THE PHYSIOLOGIST

A Publication of the American Physiological Society | Volume 29, Number 3 | June 1986

EDITORIAL

SBIR: Boon or Boondoggle?

More often than not, the saying "life is not fair" can be used to describe perceived inequities in biomedical research funding. Whether it is the congressionally mandated funding of a program previously rejected via the peer-review process or the case of the investigator reviewed by Study Section A being funded with a priority score of 180 while the investigator receiving a priority score of 150 from Study Section B is told to reapply, for some individuals, life is a little fairer than for others.

Such examples of funding inequities abound and are frustrating to all parties. However, the most unfair of life's examples is the Small Business Innovation Research (SBIR) Program. The Small Business Innovation Development Act, signed into law on July 22, 1982, by President Reagan, was the culmination of an extensive series of hearings concerning small business innovation development. The purpose of the legislation was to *1*) stimulate technological innovation, *2*). use small business to meet federal research and development needs, *3*) increase private sector commercialization of innovations derived from federal research and development, and *4*) foster and encourage participation by minority and disadvantaged persons in technological innovations.

For the small business community, passage of this legislation proved to be a *boon* for it endorsed the principle that small business produces significantly more innovations per research and development

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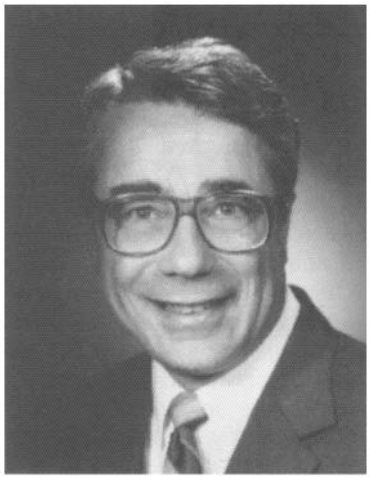
Fifty-Ninth President of APS

Franklyn G. Knox



Franklyn G. Knox, M.D., Ph.D., is the 59th President of the American Physiological Society. Dr. Knox, who has been active in Society affairs since 1961, succeeds Dr. Howard E. Morgan as APS's chief elected officer.

Born in Rochester, New York, Dr. Knox received his Bachelor of Science degree cum laude from the University of Buffalo with a major in pharmacy. He was the first to complete the combined M.D./Ph.D. program (physiology) when he received both degrees from the State University of New York in Buffalo in 1965. Dr. Knox continued his physiology career with postdoctoral research training in the Laboratory of Kidney and Electrolyte Metabolism at the National Institutes of Health with Dr. Robert W. Berliner. In 1968 he joined the faculty of the University of Missouri at Columbia, where he taught the respiratory physiology section of the medical school course and established a research laboratory for the study of the kidney with micropuncture techniques. In 1971 he was recruited to the Mayo Clinic, then in the very early stages of establishing the Mayo Medical School. This provided an opportunity for developing a medical curriculum in an institution noted for its excellence in medicine and the opportunity to develop innovative approaches with a small class of students. From 1974 to 1983 he served as Chairman of the Department of Physiology and Biophysics and during the second half of that appointment served simultaneously as Associate Director for Graduate Education: Research Training and Degree Programs of Mayo Graduate School of Medicine. Dr. Knox was appointed Director for Education for Mayo Foundation and Dean of the Mayo Medical School in 1983, the positions he presently holds. During his tenure as Director and Dean, a most significant accomplishment was the establishment of Mayo as an independent degree-granting institution.

Dr. Knox's research work has touched on many aspects of kidney physiology; however, the main focus has been on the role of renal hormones and physical factors in the regulation of sodium excretion and the mechanisms controlling tubular reabsorption of phosphorus. He has authored over 175 publications in these areas.

As a member of the American Physiological Society, Dr. Knox served as the first Chairman of the Renal Section (1975–1977). He presented the Bowditch Lecture in 1977, has been a member of the Council since 1982, has served as a member and as Chairman of the Program Committee, the Publications Committee, and the Commit-

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dollar than large companies and universities. For Congress and the President, the SBIR program was viewed as a *boon* to the economy, enabling small business innovation to stimulate the economy and contribute to a reduction of the deficit.

During a time of retrenchment and diminishing funds for the research endeavor, it is difficult to view the SBIR Program as anything other than a *boondoggle*. At the time of the act's passage, there was no need for a congressionally mandated set-aside of funds for the small business community. For years, for-profit companies were eligible to apply for NIH research grants but most elected not to because of proprietary problems and government regulations. Indeed, the SBIR program was not designed for the successful company but for the borderline company. The set-aside of funds and the need to allocate the total amount unleashed a flood of questionable proposals.

