequate laboratory and office space and other facilities. My present project, in collaboration with Dr. M. J. Javid of our Division of Neurological Surgery, is a study of anticonvulsant drugs as antagonists of dissimilar chemical convulsants. I continue to work almost as many hours per week as in the past, am enjoying it, and am quite content.

As for words of wisdom to younger colleagues, I have only this from Mark Twain: "Always do right. This will gratify some folks, and astonish the rest."

Ts'ai-Fan Yu to Edward:

I am continuing my full-time research in gout. To date, I have been the author or coauthor of 180 papers; also published one book on gout and uric acid metabolism, a chapter on gout and pseudogout in the book of rheumatic diseases edited by Warren Katz, and several papers and chapters in press. I do hope my activities will be continued without abeyance in the near future.

Henry I. Kohn to Edward:

I don't think my news will be of much interest, since I have been outside of the field of physiology for many years and I doubt that anyone would remember me. I am still at the Shields Warren Radiation Laboratory doing research, and have an appointment as Professor of Radiation Biology at the Harvard Medical School. My primary interest is in mutational research — the estimation of the genetic hazard of ionizing radiations and chemicals to the germ line, studies in the mouse, as a model for man.

Howard Rostorfer to Edward:

As you know, Theresa and I retired from Indiana University because of our failing health — she, after years of battling arthritis with drugs and over a dozen surgeries and I, after a right renalectomy and adrenalectomy. Since retirement she has acquired two artificial knees and I have had a colonic resection for carcinoma.

So, we are here on a mountain at an altitude of 2,640 ft. overlooking the Tennessee Valley which was once a very beautiful sight the year round; but, in the last ten years it has turned into a smog-filled, remote place we seldom see in the summer time. The cause of the terrible change is the eleven million tourists and their automobiles that come to the Great Smoky National Park (I mean Gatlinburg and its hundreds of tourist traps) between the months of June and October.

Of course, I miss teaching, research, Indiana University and my colleagues, but I enjoy living here in the woods. I have time to read, and rather than work cross-word puzzles, I have been working calculus problems, which is much more fun. The only trouble is trying to get to sleep when I have been unable to solve a problem.

Since I have always been a teacher, I have continued the activity with a class of chipmunks. At first I thought they were disadvantaged individuals but they soon proved me wrong. The class consists of various experiments designed to study the limit of intelligence, physical ability and endurance, even fatigue. Chipmunks learned quickly to get to and into my bird-feeder which they occupied to such an extent the birds had little chance to get to the tray to eat what few sunflower seeds were left. The tray was in a small hickory tree about half-way up the trunk. In order to turn off the chipmunks and give the birds a chance, I formed a strip of aluminum metal around the trunk in the form of an inverted funnel. The chipmunks crowded under the funnel but they could get no farther. They spent much time peering from under the funnel. I decided this was an unfair test of my class. I suspended the feeding tray from a limb so the distance from the trunk under the funnel to the tray was about right for an athletic chipmunk to leap to the tray. Having done this, I retired to a window to watch. Very soon the munks crowded under the funnel to study the situation. Then they went down and sat on the stone wall under the tree to contemplate. After a while one of them went up under the funnel, measured the distance, developed a maximum angular velocity and cast himself into the greater space. He just missed. He returned to the stone wall for a few minutes and then tried again. This time he did not do quite as well. He repeated the performance 17 times in ten minutes. The paths of his body through space were a series of die-away curves, each lower than the previous effort with the last a simple jump into the woods. After this, all the chipmunks sat on the wall, a picture of dejection. If the brightest guy in class could not get it, what chance had they.

This all indicates chipmunks are intelligent if one measures them in context of their experience, which is true of us all.

The trouble with retirement is there is too much to do, even for those of us who cannot travel but who only sit and think. There is too much to know and one is driven to know more and more. I wish you continued good health and I thank you for your interest and friendship throughout the years.

Marcel Verzeano to Edward:

I am still pursuing my research on the electrical activity of the brain in relation to perception and memory. I am also conducting a research program on changes in evoked potentials related to disorders of the nervous system. At the present time, I have no plans to leave the University of California.

L. Joe Berry to Edward:

Fortunately, I am fully occupied with research and with scientific writing. I also have a position in the American Society for Microbiology to which I devote considerable time and derive great satisfaction from it. I am Chairman of the Board of Education and Training and am pleased to report that this Society is becoming actively involved in problems of teaching and essentially for the first time in our history. I know that the APS is equally involved, and professional societies in my judgment should not only promote scientific research in their areas but also devote some of their energies and resources to the improvement of the educational process.

Richard L. Riley to Edward:

I retired from Johns Hopkins University at the end of June after 27 years, the last 16 as Chairman of the Department of Environmental Medicine. When I took over, the faculty of the department consisted of Anna Baetjer and John Fales. My first recruit was Solbert Permutt. Our interests in the early days were primarily physiological. The Department has since grown to one of the largest in the School of Hygiene and Public Health, largely through the addition of faculty with skills related to environmental problems. But increasing size and increasing age do not make a congenial mix, and I find a sense of relief in handing over to Gareth Green, a man ideally suited to the current responsibilities of the Department. After a six-month overlap with the Greens, Polly and I sold our house in Baltimore and moved to Petersham, Massachusetts, where relatively simple living is still possible. So far I have been busy finishing papers from the Baltimore era and carrying out the responsibilities of President of the American Thoracic Society.

I am not thrilled by complex experimental techniques, and I view the excesses of our technological society, particularly as applied to medical care, with misgivings. I am content to enjoy the little events of country life, the love of friends and family, and small successes in putting together my Hubbard harpsichord kit.

Nathan Lifson to Edward:

I am thankful to be able to say that my situation is unchanged with respect to last year.

Paul C. Bucy to Edward:

I continue as Editor and Publisher of *Surgical Neurology*. *Surgical Neurology* is an independent, international journal devoted to neurological surgery. It publishes material not only regarding neurological surgery, but regarding research

related to neurological surgery, diagnostic and technical developments, and historical articles. *Surgical Neurology* is now in its ninth volume. We have been delighted with the reception it has received. It now has over 4,100 subscribers, approximately one-third of whom reside outside of the United States and Canada. It publishes material submitted from all parts of the world. This includes approximately 65% from the United States and Canada and 35% from elsewhere in the world.

In addition to my work as Editor and Publisher I rather frequently serve as Visiting Professor at various institutions and participate in various medical and scientific meetings. I serve as a consultant to the National Institutes of Neurological and Communicative Disorders and Stroke.

As you can see, although I have retired from active practice of neurological surgery and no longer am engaged in either doing research or supervising it, I find myself occupied with the neurological field in many ways.

As a "senior member" my advice to those who have not yet retired is to find something in which they are interested to do following retirement.

Willem J. Kolff to Edward:

My title is Professor of Surgery and Research Professor of Engineering. I am Director of the Institute for Biomedical Engineering at the University of Utah.

There is great activity in the Artificial Kidney field. Filtrating Artificial Kidneys are serious competitors for the dialyzers. A closed system Peritoneal Lavage is better for diabetics. We are making all of that wearable. Dialysis of schizophrenics and of patients with exfoliative dermatitis is now indicated on an experimental basis. First results are amazingly promising.

This work is done with:

Dr. Elisabet Thor, Robert L. Stephen and Carl Kablitz.

Dr. Steve Jacobsen and Co-workers designed the Wearable Artificial Kidney.

Drs. U. Shettigar, Don Owen, Donald E. Gregonis, and John M. Walker work on sorbents of urea.

Mr. R. Kirkham coordinates Peritoneal Lavage.

In the Artificial Heart Field, we have had a calf live more than six months; another one, now going more than 100 days, walks one hour on the treadmill without resting. Our aim is to develop a series without mortality. Only then will we be ready for human implantation.

Leaders of this section are:

Dr. Don Olsen, Dr. Jack Kolff, Lee Smith, Dr. Ted Stanley, Dr. Jeffrey Peters, Dr. Robert Jarvik, Dr. Donald Owen, Dr. Joe Andrade, Dr. S. W. Kim, Dennis Coleman, Dr. Kiroyuki Fukumasu, Dr. John Lawson, Dr. Gary Sandquist, Dr. Fumio Iwaya, Steve Nielsen, and Tom Kessler.

Our Artificial Arm is more advanced than any other Artificial Arm. It is lighter, moves faster, can hold a load and is directed by myographic signals.

Leaders of this section are:

Dr. Steve Jacobsen, Richard D. Luntz, Todd Johnson and Dave Knutti.

Our Artificial Eye project has proven the feasibility of stimulating the visual cortex of the brain in one blind man for more than two years. There was no increase in threshold. The blind man sees points of light when the electrodes on the visual cortex are stimulated. Reading of Braille and recognizing a horizontal or black line on a blackboard is possible through direct stimulation of the brain. This program was started in 1969 by Dr. William Dobelle with Dr. Mike Mladejovsky, Dr. J. Girvin (London, Ontario, Canada), Dr. Ted Roberts, Jerry Evans, and with the help of many others. This program is now moving with Dr. William Dobelle to Columbia University in New York City.

Our Artificial Ear program which stimulates the nerve in the cochlea of totally deaf people, will remain at the University of Utah under Dr. Don Eddington. Totally deaf patients when they have an intact nerve, can detect sounds, some pitch and of course rhythm.

Leaders of this section are:

Drs. Don Eddington and Jim Parkin with the help of Derald Brackmann in Los Angeles.

Our Microcircuit Laboratory has the capability of designing and making the newest version of microcircuits. The reduction of original art work which used to be 250,000 times is being reduced further. (The entire King James Bible will now fit on 1/8 of a postage stamp.) I^2L circuits should enter the Medical Field since they are resistant to changes in temperature, have a long life and use very little current.

Leaders in the Microcircuit Laboratory are:

Dr. John Hanson, Dr. Mike Mladejovsky, Don Hill, Kent Smith, and Dr. Robert Huber.

My life is wonderful, because I have such excellent co-workers. I wish that more young physiologists would join us. We offer entirely new approaches to many old problems.

W. C. McNelly to Dr. Dill:

I had a letter from Dr. Adolph on the occasion of my 80th birthday in March 1978.

During the forty years of teaching at Miami University, Oxford, Ohio, I earned a Master of Science in Zoology, 1928 and a Ph.D. in Physiology in 1934. I retired in 1965 at age 67. In 1931 or 1932, I attended the first APS meeting in Philadelphia. I missed not more than six of those annual meetings from 1932 to 1965.

Miami University is sometimes referred to as The Cradle of Coaches. From 1930 to 1965, 95% of these Physical Education students and future coaches were in my classes.

Since retirement, I have maintained my APS membership and keep up with some of the literature. Mrs. McNelly and I have traveled in all of the 50 states and Canada. We have spent 12 of the last 13 winters in Tucson, Arizona. I have become interested in Bench Rest Target Shooting and have four very good target rifles. I still do some finishing and restoring of antique furniture. At age 80 I am not interested in a position that enables me to continue scientific activities. We still feel we are a part of Miami.

* * * *

Irving H. Wagman
1916 – 1977

Irving H. Wagman, Professor of Physiology at the University of California at Davis, died December 13, 1977 following a prolonged illness. Dr. Wagman, who had been a member of the APS since 1946, was a dedicated scientist and teacher and he will be sorely missed by those of us who were fortunate enough to have known him.

A native of New York City, Dr. Wagman received his B.S. degree from CCNY in 1936 and his M.S. (1937) and Ph.D. (1941) degrees in Physiology from the University of California at Berkeley. He began his career as a neurophysiologist at Berkeley where he studied with J. M. D. Olmsted. His early research was on the control of pupil diameter and he continued his studies in vision and occulomotor mechanics for the next twenty years.

During World War II Dr. Wagman participated in classified studies of vision under conditions of low-level illumination with H. K. Hartline in Philadelphia. After the war he joined the faculty of the Jefferson Medical College. In 1954 he moved to the Mount Sinai Hospital in New York City where he became an integral member of the research team, headed by Morris Bender, that established a strong reputation for their studies of the control of eye movements. Wagman's role in these cooperative efforts was recognized by his election to the Harvey Society of New York, the Association for Research in Nervous and Mental Diseases, the American Academy of Neurology and the American Neurological Association. He was especially proud of his membership in the AAN and the ANA because he was one of the few basic scientists to be so recognized by the clinical societies.

In 1961 Dr. Wagman returned to California to join the research faculty at the University of California School of Medicine in San Francisco. His research interests changed at the same time and he became involved in studies of cutaneous sensation and sensorimotor integration. He made his last move, to Davis, in 1965 where he continued his work on somesthesia and somatic reflexes until the time of his death.

When Dr. Wagman moved to Davis he became deeply involved in both undergraduate and graduate teaching. The Department of Animal Physiology was just emerging as a strong undergraduate teaching department (it is still one of the few departments to offer a baccalaureate degree in Physiology) and the interdepartmental Graduate Group in Physiology was being developed under the leadership of Loren Carlson. Wagman was very instrumental in the development of both programs.

The most rewarding experience for Dr. Wagman during his years at Davis was his involvement in the undergraduate teaching program. He worked closely with a small nucleus of dedicated faculty to develop a high-caliber curriculum that included sophisticated laboratory courses and self-paced learning programs to supplement the lecture courses. He challenged the students in a way that few are able to do and he was continually amazed at the enthusiasm with which the students accepted his challenge. The continued increase in the enrollment in these courses has reflected the success of Wagman's efforts to develop a series of high-quality undergraduate courses in Physiology to serve students in all disciplines.

During his twelve years at Davis Dr. Wagman had several students complete their graduate programs under his supervision and he contributed significantly to the programs of many others. He had a unique ability to recognize the individual talents of students and he encouraged them to do what they were best suited for. He set high standards and demanded a total commitment from his students and he succeeded because he expected no less from himself; his own standards served as an example to both his students and his colleagues.

Dr. Wagman had an infectious curiosity about everything around him. To him, science was more than a pursuit of new knowledge. He worked hard to instill in his students an appreciation for the history, the philosophy and the ethics of science and he emphasized the unique obligations that scientists have to society. His strict adherence to his personal and academic principles was demonstrated several times throughout his lifetime, but never more forcefully than in 1953, when he refused to sign the loyalty oath. His decision not only cost him his current position but it also meant that he was to be denied several subsequent opportunities in later years. He never regretted his action, because for him it was impossible to distinguish between personal and professional integrity. He felt strongly that he could not maintain his credibility as a scientist and a teacher if he were to sacrifice his principles in the name of personal expediency.

Dr. Wagman was especially proud of the accomplishments of his family, his students, and his colleagues. He made many friends around the world and he greatly enjoyed the chance to travel so that he could renew old acquaintances. The author was traveling with him to the I.U.P.S. Congress in Paris in 1977 when Dr. Wagman became seriously ill in London and had to return to California without having the chance to see so many of the people that he had looked forward to visiting with. The sadness with which this news was received by his friends at the Congress was a measure of the personal and professional esteem held for him.

Dr. Wagman was preceded in death by his wife, Dorothy, in 1976. He is survived by his children, William, Karen, Daniel and Ann as well as by a large number of students and friends who were also "family" to him.

James A. McMillan
Dept. of Physiology
Montana State University, Bozeman

Note: Dr. McMillan wishes to acknowledge the assistance of the following people in preparation of the memorial:

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Mary Forsling, Middlesex Hospital Medical School, London, England
Ann E. Kammer, Division of Biology, Kansas State University
Executive Editor: M. C. Shelesnyak, A.P.S.

THE PHYSIOLOGY TEACHER

ELECTRICAL RECORDING OF MECHANORECEPTOR ACTIVITY

Ann E. Kammer
Division of Biology, Kansas State University
Manhattan, Kansas 66506

The two main objectives of this experiment are to give beginning physiology students a successful experience with neurophysiological techniques and to demonstrate some properties of sensory neurons. The experiment entails using pin electrodes to record extracellularly from mechanoreceptors in the cockroach leg. The preparation can be set up in less than 30 minutes, if the electrodes and equipment are ready for use. The preparation survives for 2-3 hours, and stimuli can be applied by hand. Because the experiment is so easily performed, a student in the first laboratory session of a neurophysiology class can observe biological responses while learning to operate the equipment. The preparation can also be used as a "hands-on" demonstration in undergraduate human physiology courses. In this context it can be combined with traditional observations on the somatosensory system.