In the program's first year (FY83), NIH spent 0.2% of its R & D budget (approximately $6.5 million) on applications with a 44% approval rate. The mean priority score for the approved SBIR Phase 1 applications was 271 in FY83. NIH found it so difficult to spend the money that NCI was forced to pay a proposal with a priority score of 499.

While the quality of the proposals has improved since the inception of the SBIR program, the financial stake has also improved. Successful Phase 1 recipients can now compete for Phase 2 awards of $500,000 over 2 years. From a meager $6.5 million in FY83, the program should grow to over $40 million in FY86 and FY87. The stakes have escalated considerably at a time when Gramm-Rudman-Hollings is threatening the vitality of the biomedical community.

If one considers that the average research award to a university investigator is approximately $160,000, it becomes apparent that the FY86 SBIR set-aside could be translated into over 250 new and competing renewal applications. If the SBIR program is truly an innovative program that has stimulated the nation's economy and small businesses are indeed the source of more innovations per research and development dollar than large companies, why is it that President Reagan is recommending that funding for the Small Business Administration be markedly reduced? Are we missing something in our evaluation of the program, or has the SBIR program been a *boondoggle* siphoning off research dollars that could be better spent by the university research community.

One of the frustrations associated with the program is the perceived inequity in the review and evaluation of these applications. While members of the university research community operate under conditions in which only 25% of the approved applications are funded, small business benefits from a set-aside that allows 40–50% of the approved applications to be funded.

The time is ripe for the biomedical community to suggest some trade-offs as we reexamine key features of the US research enterprise. Without trade-offs there is a risk that important contributions of basic research to national goals may be seriously curtailed by a long period of constraint in federal funding.

Now is the time to reassess the responsibilities of the federal government for the support of biomedical research. We must not let it flounder in a sea of deficits. Let us reevaluate the importance of the SBIR program to make certain that the legislation is not renewed. The university research community cannot continue to operate as usual in the face of the threat of the Gramm-Rudman-Hollings law. The projected federal reductions in research support will only exacerbate the current problems that we face in educating young scientists. We must strive to find the means to continue support of biomedical research, and if that means the end of a *boondoggle* remember "life is not fair."

Martin Frank

The Physiologist
Published bimonthly and distributed by
The American Physiological Society
9650 Rockville Pike
Bethesda, Maryland 20814

ISSN 0031-9376

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Executive Secretary-Treasurer

Subscriptions: Distributed to members as part of their membership; nonmembers and institutions, $60.00 per year in the United States; elsewhere $75.00. Single copies and back issues, including Fall Abstracts issue, when available, $15.00 each. In 1986 subscribers to *The Physiologist* will receive it, the abstracts of the Fall Meeting of the American Physiological Society, and *News in Physiological Sciences*. The American Physiological Society assumes no responsibility for the statements and opinions advanced by contributors to *The Physiologist*.

Deadline for submission of material for publication: Dec. 5, February issue; Feb. 5, April issue; April 5, June issue; June 5, August issue, Aug. 5, October issue; Oct. 5, December issue. **If you change your address or telephone number, please notify the central office as soon as possible.**

PEOPLE YOU SHOULD KNOW

George E. Brown, Jr. . . .

California Congressman Shares Views on Animal Welfare Act Amendments, Laboratory Vandalism, APHIS Funding

In May 1984 Representative George E. Brown, Jr., introduced a bill entitled "Improved Standards for Laboratory Animals Act." It was the companion piece to a Senate bill with the same name.

The purpose of the legislation being proposed to the 98th Congress by both Brown and Senator Robert J. Dole was to amend some provisions of the Animal Welfare Act in light of allegations that the US Department of Agriculture (USDA) was not adequately enforcing the standards established for the care and treatment of laboratory animals.

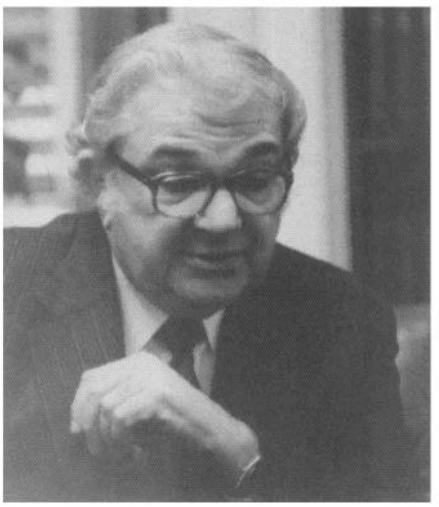
Nineteen months later—a relatively short period of time even with the bipartisan sponsorship and the convening of the 99th Congress in January 1985—the proposed amendments were enacted and become effective next December.

Brown has been much more than an interested spectator on issues concerning laboratory animals. In October 1981 he was an acute questioner of the witnesses who testified before the House subcommittee on Science, Research, and Technology during its review of current practices of laboratory animal care, use, and treatment. The two days of public hearings centered on testimony from representatives from federal agencies, animal welfare societies, and research and educational institutions.

The subcommittee's review of laboratory animal practices was a result of an animal rights activist's claim to police a month before and the subsequent arrest of a researcher and his animal caretaker on charges that 17 monkeys were being mistreated at a Silver Spring, MD, research facility. The facility had been inspected several times by the USDA's Animal and Plant Health Inspection Service (APHIS) with no major faults reported.

The subcommittee's review also provided grounds for additional congressional hearings that focused on the Animal Welfare Act: Dole conducted such hearings in the Senate in 1983 and Brown held similar hearings in the House in 1984. The testimony presented at those hearings were, by and large, the basis for the amendments enacted last December.

The laboratory animal issue became a local issue for Brown in April 1985 when



the Animal Liberation Front struck in his home district by vandalizing a research facility at the University of California at Riverside. The vandals stole 467 laboratory animals and caused $683,000 in property damage. Charges of animal abuse by the raiders resulted in an on-site inspection of the facility by NIH, which reported that the facility "has an appropriate program" for laboratory animal care and that "no corrective action with respect to this program is necessary."

Within 6 weeks of the Riverside raid Brown introduced a second bill dealing with the welfare of laboratory animals. This bill, however, calls for federal penalties for those persons found to be responsible for the destruction or theft of property at a research facility. The purpose of this legislation is to enable authorities to follow vandals across state lines.

Although the proposal for federal penalties has not generated much support within the Congress itself, the bill has been credited by some as giving the Animal Liberation Front second thoughts about its tactics, inasmuch as further vandalism of research facilities could generate the support needed for the bill's enactment.

Since 1982 the Animal Liberation Front has conducted four raids a year at academic research institutions. However, after Brown's call for federal penalties the underground animal rights group has shunned research facilities as targets.

Brown, who is a long-time friend of the science community, was first elected to represent his southern California district in the 88th Congress (1963-1964) and has served every Congress since that time except the 92nd Congress (1971-1972), when he unsuccessfully sought a Senate seat.

A ranking Democrat on the Agriculture, Science and Technology, and Intelligence (Select) Committees and Chairman of the Subcommittee on Transportation, Aviation, and Materials, Brown is fourth in years of congressional service among the 47 members (including both Senators) in the California delegation.

To better understand the effects the amendments to the Animal Welfare Act will have on the care, use, and treatment of laboratory animals, the American Physiological Society asked Brown these questions.

What reactions, if any, have you had from animal rights advocates and the research community regarding the recently enacted amendments to the Animal Welfare Act?

During consideration of the legislation, I received many comments regarding the legislation. While a portion of these were extreme, for the most part, these letters focused on specific provisions of the legislation that were of individual concern. The main goal of this legislation was to improve laboratory animal care and treatment while at the same time creating minimal burden to research facilities. Comments that offered suggestions toward these goals were carefully considered. And, for the most part, they were extremely helpful in reaching a balance between the concerns of both the scientific community and the animal welfare community.

Since the legislation was passed and signed into law, I have received very supportive reactions overall. I have received stacks of letters from members of the animal welfare community who are excited that additional measures to ensure humane care of laboratory animals have been put into law. I also have received many letters from individual researchers, as well as several scientific associations, thanking the Congress for recognizing the science community's needs, taking a moderate approach in this legislation, and preserving the ability of researchers to continue their work. I have received very few negative letters. However, I suspect that is because those who disagree with the legislation see no reason to write at this point.

What do you believe has been accomplished by these amendments?

Most importantly, passage of these Animal Welfare Act Amendments, coupled

with the recent changes in NIH's animal care guidelines, as well as the amendments in the 1986 NIH authorizations, has established a very clear federal policy change. These changes in our federal laws represent a confirmation that our society has become increasingly concerned about the care of laboratory animals and have sent a message to research facilities that the federal government will consider proper animal care a higher priority. I say this is most important, because good animal care can be only achieved when individual researchers consider it important. The federal policy changes that have taken place over the past year have helped to bring this issue to the attention of individuals working with animals, and, for the most part, I expect these standards will be met without the federal government having to take extensive disciplinary actions.