An older version of the experiment has been described previously (Welsh, et al, 1968). Recently, while this manuscript was in preparation, a new and useful description appeared (Oakley & Schafer, 1978). The following account is intended primarily for students in a beginning course in human physiology.

BACKGROUND

The body surface of animals is well supplied with receptors sensitive to tactile stimulation. The distribution of these receptors in human skin can be mapped by touching the skin with a pair of pointed probes separated by different distances. Normally these receptors are stimulated by contact with an object or, in some cases, by movement of an appendage or joint. Movement also stimulates proprioceptors associated with joints and muscles. Receptors that are functionally similar to these human ones are present in insects, particularly in association with tactile hairs, spines, and specialized structures in the cuticle. Each of these receptors has a sensitive ending attached to the cuticle or hair. The receptor cell converts the stimulus, i.e. a mechanical deformation, into electrical signals (nerve impulses) that are conducted along the axon to the CNS. These action potentials can be observed by placing recording electrodes near the sensory nerve. By applying localized stimulation to individual hairs, it is sometimes possible to record the activity of only one sensory neuron.

The following properties of sensory neurons can be demonstrated: (1) the duration of an individual action potential is 1-2 msec; (2) the strength of the stimulus influences the number of impulses per sec; (3) some receptors are phasic, responding only to a change in the stimulus, whereas others are tonic, producing impulses for as long as a steady stimulus is applied; (4) some mechanoreceptors have directional sensitivity.

METHODS

Electrodes are fabricated from fine insect pins (size 00, 000 or minuten-Nadeln). If lacquered pins are used, scrape the insulation off the blunt end by rubbing the pin on fine sandpaper or emery cloth. Three pins are required, two for active electrodes and the third for ground. Solder each pin to one of the light-weight wires in a shielded cable (phono hook-up cable works well). Since soldering to the steel insect pins is usually difficult, wrap the wire tightly around the pin and use plenty of flux. Complete the input cable by attaching connectors appropriate for the preamplifier to be used (e.g., for the Grass P-15 preamplifier solder a pin plug to each wire, or simply coat the end of the wire with solder). Solder the metal shield of the cable to the ground lead at the preamplifier end of the cable. Carefully scrape lacquer off the tips of the two insect pins that are to be used as active leads. A small exposed area facilitates the isolation of single units. Expose a larger area of metal on the third (ground) electrode. Check that the electrical connections between the insect pins and the wires are adequate by touching the tip of the pin to one probe of an ohmmeter while holding the second probe against the connector on the other end of the wire.

The recording equipment consists of a preamplifier with differential input, a single-beam oscilloscope, and an audio monitor connected in parallel with the oscilloscope. The system should have a sensitivity of 100 μV, since most signals will be less than 500 μV in amplitude. (A typical system consists of a Grass P-15 preamplifier with the amplification set at 100-fold, and a oscilloscope set on 10 mV/div.). The band-

pass of the preamplifier is not crucial; set the low frequency cut-off at 30Hz and the high-frequency cut-off at 30-100 KHz. Start with the oscilloscope on automatic sweep, or free-run, with a convenient sweep speed, such as 50 msec per division. The set-up must be well grounded. If there is 60-cycle interference, work in a metal-screen cage, or make a small shielded enclosure from a piece of aluminum foil connected to ground.

Prepare a leg for recording as follows. Remove a metathoracic (last) leg from a large cockroach (*Periplaneta americana* or other species) by cutting through the coxa near the body. Fasten the leg to a small wax-filled dissecting dish by placing pins over the femur (Fig. 1), or by pressing the coxa and femur gently into a depression in the top of a mound of soft wax or modelling clay. The femur must be held firmly in place, while the tibia and tarsus are left free to be touched and moved. Electrode placement can be done free-hand, but may be facilitated by using fine forceps and a dissecting microscope. Insert the ground electrode firmly into the coxa (it can be pushed through into the wax). Arrange the electrode cable so that the tips of the recording electrodes fall against the leg. The weight of the electrodes and the cable will then help hold the electrodes in place. Gently insert the recording electrodes just to one side of the midline of the femur (Fig. 1). Since the leg is narrow and the leg nerve is situated in its center, electrodes so placed are necessarily near the nerve. Be careful that the electrodes do not pass through the leg; the exposed tips of the electrode must be inside the cuticle.

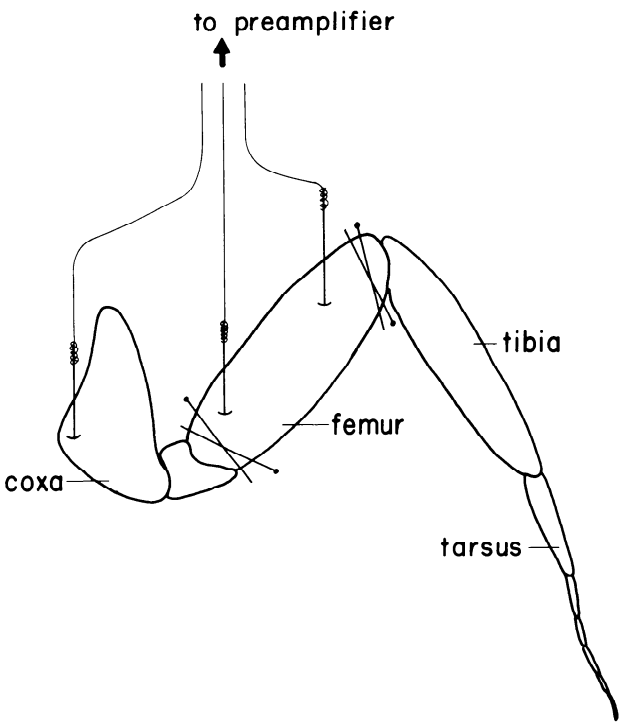

Fig. 1 Diagram of a cockroach leg, showing placement of the electrode. Details such as the tactile spines have been omitted.

Tonic activity may be immediately apparent (Fig. 2A). Brush the tibia and tarsus lightly with a small probe (an insulated insect pin or a glass capillary pulled to narrow tip). When applying stimuli, ground yourself by holding on to the cage or a grounded wire. Action potentials from receptors should be readily obtained. Minor adjustment in electrode position may improve the recording. If no signals are obtained, note the noise level and then remove the recording electrodes from the preparation. The noise with the electrodes in the air should appear larger than when the elctrodes are making good electrical contact with the hemolymph inside the leg. If necessary, scrape the electrode tips again to make sure that metal is exposed, or recheck the connections with the ohmmeter.

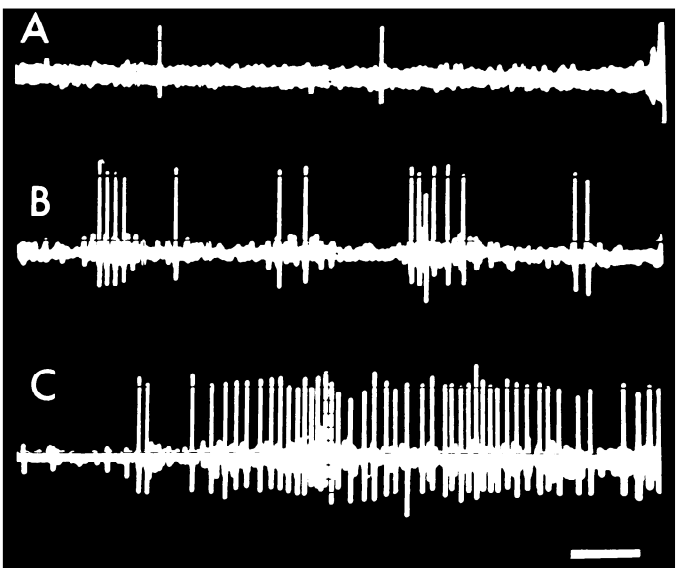

Fig. 2 Typical recordings of mechanoreceptor activity. A, No phasic stimulation; B, stimulation with a hand-held probe; C, stronger stimulation. (Time marks: A, 200 msec, B, C, 50 msec).

OBSERVATIONS

After good electrical contact has been made and action potentials are clearly discernible in the recording, lightly touch various regions of the leg, move the tarsus, and move individual spines on the leg. When a particularly responsive receptor is located, increase the sweep speed to 1 msec/div and measure the duration of the action potential. Calculate a theoretical maximum frequency of firing (number of action potentials per second), and compare it with observed values. Determine the amplitude of the action potential, and compare the observed value with the amplitude expected from intracellular recording from a nerve cell (see textbook). With the extracellular recording technique used here, action potentials from different sensory neurons appear to have different amplitudes, partly because of differences in axon diameters and partly because of position with respect to the recording electrodes.

Return the sweep speed to 50 msec/div and determine the effect of varying the strength of the stimulus or the rate at which the stimulus is applied (Fig. 2B,C). With stimuli delivered by hand, it is possible to demonstrate that a stronger stimulus elicits more action potentials per second, up to a maximum. Quantitative study of spike frequency as a function of stimulus strength requires additional apparatus. Stimulus strength can be measured by mounting a probe on a sensitive isometric transducer, or stimuli can be delivered under electronic control by mounting a probe on a loudspeaker driven by a stimulator (see Oakley and Schafer, 1978).

Compare the effect of repeatedly touching a sensitive spot with the effect of applying steady pressure. A hand-held probe usually is not sufficiently stationary; mounting the

probe on a manipulator will facilitate this experiment. Attempt to record from both phasic and tonic receptors. Determine whether or not a tactile spine or hair is directionally sensitive by determining if different firing frequencies are produced when the hair is deflected to the same extent in different directions.

ADDITIONAL EXPERIMENTS

The preparation has been used to study the effects of temperature on sensory axons (Chapman and Pankhurst, 1967). Developmental studies are possible; functional continuity during the moulting cycle has been demonstrated (Moran, et al. 1976). The preparation has also been used to demonstrate some effects of an anaesthetic, benzocaine, applied as a salve on the surface of the tibia (Kammer, unpublished).

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CHANGES IN EDITORIAL BOARD OF THE PHYSIOLOGY TEACHER

Some changes have recently occurred in the Editorial Board of *The Physiology Teacher*.

Mary Dittbrenner, who has served devotedly as Executive Editor of *The Physiology Teacher* for the last several years, has resigned from APS to accept an educational position in Kenya.

Dr. M. C. Shelesnyak, a Retired Member of the APS who has been assisting with the organization of the Society's archives and who has a distinguished background in editorial activities, has agreed to serve as Executive Editor of The Physiology Teacher Section of *The Physiologist* for the indefinite future.

Dr. Mary Forsling of the Middlesex Hospital Medical School, London, England, U.K. has joined the Board, having been nominated by the Physiological Society. Articles included in the present issue are due to her efforts.

Dr. Ann Kammer of the Department of Biology, Kansas State University, who has given active support to *The Physiology Teacher* has joined the Board.

Dr. Michael Greenberg has resigned from the Board because of his departure from the U.S. on sabbatical.

The Editorial Board urges members of the APS to continue and extend their support in making *The Physiology Teacher* innovative and useful.

CARDIOVASCULAR PHYSIOLOGY FOR FIRST-YEAR MEDICAL STUDENTS: TEACHING AND LEARNING THROUGH GAMES

Venetia M. France, Department of Physiology,
University of London King's College,
London, WC2R 2LS England

ABSTRACT The objective of the game described, "Cardiovascular Rummy", is to help students learn to manipulate, mentally and verbally, concepts fundamental to the functions of the cardiovascular system (CVS); and to understand the interrelationships between different controlled variables in the system.

One important long-term mechanism for socialisation and learning by young children is play – although the idea of games and simulations as an aid to learning and a reinforcement of more formal instruction has been slow in acceptance by educationalists. Perhaps because of a long-held feeling that for older children and certainly adults "all idle persuits were a Satanic trap to lure the godly from the path of duty,"[1] a view still current in the form *anything which is enjoyed cannot be beneficial* or, in the medical profession, that medical studies require serious application, and to introduce learning games may reflect adversely on the status of the discipline.

Recently, a number of games and simulations have been developed for use in schools; but those marketed for university students are limited in number and scope. However, a list of source material is given as references 2-7. Gaming may be a very effective aid to developing skills in areas such as conceptualisation, problem solving and diagnosis.

First-year medical or dental students are sometimes confused by the inter-relationships within cardiovascular system (CVS) physiology, and they may be assisted in forming their own conceptual framework by peer-group discussions based on the material presented in formal teaching sessions. An opportunity for in-depth peer-group discussion is offered by encouraging students to play a simple card game, which they enjoy. The game provides an excellent opportunity for manipulation of concepts essential to an understanding of CVS physiology, and is sufficiently competitive to maintain interest. The basis for the game is Rummy and the idea may be easily adapted by students or faculty for use in other study areas including respiratory, renal or gastro-intestinal physiology as well as topics in other disciplines.

A successful learning experience depends on full involvement of the students; and their commitment may depend on the attitudes of the instructor and her* enthusiasm for the exercise. Hence it is important that instructor or faculty member and students feel free to modify published games to suit their requirements. The most successful games will undoubtedly be those devised in response to a particular local need: when the commitment of the originator will catch the imagination of her* students.

Cardiovascular Rummy

The card game Rummy provides a simple model for many possible learning games where associations and heirarchies are to be assimilated. As with Poker, Rummy and its variations is based on melding groups of cards in sequence or of the same rank. Scoring is on the principle that cards not so grouped into scoring combinations when a critical point is reached are counted as penalty cards. Usually, the critical point is when one player has no remaining cards. The cards making up the suggested set are shown in Table and since they do not fall into conventional "suits", cards of the same rank are defined as cards which provide the same effect. More common in this game are runs of cards showing a causal relationship.

Table

Blood pressure (up)
Blood pressure (down)
Heart rate (up)
Heart rate (down)
Total peripheral resistance (up)
Total peripheral resistance (down)

Stroke volume (up/down)
Tachycardia
Bradycardia
Cardiac output (up/down)

Venous return (up/down)
End - diastolic ventricular volume (up/down)
Force of contraction (increased)
Sympathetic stimulation
Sympathetic inhibition
Parasympathetic stimulation
Parasympathetic inhibition
Acetylcholine
Nor-adrenaline
Plasma adrenaline
Vasomotor centre stimulation
Vasomotor centre inhibition
Cardiac acceleratory centre
Arteriolar dilation
Arteriolar constriction
Baroreceptors (increase/decrease)
Peripheral chemo-receptors (increase)

Exercise
Hemorrhage
Muscle blood flow
Local pH
Tissue pCO_2
Capillary filtration
Capillary pressure
Colloid osmotic pressure
Blood volume (increased/decreased)
Respiratory centre (stimulated)

Muscle pump
Thoracic pump
Vene-constriction
Valves

SA node
AV node
Bundle of His

Card deck for Cardiovascular Rummy. Many further developments are possible according to the needs of the students and particular course objectives.

After shuffling the pack, 7 cards are dealt to each player and the remainder placed in the centre with the top card face up beside the pack. The first player takes a card and, if she is able, lays down a run of three or more cards. As the cards are laid down the player explains their causal relationship. If the other players agree, the cards remain on the table and may be added to, with appropriate justification, during the game. If it can be shown that the player's argument linking the cards is inadequate or fallacious, then the player must take up the cards again, discard, and the play passes to the next person. As soon as a player has successfully laid down a run of cards, she may place cards on any suitable runs already on the table — the object being to play all her cards except the one to be discarded. When one player has played all her cards, the game ends and students score according to the number of cards remaining in their hands.

The Rummy game, whether for the CVS or another topic, is perhaps best seen by the teacher as a vehicle for first-year students to gain facility in experiencing themselves and to learn from each other. Discussion centering around each player's justification of her "run" of related cards is the most important aspect, and students should be encouraged to use lecture and laboratory notes, and textbooks to verify or clarify points of uncertainty. The teacher may have several games running concurrently and may facilitate groups both by encouraging less extroverted students to lay down runs of cards — even if they lack confidence in their ability to justify them, and by stimulating discussion generally without providing easy answers.

A semi-supervised situation is useful for students to acquire the rules; subsequently they may be encouraged to make or borrow cards for use in their own time.