More specifically, the amendments will reduce pain and suffering of animals by requiring the use of painkillers, animal care training for employees working with animals, and raising other animal care standards. This act will improve enforcement of animal care laws by encouraging self-monitoring of animal care within facilities by having each facility appoint an institutional animal committee and by requiring the suspension or revocation of funding to facilities that are not in compliance with animal care laws. It will help reduce the numbers of animals used in experiments by disseminating information regarding newly developed alternatives to live animal research, as well as reducing unintended duplication of research by initiating a national information service.

What further action, if any, needs to be taken by the Congress to assure the public that laboratory animals are being well cared for and are used humanely?

That is a tough question. As long as there are isolated incidents of animal negligence or abuse, such as at the University of Pennsylvania Head Injury Clinic, it will be difficult to assure the public that our animal care laws are being enforced.

However, I suspect half of the frustration of the animal rights movement has been the unwillingness of the NIH or APHIS to follow up on complaints regarding specific facilities or to enforce existing laws; thus, facilities have had little incentive to monitor their own animal care. Improving the system, which in my mind includes annual inspections, investigating complaints about animal negligence, closer monitoring of facilities in violation of animal care laws, as well as expedited disciplinary actions, will help assure the public that the system is indeed working. And, I think we are moving in that direction. As you know, NIH, responding to complaints and the results of their own inspection, recently took action against Columbia University until conditions are improved. When Columbia has addressed its deficiencies, funding shall be restored. This was done without having to resort to illegal actions or a large media play by animal rights groups, and that is the way it should be.

When President Reagan has once again proposed to eliminate funding for the Animal Welfare Program at APHIS, the Congress has restored this funding for the last 5 years, and I intend to work to restore funding this year.

George E. Brown, Jr, and Martin Frank.

When you resubmitted your bill in the current Congress, you said that the "high rate of violations (of the Animal Welfare Act) is a signal that our animal care laws must receive higher priority, both by animal users and by our enforcement agencies." Although not too many would argue the point with you, it does raise several unanswered questions about the users and the enforcers. In what general areas do you believe the animal users have failed in complying with the Animal Welfare Act?

My comments regarding a high rate of violations of the Animal Welfare Act were in reference to a number of APHIS inspection reports I have seen. For the most part, I believe that the majority of our animal users are in compliance with our animal care laws. However, I have been concerned that, in the past, those who have not are allowed to be repeatedly found in violation of laws, sometimes for several years before any disciplinary action is taken. It is these repeated offenders which most alarmed me.

How will the newly enacted amendments assure that animal users will be able to improve upon these shortcomings?

It is my hope that the institutional animal committees within each facility will catch most of the violations as they occur, and problems will be addressed before they are allowed to get out of hand. If there are continued problems, the legislation instructs APHIS to monitor facilities until deviations from the law have been corrected. If, after given an opportunity to make these corrections, the facility still hasn't addressed the problems, then the Animal Welfare Act gives APHIS and any federal agency funding research at that facility the ability to revoke funding. Again, I might stress that the most important change has been not in the law but in attitude.

And now a question about enforcement. USDA, through APHIS, is charged with the enforcement of the provisions of the Animal Welfare Act. For years APHIS has claimed that it lacks sufficient funds to fulfill its responsibilities; USDA has testified that it already is over burdened and opposes any additional animal care responsibilities; and the Reagan Administration has tried several times to eliminate the government's role by recommending that the responsibility for enforcement of animal care laws be turned over to state and local governments and nonprofit agencies. Moreover, all of this may become murkier should the Gramm-Rudman-Hollings provisions take a toll of the funds appropriated for enforcement activities. The question is: With this history of foot-dragging within the Executive Branch and the perceived pressures from Gramm-Rudman-Hollings cutbacks, how can enforcement agencies be expected to fulfill their priorities on animal care laws?

This is a very valid question, and one which I addressed briefly earlier. APHIS does have a limited budget. In addition, it is also responsible for animal and plant health. Outbreaks of disease or pests, such as the medfly, have in the past interrupted the animal welfare program. However, while the animal welfare program was funded last year at $4.7 million dollars, APHIS, in efforts to improve the program, actually spent closer to $5.8 million. I will work to ensure APHIS receives adequate funding this year. While the Congress may not decide to appropriate an increase in funding, funding at the FY85 level is enough to follow through on complaints and monitor facilities found in violation.

The amendments that were passed last year will give APHIS additional assistance in enforcement. First, they will put some teeth behind the Animal Welfare Act, by requiring suspension or revocation of federal funds for a facility that is repeatedly in violation of the Animal Welfare Act. This means that a facility will not be allowed to continue in violation for years, such as happened at the City of Hope and at the

University of Pennsylvania, nor will facilities be as likely to risk loss of funding. Second, the amendments call for each facility to monitor its own animal care with the institutional animal committee. I suspect these committees will bring increased attention to animal care and catch many minor problems before they are allowed to get out of hand.