In conclusion it may be said that first-year students who have used this or other similar games to compliment formal teaching have gained in confidence in handling discussions about the cardiovascular system, have expressed enthusiasm for the game, and generally shown increased motivation for acquiring a good working knowledge of cardiovascular physiology.

*(Editor's note: The game can also be used by male instructors with male and female students.)

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HUMAN PHYSIOLOGY IN HEALTH AND DISEASE –

Mary L. Forsling, Department of Physiology,
The Middlesex Hospital Medical School, London, W1P 6DB.

An Orientation Course

The percentage of medically qualified staff in preclinical departments of Physiology in the United Kingdom has been falling over the past few years and is presently around 33%. The proportion may be expected to drop still further as only 12 - 15% of physiologists in the age range 25 - 40 are medically qualified. The fact that many physiology courses are becoming vocationally orientated presents a further problem. The Education and Information Sub-Committee of the Physiological Society together with Professor R.H.T. Edwards therefore decided to run a second 'orientation course', the purpose of which was to enable scientifically qualified staff teaching medical students to see the practical application of physiological concepts in clinical medicine. The course would provide a forum in which clinicians would discuss the problems which they met, the way in which they solved them and the application of basic physology to these processes. The course was held at University College Hospital and Medical School between Easter and the scientific meeting of the Physiological Society held at University College London, which imposed a time limit of two days on the meeting. The first day was devoted to the principles of human physiology and studies in man, and the second day was concerned with the application of these principles to clinical problems. The meeting was divided into lectures, short talks, open discussions and a series of demonstrations. It was hoped that after the course the participants would be stimulated to establish contact with clinical colleagues in their own medical school and have a closer concept of the place of physiology in medical education and hence the approach to physiology, which should be followed in their own University. Outline of the Course is Table 1.

Some weeks before the meeting, the participants were sent a list of ten demonstrations for each afternoon and asked to select five they would find of greatest value and interest. Those for Wednesday afternoon were devoted to measurement in man and it was planned that the participants might have the opportunity of being subjects themselves. For the Thursday the participants were given the opportunity to choose from visits to various hospital departments and specialities. To enable everyone to take part in these events, numbers were of necessity limited.

In only two days it was a difficult brief to cover 'human physiology'. However, a fairly wide range of topics was covered. There was a brisk and, for some, an early start at 9:00 a.m. when Professor Edwards welcomed the participants, thirty-five from all corners of the United Kingdom and Eire and one from Brazil. He then delivered a stimulating talk on exercise and muscle, covering many aspects including possible criteria for choosing olympic athletes and finished by considering the causes of muscle weakness and fatigue, a consideration amplified by Dr. A. Young, who presented a case illustration of a student with psychogenic muscle weakness, which was treated with exercise therapy. The control of muscle activity was considered in some detail by Dr. P.A. Merton. He has been able to obtain a surprising amount of information on the control of movement by studying the flexion movement of the top joint of the thumb. By following halts, stretches and release in addition to the control response, he obtained records resembling and named 'tulips', changes of which were seen in various nervous diseases.

The final session of the morning was devoted to respiration and circulation. Dr. S.G. Spiro opened the session with a summary of the factors influencing the flow of air within the respiratory tree. This led onto tests of airway function and Dr. P.J.D. Heaf then introduced the subject of blood supply to the lungs and the ventilation/perfusion ratio, illustrating the topic with X-rays from a number of patients. The last speaker of the morning, Professor L.B. Strang, gave a lucid exposition of the changes occurring at birth with the first breath, his themes being initiation, aeration and removal of secretions, together with the associated alterations in the fetal circulation.

The afternoon started with a lecture on renal physiology and acid base balance, as illustrated by renal tubular acidosis, given by Professor O.M. Wrong. He described a number of cases which showed the importance of a basic understanding of physiology in the management of disease. This was rapidly followed by a lively session on the gastro-intestinal tract – a session which was a relatively late addition to the course in response to complaints from Dr. D.L. Wingate that gastro-intestinal physiology was, on the whole, poorly taught and that failure to include the topic would not improve matters. The two talks were based on a "stop-go policy" or rather "go-stop". Dr. D.L. Wingate elucidated the mechanisms whereby the products of digestion were propelled down the G.I. tract, and Dr. D.A.W. Edwards gave an account of the sphincters which control the movement of foodstuff. Then followed tea and a chance for informal discussion.

The remainder of the afternoon was devoted to demonstrations. The participants were given an opportunity to see techniques for respiration and blood flow measurements, and tests of skeletal muscle and lung function. The metabolic and hormonal responses to dynamic exercise was presented by Dr. M. Rennie and finally there was a wide-ranging demonstration of mountain physiology by Dr. Mary L. Forsling, Dr. L.G.C.E. Pugh and Professor E.S. Williams. Many of the hazards of a rapid ascent to altitude were illustrated and those taking part were fortunate enough to see and handle the equipment used by Dr. Pugh on the successful Everest expedition of 1953. This demonstration well illustrated the point that relatively simple though ingeniously devised equipment and experimental design allow useful determinations to be made in the field. The day ended with sherry and a chance for general discussion with the contributors.

Thursday got under way with two case presentations illustrating the investigation of breathlessness, a condition in which the importance of clinical tests to identify the underlying conditions was clear. Of the many causes of breathlessness, the first patient had psychogenic breathlessness disproportionate to the airways obstruction and responded to progressive training. In the second patient, breathlessness was due to asthma and treatment was to relieve the airways obstruction. Both patients achieved marked increases in exercise tolerance and improvement of symptoms. Then followed a discussion of the underlying changes in muscle weakness. The case was presented of a woman with polymyositis, an inflammatory condition which was treated with high doses of corticosteroids. These in themselves are catabolic and could contribute further to muscle breakdown. However, monitoring muscle strength and nitrogen balance allowed the progress of the disease and treatment to be assessed and the patient eventually made a satisfactory recovery.

The second period of the morning and the first in the afternoon were devoted to computer models of human physiological systems – the 'Mac' family of physiological models devised by Professor Dickinson and his colleagues. Four models were discussed and illustrated by Dr. D. Ingram – MacMan, the heart and peripheral circulation; MacPuf, the lungs and blood gas exchanges; MacPee, the kidneys and body fluids and MacDope, a model for training in pharmacodynamics and the techniques of prescribing. These models, especially MacDope, can be used in both teaching and research. They are valuable interactive computer systems which students can use to increase comprehension of the various physiological systems and in problem solving. After lunch the four programmes were running and Drs. Ingram and Cusworth guided the participants through the seeming complexities of the operational procedures. Several manoevres were tried, such as a small haemorrhage, the changes of renal disease and drug administration, although occasionally inappropriate information was entered and the computer would flash 'The patient has just died. Do you have a good lawyer?'.

Then followed an afternoon of clinical demonstrations. Clinical electromyography, respiration and circulation monitoring and lung function studies in patients were all shown. The new EMI whole-body scanner (computerised axial tomography) was on display, allowing the opportunity to compare standard X-ray pictures with the EMI scans. Groups of participants were also taken on a medical registrar's ward round when they discussed the problems facing insulin-dependent diabetics and patients with osteomalacia.

In the final discussion period, Professor Edwards brought the different threads of the course together and discussed the ways of teaching human physiology and possible practical studies students could perform on themselves. He emphasized the similarities between the intuitive reasoning of the creative scientist and the processes involved in proposing and confirming diagnoses in patients. It was important that there should be a close working relationship between physiologists and clinicians. He left us with the thought 'Only connect' (E.M. Forster).

Reaction to the Course can be judged from replies to a questionnaire which was completed by the participants. The results are summarized in Table 2.

Table 1. Outline of activities at the Course.