Should imposed fiscal constraints prohibit the federal government from effectively enforcing the provision of the Animal Welfare Act, what alternative would you consider to be acceptable?

Well, the administration has inferred that these programs should be picked up at the state or local level. If states had adequate funding and placed an adequate priority on these laws, that would be acceptable. States might also require private inspection, such as by the American Association for accreditation of Laboratory Animal Care (AAALAC).

However, I am concerned that each state will take laboratory animal care supervision in varying degrees of importance. As you know, in California a bill has passed the state senate and is now being considered by the state assembly, which would allow "humane officers" appointed by animal welfare groups to inspect facilities. I'm not so sure that nongovernment inspection would be as accurate and as respected as a well-run government program or that it would be well accepted by research facilities.

In several other instances where an industry is inspected, such as in produce and livestock agriculture areas, a "user-fee" helps pay for the program. I think this would be the best avenue for ensuring a fair and effective program if we cannot continue adequate federal funding.

Among the amendments enacted was a provision requiring standards for exercising dogs. Why were dogs singled out for exercise and not other animals, such as cats?

An animal's minimum requirement for exercise is not as easily defined as other primary needs such as food, water, and shelter. However, we do know that some animals are more sedentary than others. The concern over dogs is that many of these animals are purchased from pounds and have been accustomed to a certain amount of exercise in the past. Many feel that it is more inhumane to pen up an animal when it is used to exercise than when it has been basically sedentary all its life, and I would have to agree with that. At this point, dogs and cats are basically the only animals purchased that have been allowed freedom of movement in the past. While there are those who felt that all animals should be provided with exercise, we realize that this is a new requirement for animal housing and care. The dogs seemed to be of most concern, and, in trying to keep the impact of these amendments to facilities down to a minimum, we limited that provision to dogs. However, the amendments also call for "an environment adequate to promote the psychological well-being of primates," which in the report is also defined to include freedom of motion.

Since 1979 animal rights groups have conducted a total of 15 raids on research facilities in five states and the District of Columbia, all of which have cost the taxpayers millions of dollars in lost research funded by the federal government. Yet, your call to aid authorities to prosecute those responsible for this vandalism has found little support among your colleagues. Why is that?

Actually, I'm not sure how many have really studied it. Unlike H.R. 2653, this proposal was new in this Congress and new proposals often take time to gain attention. In the past, Congress has often been wary of changing the delicate balance between state and federal law-enforcement activities and I suspect this, coupled with not enough understanding of the problem, is the reason for some hesitation. Further, as far as I can tell, there has been little effort from the public to draw the attention of the Congress to this bill.

What should scientists, in general, and physiologists, in particular, be doing to assist you in this effort to make the destruction and theft at federally funded research institutions a federal offense?

As you know, any illegal activity that has included the use of a phone or the US mail service is already a federal offense. There are other provisions also that would allow federal law-enforcement officials to get involved in current cases.

However, if you are serious about getting the laws changed, then you are going to have to let your federal representatives know about your concerns, and why these changes are important to you.

Thank you Congressman Brown.

William M. Samuels, CAE

Future Meetings

1986	
IUPS Congress	July 12–18, Vancouver, Canada
APS Fall Meeting	October 5–10, New Orleans
1987	
FASEB Annual Meeting*	March 29–April 3, Washington, DC
APS Fall Meeting	October 11–16, San Diego
1988	
FASEB Annual Meeting	May 1–6, Las Vegas
Joint APS/ASPET Fall Meeting	October 9–14, Montreal

* APS Centennial Celebration

PAST PRESIDENT'S ADDRESS

Physiology with Backpack

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The last meeting of the American Physiological Society was not the Spring Meeting in Anaheim, California, as some might think, but one in Cambridge, England, in September 1985. This was the historic, first joint meeting of British and American Physiological Societies and was held at the invitation of the former. It is remarkable that, although the societies have been in existence for approximately 100 years, this was their first combined meeting. This is especially surprising considering the very close links that have always existed between British and American physiologists and that were especially strong in the last two decades of the 19th century. For example, when the (British) *Journal of Physiology* was begun in 1878 (the first physiological journal in the English language), the editorial board consisted equally of physiologists from the two countries, and there was even a period when American physiologists held a majority on the editorial board.

The joint meeting of the two societies in Cambridge was memorable, especially the splendid dinner in the Great Hall of King's College. There we were reminded of two eminent physiologists who had attended that famous university. The first was William Harvey at the end of the 16th century, and the other was Stephen Hales a little over 100 years later. The latter's grave in his church at Teddington, just outside London, is presently being restored and the APS has made a modest contribution. More recently, the Cambridge School of Physiology has played a key role in the development of physiology in the UK following its establishment by Michael Foster in 1870 (4).