Lectures and discussions:

1. Exercise and Muscle
2. Control of Movement
3. Respiration and Circulation
4. Kidney and Acid-Base Regulation
5. Neurohumoral Controls in the Digestive Tract
6. Illustrative Case Histories
7. Demonstration of computer models
8. Human Physiology in Health and Disease

Human Physiology Demonstrations:

1. Skeletal muscle function
2. Lung function
3. Metabolic and hormonal responses to dynamic exercise
4. Mountain Physiology
5. Physical techniques for respiratory and blood flow measurements

Clinical Demonstrations and visits to Hospital Departments in University College Hospital:

1. Clinical electromyography
2. Lung function studies in patients
3. Respiratory and circulatory monitoring in the Intensive Care Unit
4. The EMI Whole Body Scanner
5. Medical Registrar's Ward Round

Table 2.
PARTICIPANT RESPONSE TO QUESTIONNAIRE:
ORIENTATION COURSE
"Human Physiology in Health & Disease" (N = 35)

On a scale of (Yes to No)	1	2	3	4	5
1. Did you find the course of value?	14	19	1	1	0
2. Would you come on another course or recommend someone else to attend?	20	12	0	2	0
3. Have we satisfied your reason for attending the course?	9	20	4	2	0
4. Do you now feel stimulated to make contact with clinical colleagues for teaching and research?	13	10	10	1	1
5. Did we provide any help with your personal teaching?	14	15	3	3	0
6. Do you feel that you have a greater insight into the place of physiology in clinical medicine?	21	7	7	0	0
7. Was sufficient guidance on reading given?	9	10	10	6	0
8. Was the timetable satisfactory Too full - 42%	9	4	8	12	2
9. Was the balance of the timetable right? Lectures - too many (13%) Demonstrations - too many (13%) Clinical Demonstrations - Not enough (20%) Visits to clinical departments - Not enough (20%) Contact with individual clinicians - not enough (20%)	17	13	2	3	0
10. Were the lectures pitched at the right level?	15	20	0	0	0
11. Did you find the course fell at a convenient time?	25	7	3	0	0
12. Did you find the length of the course appropriate? (3 days 32%)	16	14	3	2	0
14. Would you be prepared to pay a higher registration fee?	24	6	5	0	0

BOOK REVIEWS

Physical Performance Fitness and Diet. D.R. Young. Charles C. Thomas, Springfield, Illinois, 1977. 113 pp. illus. $9.75.

A useful small book of 113 pages that is well characterized by its title. It is part of a series sponsored by Thomas of American Lectures in Environmental Studies. The author's goal was to deal principally with the relationships among diet, fitness and work performance while considering the extreme nutritional states ranging from starvation and emaciation to obesity. For the most part he succeeded. The chronic disease states associated with diabetes and coronary heart disease are also emphasized. Although attention is given to current concepts regarding metabolic regulation and interactions, discussion is based on a selected review of the literature. This was done intentionally by the author "to delineate the large grey areas where knowledge is incomplete and also to discuss – research studies that either have advanced knowledge or illustrate the breadth of the problems that researchers must address." Emphasis is on human studies although background for interpretation is provided from animal studies. Most science-oriented readers will be interested in the sections on: performance capacity and nutriture, performance and body composition, and growth hormones and insulin mechanisms. The 10 page section on sports medicine appears somewhat out of place in this book because of emphasis on sports-related injuries. Fortunately the sports medicine section is not long enough to detract from the book to a major extent. Overall, interesting reading for an evening or two.

E.R. Buskirk
Human Performance Laboratory
Pennsylvania State University
University Park, PA 16802

Serotonin in Health & Disease: Physiological and Pharmacological Action. Vol. 2. Walter B. Essman, Ed. Spectrum Publications: Jamaica, N.Y., 1978. 443 pp. illus. index $37.50.

The above referenced publication documents, organizes and describes in-depth original research on the effects of serotonin in the central nervous system and peripheral organs. With an approach, which combines good molecular biology and biochemistry with concerns of the clinics, the authors seem to make sense out of new as well as controversial findings. They point the way to future research in neurochemistry of thermoregulation and biological rhythms; developmental and behavioral embryology; neurochemical and neuroanatomical basis for species differences; and psychopathological and developmental disorders found in the clinics.

This book is a unique source of information on serotonin covering many aspects of the functional significance of re-

gional distribution, cellular storage and release as affected by pharmacological agents, and the pharmacological effects of serotonin. There is good coverage of the implication of serotonin in certain disease states. The contributors are knowledgeable about their subject and productive scientifically. This volume is an excellent reference work on the topics covered.

William L. West, Ph.D.
Howard University
College of Medicine
Department of Pharmacology
Washington, D.C. 20059

Essentials of Physiological Psychology. Francis Leukel. C.V. Mosby Co: Saint Louis, 1978, 330 pp. 101 illus. $9.50.

Clearly, this paperback book is intended as a textbook for undergraduate students in the freshman or sophomore year in college. Consequently, it should be evaluated in terms of its content of correct information for the students and its likelihood of tapping the students' interests and motivation and holding their attention. The material, of necessity, must be presented superficially without much detail in an effort to "paint the big picture." Just how much technical detail to present will depend on the level of prior understanding that the author presumes that the students have. This text seems aimed at students who, apparently, have little more background than they may have obtained in high school biology.

Although not indicated, the book is divided into three large sections: the first 74 pages are concerned primarily with the introduction, cell biology, and a brief overview of anatomy and physiology of the human nervous system (about 26% of the book). The next section (about 36% of the book) is concerned with sensory systems. It seems little different (except in the commitment of pages) from what one would find in many introductory psychology texts. The last section of the book (about 37%) is devoted to more complex behavioral characteristics usually considered as part of psychology's turf: consciousness, sleep, dreaming, arousal (including a section on transcendental meditation), motivation (including a section on sex), needs, emotion (including a section, with a large table, on psychoactive drugs), learning, and stress. The book contains a 12-page glossary that should be helpful to students, a 10-page list of references (which on the whole are quite up-to-date) and a 30-page index.

The book is marred by a few errors, some trivial, but how serious they are will depend on the student. Rosenzweig's name is spelled wrong (p. 302); the author speaks of the *consistency* of the internal environment when the usual word is *constancy* (p. 191) and table 3 on p. 23 contains several errors, the most egregious of which suggests that hypo secretion of gonadal endocrine glands *in*creases sexual vigor. There may be more errors that were not detected by this reader, but these three suggest, at least, rather hurried proofreading.

There is one rather general criticism that should be mentioned as regards this textbook (as well as most others) in the area of physiological psychology. Most research on the nervous system and behavior is carried out on lower animals. At the level of cells and tissues there is not much of a problem in extrapolating to humans, but behavior differs tremendously among species as the constraint of natural selection has molded adaptive brain-behavior patterns. Consequently, extrapolation of brain-behavior functions from lower animals to *Homo sapiens* is difficult and fraught with ambiguities less salient in other areas of physiology. The beginning student needs to be introduced to evolutionary behavioral biology. The jump between the neuroanatomical factors in a rat's learning a maze and a college students' trying to understand the "great ideas" of western civilization is an unpersuasive one. Nor does the sequence of rat, cat, monkey, and man, species on which most brain-behavior research is done, represent an evolutionary sequence. This book seems to presume that whatever brain-behavior relations obtain in the rat (or other animal), automatically and uncritically apply to humans.

Garth J. Thomas
Center for Brain Research
University 4 Rochester
Rochester, NY 14642

Comparative Physiology: Water, Ions and Fluid Mechanics, edited by K. Schmidt-Nielsen, L. Bolis and S.H.P. Maddrell, Cambridge Univ. Press, 1978. 345 pp. illus. indices (15 pp.) $43.50.

The book contains 23 papers presented in 1976 by primarily European and Canadian scientists at an International Conference on Comparative Physiology. The papers are organized into three separate subject areas: (1) water transport and uptake, (2) osmotic and ionic regulation in unbalanced environments (meaning, terrestrial and hypersaline environments), and (3) fluid mechanics in biology. The contributions range in scope from original investigations to discursive reviews, and the diversity is reflected in format (one original report proceeds directly from the introduction to the results with no account of methods). As in many symposia dealing with a particular phenomenon in diverse biological material, there is some redundancy in the presentations of background material, especially in the section on fluid mechanics.

The scientific quality is, on the whole, good. The critical discussions of familiar topics such as water transport are timely, and the enunciation of questions on less familiar subjects such as the flow properties of cell-free fluids in open spaces is provocative. The organizers of the conference have made an effort to broaden the coverage of the topics by including investigators whose work is not widely known in animal physiology. There is, for example, a general review (D.J. Ellar) on salt and water balance in halophilic bacteria in the section on osmotic and ionic regulation.

The book will be of greatest interest to active investigators in the three fields who wish to be apprised of the recent findings of their colleagues in other countries. It will also be useful to nonspecialists as source material on the controversial aspects of fluid transport (e.g. papers by J. Fischburg and A.E. Hill), and an admirably simple account of fluid mechanics in circulatory systems (T.J. Pedley).