Those of us who took the opportunity to visit some of the surrounding parts of Cambridgeshire, such as the magnificent cathedral at Ely, saw some of the attractions of what is known as the Fen Country. This is so named because it is low-lying and was subject to seasonal flooding before its extensive drainage system was completed (5). In many respects, it is similar to the low-lying country of The Netherlands on the other side of the North Sea.

Excerpts from the Past President's Address, American Physiological Society Fall Meeting, Niagara Falls, NY, October 1985.

Oddly enough, we find ourselves in Fenn country again for this next meeting. I refer of course to Wallace O. Fenn, who was Chairman of Physiology at the University of Rochester from 1924 to 1959 and who was such a dominant figure in the development of American physiology during that time. Figure 1 is a fine photograph of Wallace Fenn, Hermann Rahn, and Arthur Otis taken at the 1963 Fall Meeting in Coral Gables, Florida. These three laid the foundations of much of present-day respiratory physiology.

It was Orr Reynolds who suggested that I look at Fenn's Past President's address, which was delivered at the first Fall Meeting of the Society in Minneapolis, Minnesota, on September 16, 1948 (1). The title was *Physiology on Horseback*, and I have unashamedly cribbed my title from his. Fenn's title referred to the fact that physiologists during World War II had been forced to abandon their ivory towers and go out into the field to tackle some of the immediate problems faced by a country at war. Fenn accepted the challenge and in fact his career showed a remarkable degree of adaptability to changing times.

Much of his early work was done on the basic physiology of muscle contraction following a period in London with A. V. Hill. He also worked extensively on the fate of potassium ions in cells. These topics were apparently far removed from the applications of physiology to environmental problems. However, when World War II came, he was catapulted into research on questions raised by high-altitude flight and diving. When asked to tackle problems of pressure breathing in high-altitude fliers, he (together with Rahn and Otis) laid the foundations of modern respiratory mechanics. Problems of hypoxia at high altitude led them into pulmonary gas exchange and their key contributions in the area of ventilation-perfusion relationships. The obvious importance of environmental aspects of physiology, especially in relation to respiration, led to the formation of the *Journal of Applied Physiology*, which remains a cornerstone in this area. Fenn progressed from problems of low barometric pressure to those of high pressure and ultimately to those of the new area of space physiology.

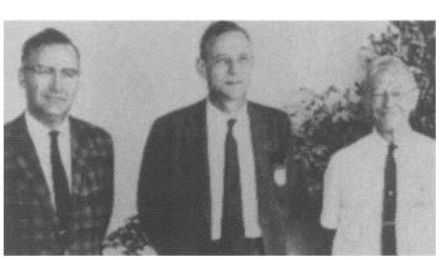

Fig. 1. *Left to right*: Arthur Otis, Hermann Rahn, and Wallace Fenn at 1963 Fall Meeting of American Physiological Society in Coral Gables, FL.

It has become fashionable to ask where physiology is going. No one can deny that some of the most important advances are being made at the cellular and subcellular level and that some departments of physiology are beginning to look like departments of cell biology. I see no problem with defining physiology in the broadest sense, although this move to the cell sometimes creates difficulties in the teaching of organ physiology to medical students, a critically important area since it forms the basis of the intelligent practice of medicine. However, the other great area of physiology that will never lose its importance is integrative physiology, including the interaction of the organism with its environment. This topic is special to the science of physiology, and Fenn showed how exciting this approach could be as he followed physiology into high altitude, great depths, and ultimately into space.

Wallace Fenn showed great imagination, vision, and enthusiasm. For example, the speed of advance of space physiology was dramatic in those early days. This can be seen from the symposium "Life in Space," which was held in Atlantic City in the spring of 1959, less than 1 year after the launch of Sputnik (2). Fenn could see a long way ahead and he regretted that he would not be around as the physiological problems in space developed still further. "The best is yet to come" he said in his moving review "Born Fifty Years Too Soon" (3). Those were the days when NASA could count on some of the best physiologists in this country for help and advice. I sense that this is not true today and wonder why. The best physical scientists still serve on the top NASA committees, but some of the life scientists seem to be disillusioned.

It is a pity that Fenn is not here with us today. What would he have made of astronaut Fisher hot-wiring the dormant LEASAT satellite (Fig. 2)? This certainly raises some interesting problems of physiology with a backpack. Even more astonishing to him would have been the photographs of astronaut Nelson attempting to capture the orbiting, vagrant Solar Maxi-

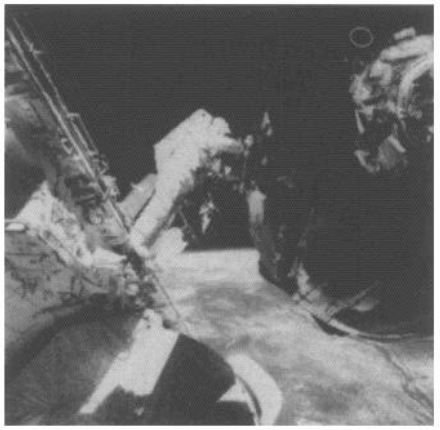

Fig. 2. Astronaut Fisher hot-wiring dormant LEASAT satellite.

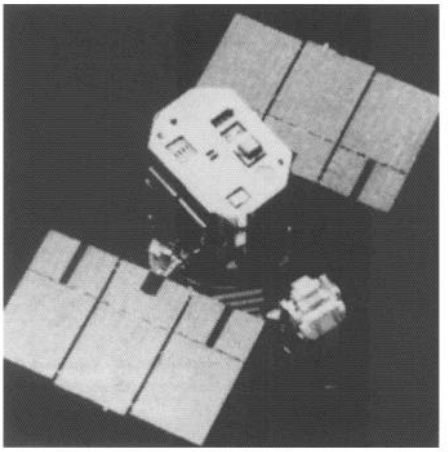

Fig. 3. Astronaut Nelson attempting to capture Solar Maximum Satellite in orbit.

mum Satellite using his Manned Maneuvering Unit backpack (Fig. 3). How he would have liked to have been part of the discussions on the physiological problems posed by the Space Station planned for the early 1990s.

I like to think that Fenn would have enjoyed discussing the results of another project of "physiology with backpack," the American Medical Research Expedition to Everest. The objective of this expedition in 1981 was to obtain physiological measurements on man at extreme altitudes, including the highest point in the world (6). This was certainly an ambitious goal; even reaching the summit is still a considerable undertaking and indeed the six expeditions to Everest immediately preceding our own were not successful in getting to the top.

However, we were lucky enough to have considerable success, and extensive physiological measurements were carried out at four sites on the mountain: base camp at an altitude of 5,400 m (17,700 ft), where we had a rigid prefabricated laboratory; camp 2 at an altitude of 6,300 m (20,700 ft), where another small but comfortable and warm laboratory was set up complete with heat and power; camp 5 at 8,050 m (26,400 ft); and finally the summit itself at an altitude of 8,848 m (29,028 ft). The measurements at the summit included alveolar gas samples, the first direct measurement of barometric pressure, temperature, and electrocardiogram. In addition, maximal oxygen uptake on the summit was determined from measurements on well-acclimatized subjects at 6,300 m when they were breathing only 14% oxygen. The physiological measurements made at the three lower altitudes included control of ventilation, effects of hemodilution on performance and central nervous system function, blood physiology, sleep studies, metabolic and hormone measurements, intestinal absorption, and neuropsychometric tests.

The results of the expedition are too extensive to be summarized here and have been described elsewhere (7). They showed that man can tolerate the extreme hypoxia of these great altitudes only by an enormous increase in ventilation that results in an alveolar Pco_2 on the summit of only 7.5 Torr and an arterial pH of over 7.7. Even so, the arterial Po_2 is apparently less than 30 Torr, and maximal oxygen uptake is about 1 l/min. Striking changes in many aspects of metabolism were seen, and there was evidence that the severe hypoxia caused residual impairment of central nervous system function in many expedition members for at least 2 years after return to sea level.

The continuing challenges of environmental physiology, including high altitude, great depths, and the new frontier of space physiology, show that the discipline of physiology is alive and well. I doubt whether Wallace Fenn would show any lessening of his enthusiasm if he were with us today.

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National Medal of Science Awarded to Vernon B. Mountcastle

Vernon B. Mountcastle, Jr., Director of the Philip Bard Laboratories of Neurophysiology at the Johns Hopkins University School of Medicine, was one of 20 recent recipients of the National Medal of Science, the nation's highest scientific honor. The awards were presented by President Reagan in a ceremony on March 12 in the East Room of the White House. Mountcastle was cited "for his fundamental research on how the brain functions in processing and receiving the information gathered through the somatic sensory system." A member of APS since 1949, Mountcastle was the first Editor of the *Journal of Neurophysiology* after the Society acquired the journal in 1962 and is currently Section Editor of the *Handbook of Physiology, The Nervous System.* He has received many other awards for his pioneering contributions to the study of the higher functions of the brain, including the prestigious Lasker Award [*Physiologist* 27(1): 20, 1984].