C.P. Mangum, Ph.D.
Department of Biology
College of William & Mary
Williamsburg, VA 23185

Experimental Neurobiology: A Laboratory Manual. B. Oakley and R. Schafer, Eds. Univ. of Michigan Press, Ann Arbor, 1978. 375 pp., tables, illus. $12.95.

Claude Bernard could have been composing the introduction to *Experimental Neurobiology* when he wrote" . . . scientific courses can only serve to introduce and to create a taste for the sciences. By pointing out, from a professional chair, the results as well as the methods of a science, a teacher may form the minds of his hearers and make the apt in learning and choosing their own direction; but he can never make them men of science. The laboratory is the real nursery of true experimental scientists, i.e., those who create the science that other afterward popularize." *Experimental Neurobiology* is a laboratory manual that emphasizes the importance of "hands-on" learning. It is the book that most of us who value such an approach have been meaning to write for years.

Experimental Neurobiology consists of 33 experiments ranging from basic anatomical dissection to behavioral observations to sophisticated electro-physiological exercises including single unit recording and stereotaxic procedures. Each experiment includes an introduction to the biological principles to be demonstrated, a detailed description of the technical procedures, and a list of possible problems that may be encountered. There are two separate sections that introduce basic principles of electronic instrumentation and surgical procedures respectively.

The experiments are given a rating (1, 2 or 3 stars) based on the difficulty of the technical and surgical procedures. The authors may be a bit too generous in their estimation of potential instructors' abilities to overcome some of the expected problems, but for the most part the rating system does provide a means of deciding if a given experiment is appropriate for a given group of students.

The few shortcomings of the book result from the authors' attempt to encompass so much of neurobiology and to make the experiments appropriate for courses at the undergraduate, graduate, and professional school levels. One outcome is a disparity in the extent to which discussions of physiological principles in the different experiments reflect our current understanding of the mechanisms involved. In some cases recent developments are presented very well, in others a more classical presentation is given. Another outcome is that the instructions in many of the experiments are too complicated for beginning students but too complete for graduate students. Complete and detailed instructions often overwhelm undergraduates and make them apprehensive about the technical aspects of experimentation. On the other hand, graduate students should be given as few instructions as possible so that they can learn "why" to use a certain approach rather than "how".

Oakley and Schafer are to be commended for their ambitious effort to provide a comprehensive laboratory encompassing so many facets of neurobiology. The combination of anatomical, behavioral and physiological experiments, and the inclusion of both invertebrate and vertebrate species in different experiments, makes the book a valuable resource for those of us who consider the laboratory to be an important part of our teaching program.

James A. McMillan
Department of Biology
Montana State University
Bozeman, MT 59715

INFORMATION FOR AUTHORS:
The Laboratory Experiment

Those of you who have developed new laboratory experiments or interesting modifications of classical experiments in physiology and would like to share them with your peers and their students may find the following instructions helpful in organizing information for publication in The Physiology Teacher.

1. The title should be short and informative.
2. Give author(s) name, department and institution, city, state and zip code.
3. Submit two copies of the manuscript so that one copy can be sent to a referee for critical review.
4. State the general objective of the experiment and present the subobjectives in the introduction.
5. If the physiological process being tested or demonstrated has an interesting history, write up the background to give the student some insight into the evolution of the concepts regarding the process.
6. Give a detailed and specific list of the materials that will be needed to perform the experiment successfully. For instance:
   a. Identify the test subject.
   b. When used, identify the type and concentration of the anesthesia and the method of administration.
   c. List all required instruments, equipment and reagents. Identify the source of any special items.
   d. When new drugs or chemicals are used, the chemical name should precede the trade name and information given as to the availability and source.
   e. Give the concentration and the pH (if necessary) of all solutions.
5. Describe the procedure completely, preferably in numbered steps. Remember that a student doing the experiment for the first time needs guidance over possible pitfalls.
6. Give typical results and observations and discuss them.
7. Illustrate sample data in graphic or tabular form. Photographs of animals are not acceptable; use line drawings. Include a legend with each figure and identify each with a figure number.
8. Chemical and biochemical terms and abbreviations should be in accordance with the recommendations of the IUPAC-IUB Combined Commission on Biochemical Nomenclature. Refer to the CBE Style Manual (3rd ed., AIBS, 1972) for commonly accepted abbreviations, word symbols, etc.
9. Cite references as follows: last name of first author, followed by initials; initials and last names of each coauthor; title of article (first word only capitalized); name of journal (abbreviated as in *Chemical Abstracts List of Periodicals);* volume, inclusive pages, and year.

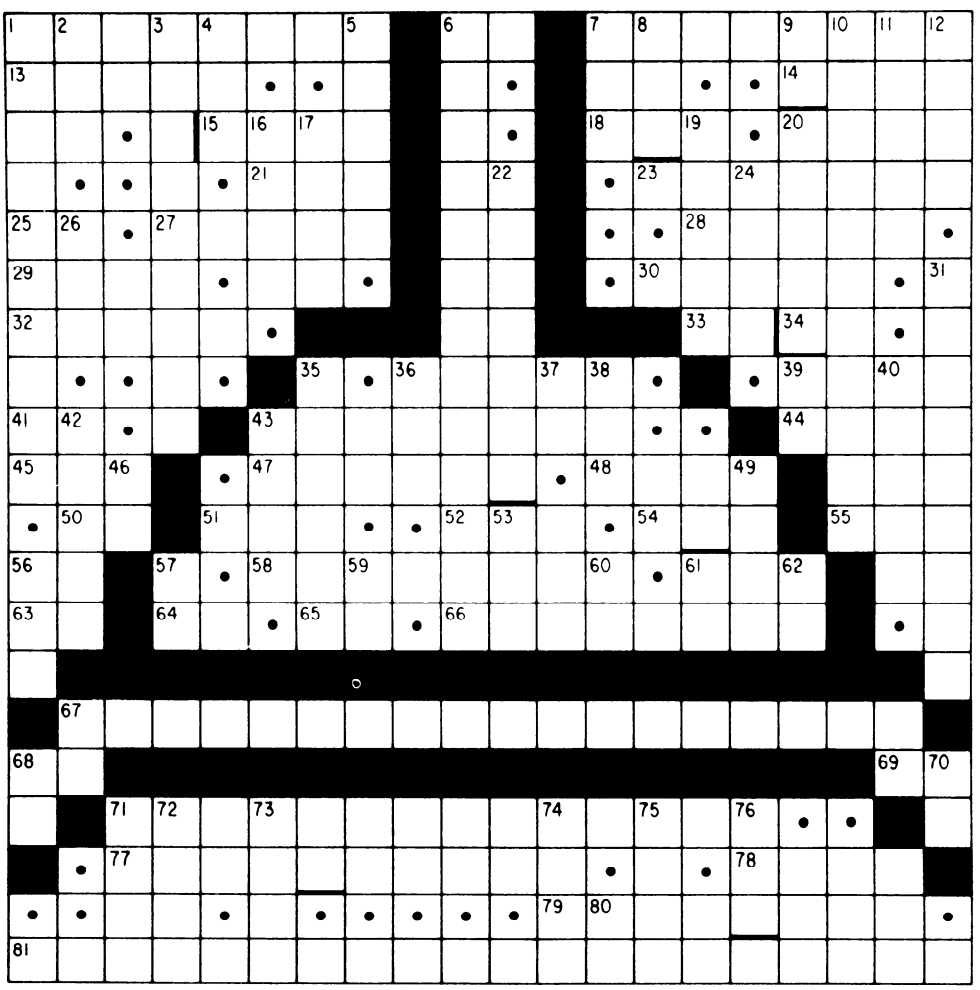
In the forthcoming issue we hope to discuss guidelines for BOOK REVIEWS.

Respiratory Physiology Crossword Puzzle

John B. West
Section of Physiology
School of Medicine
University of California, San Diego
La Jolla, Calif. 92093

This puzzle has been used on several occasions to enliven the first-year physiology course for medical and graduate students at UCSD. The puzzle has been given out every 2-3 years to ensure that the answers are forgotten in the meantime. This year the first correct answer was returned in 3 hours (during one of which the student was ostensibly listening to a lecture on the pulmonary circulation).

Some may quibble at 67 across – "dipalmitoylecithin" – because this is sometimes spelled "dipalmitoyllecithin." An alternative answer would be "mucopolysaccharide" with the clue: component of bronchial mucus. The lack of a "down" clue here makes this more sporting.



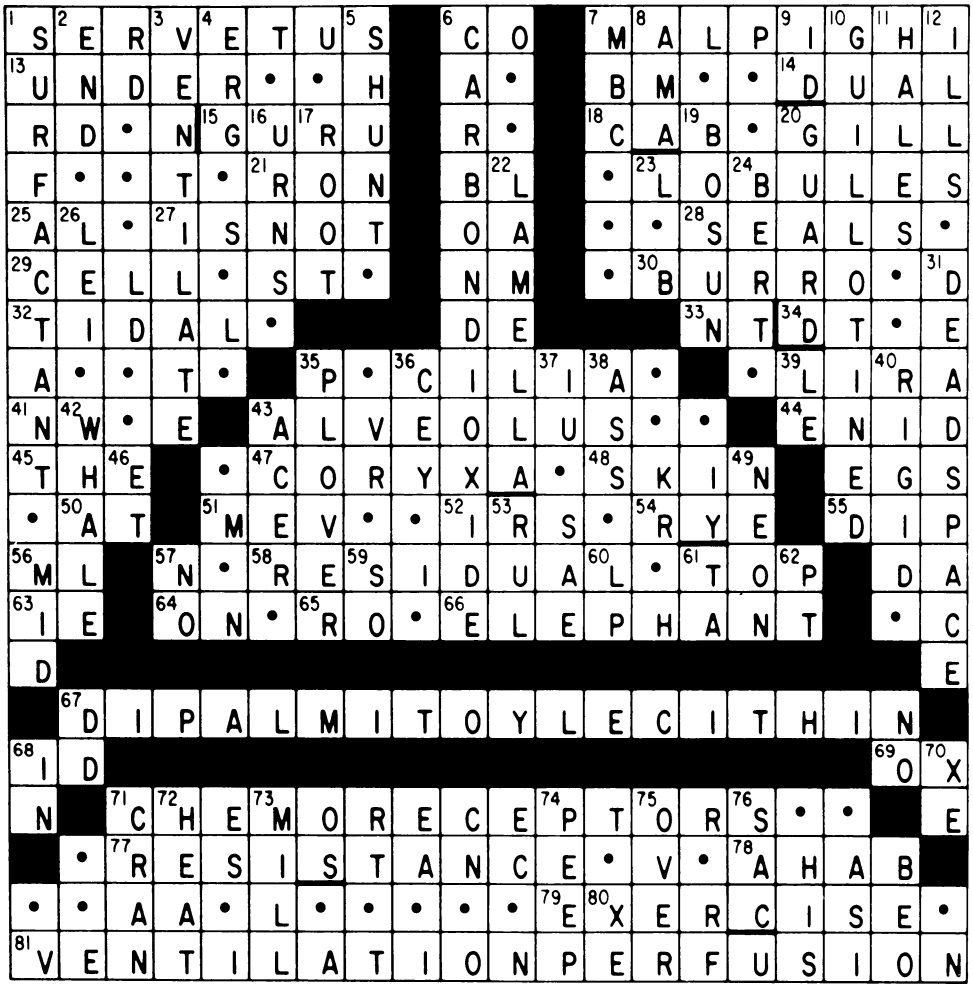
ACROSS

1. He gave one of the first descriptions of the pulmonary circulation and was later burned at the stake.
6. Gas used to measure the diffusing capacity of the lungs.
7. He first described the pulmonary capillaries.
13. . . . . ventilation always causes a rise in arterial P_{CO_2}.
14. Double
15. Teacher
18. Taxi
20. Can be used for gas exchange underwater.
21. Boy's name
23. Small lung units
25. Aluminum
27. The O_2 dissociation curve . . . . shifted to the right by increase in pH.
28. These animals have a dramatic fall in heart rate when they dive.
29. This component of blood contains most of the carbonic anhydrase.
30. This desert donkey tolerates dehydration very well.
32. Normal inspired volume.
33. Northern territory (abbr.).
34. Abbreviation for condition caused by withdrawal of a drug.
36. These remove deposited dust from the airways.
39. Italian money
41. Northwest (abbr.)
43. Smallest air space in the lung.
44. Girl's name
45. Article
47. This diving beetle carries its own scuba equipment.
48. This organ is used for gas exchange by some amphibia.
50. Astatine
51. Unit of electron energy
52. An important creditor
54. Type of bread
55. Depression
56. Unit of volume
58. Gas remaining after a maximal expiration.
61. Blood flow is least in this part of the lung.
63. That is (abbr.)
64. Supported by
65. Or (invert.)
66. This animal has no pleural cavity.
67. Thought to be a constituent of surfactant.
68. Component of psyche
69. Ungulate
71. These respond to oxygen lack.
77. This property of the airways increases at low lung volumes.
78. Famous whaling captain
79. Commonest cause of an increase in ventilation.
81. This ratio is important for pulmonary gas exchange.

DOWN

1. Important factor in promoting alveolar stability.
2. . . . tidal P_{CO_2} is close to the arterial P_{CO_2}.
3. To inspire and expire.
4. Metric unit of work.
5. The only cause of hypoxemia not corrected by 100% inspired oxygen.
6. The body has very large stores of this gas.
7. Test of ventilatory capacity.
8. These diving women have a remarkable breath-holding ability and resistance to cold.
9. Psychiatric term
10. The fate of the discoverer of oxygen
11. Eighteenth century English vicar who measured blood pressure in the horse; also the size of the alveoli.
12. Maladies
16. Vessels
17. Effect of CO_2 on the O_2 dissociation curve of fish.
19. Ship's officer
20. Security agent
22. Seen in cells that secrete surfactant.
24. Father of hyperbaric physiology.
26. Flower necklace
31. It takes no part in gas exchange
35. Gregarious wading bird
37. Measure of drug potency (abbr.)
38. Fool
40. Not compliant
42. This mammal holds the record for breathholding.
43. Maple family
46. End tidal (abbr.)
49. Inert gas
53. One of the lobes of the lung (abbr.)
56. Middle
57. If the P_{CO_2} of the blood is doubled, does the pH halve?
59. Therefore
60. 33-1/3 rpm
62. Precious metal
68. Which direction with respect to the red cells does chloride move when CO_2 is taken up by the blood.
70. Radioactive gas used for measuring distribution of ventilation and bloodflow.
71. Type of berry
72. This moves the oxygen dissociation curve to the right.
73. For grinding
74. Furtive glance
75. . . . . ventilation can cause tetany.
76. Blindly ending alveolar duct
80. Noble gas

Answer on following page.


1 S 2 E R 3 V 4 E T U 5 S 6 C O 7 M 8 A L P 9 I 10 G 11 H 12 I
13 U N D E R • • H A • B M • • 14 D U A L
R D • N 15 G 16 U 17 R U R • 18 C A 19 B • 20 G I L L
F • • T • 21 R O N B 22 L • 23 L O 24 B U L E S
25 A 26 L • 27 I S N O T O A • • 28 S E A L S •
29 C E L L • S T • N M • 30 B U R R O • 31 D
32 T I D A L • D E 33 N T 34 D T • E
A • • T • 35 P • 36 C I L 37 I 38 A • • • 39 L I 40 R A
41 N 42 W • E 43 A L V E O L U S • • 44 E N I D
45 T H 46 E • 47 C O R Y X A • 48 S K I 49 N E G S
• 50 A T 51 M E V • • 52 I 53 R S • 54 R Y E 55 D I P
56 M L 57 N • 58 R E 59 S I D U A 60 L • 61 T O 62 P D A
63 I E 64 O N • 65 R O • 66 E L E P H A N T • C
D E
67 D I P A L M I T O Y L E C I T H I N
68 I D 69 O 70 X
N 71 C 72 H E 73 M O R E C E 74 P T 75 O R 76 S • • E
• 77 R E S I S T A N C E • V • 78 A H A B
• • A A • L • • • • • 79 E 80 X E R C I S E •
81 V E N T I L A T I O N P E R F U S I O N