59TH PRESIDENT
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tee on Committees, and is currently a member of the Long-Range Planning Committee. For 5 years he served as the APS representative to the Council of Academic Societies of the Association of American Medical Colleges and continues active membership in the AAMC, with the Council of Deans, and recently as a member of the AAP/AAMC Animal Care in Research Committee. In addition to APS activities, Dr. Knox has held office, including the presidency, in the Association of Chairmen of Departments of Physiology and has held several committee chairmanships and offices in the American Heart Association, the National Kidney Foundation, and the American Society of Nephrology. Dr. Knox has also served in various capacities with the National Institutes of Health and is currently Chairman of the NIH General Medicine B Study Section. In addition to participating on several journal editorial boards, Dr. Knox was Associate Editor and then Editor of the *Journal of Laboratory and Clinical Medicine* from 1976 through 1980.

Physiology and FASEB 1986

The Spring 1986 Meeting marks a change in procedure for the Society's meetings. For the Society, FASEB '86 was the initiation of a policy of promotion of its symposia, both to the membership via publication of symposia previews in *The Physiologist* and to industry in the form of fund solicitations through the Executive Office. As a result of the cooperation of the symposia organizers, the Society has been able to meet almost the total cost of nonmember participation in the symposia (see list of contributors).

The Spring FASEB Meeting in St. Louis was a joint meeting of five FASEB member societies along with several guest societies. Overall, the participants in this meeting submitted 5,721 abstracts of volunteered papers. Of this total, 1,900 papers were submitted by the APS membership and two APS guest societies: the Society for Experimental Biology and Medicine (SEBM) and the Biomedical Engineering Society (BMES). The physiology component of FASEB '86 represented 33.21% of the short communications presented by APS members and guests.

Of the APS-sponsored papers, 377 or 19.86% represented the scientific efforts of women physiologists (as first authors) and 140 or 7.38% of non-American physiologists. In addition, 159 or 8.38% were received from US government laboratories and 54 or 2.85% were received from physiologists employed in industry. Not only did industrial physiologists submit abstracts and industry provide financial support for the symposia but industry also directly supported the research presented in 28 abstracts.

Of the 1,776 APS member-sponsored abstracts, 20.16% were designated by the authors for inclusion in topics programmed by other FASEB member societies (Table 1). Only 53.61% of the SEBM papers were designated for presentation in APS sessions.

Of the 1,840 volunteered papers programmed by APS, 21.36% of the total were the products of the other FASEB member societies, with ASPET members providing the majority (Table 2). The ASPET contributions were most noticeable in several major areas of physiology including cardiovascular, respiration, endocrinology and metabolism, cell and general, renal, and nervous system. Considerable input in endocrinology and metabolism was also received from AIN.

Table 3 shows the distribution of volunteered papers programmed by APS and its guest societies into slide and poster sessions in conformance with the various sections of the Society. Of the 1,840 papers programmed by the Program Advisory Committee (PAC), 1,226 or 66.63% were scheduled for poster sessions and 614 or 33.37% were scheduled for slide presentations. The percentage of papers programmed as posters at FASEB '86 was greater than the percentage at FASEB '85 (62.07% or 1,314 posters). Overall, the PAC programmed the volunteered papers

TABLE 1 **Volunteered Papers Sponsored by APS, SEBM, and BMES for FASEB '86**

Society	Total		FASEB Program Designation					Total
	Received	Withdrawn	APS	ASPET	AAP	AIN	AAI	
APS	1,778 (93.58%)	2	1,418 (79.84%)	184 (10.36%)	109 (6.14%)	47 (2.65%)	18 (1.01%)	1,776
SEBM	97		52 (53.61%)	23	13	8	1	97
BMES	25		25 (100.00%)					25
Total	1,900	2	1,495 (78.77%)	207 (10.91%)	122 (6.43%)	55 (3.00%)	19 (1.00%)	1,898

TABLE 2 **Programming of Volunteered Papers by APS Sections/Groups**

	APS	ASPET	AAP	AIN	AAI	Total
Cardiovascular	378	53	8	5		444
Respiration	320	31	3	1	2	357
Endocrinology & Metabolism	100	29	5	53	10	197
Environ, thermal, & exercise	104	7		4	1	116
Cell & general	63	28	3	18	6	116
Renal	59	20	2	5	1	87
Muscle	71	9	3	3		86
Epithelial transport	69	8	2	3	1	83
Neural control & autonomic regulation	65	8				73
Gastrointestinal	58	4		6		68
Water & electrolyte homeostasis	48	1		1		50
pH theme	32	11	4	1		48
Nervous system	17	22	1	1	1	42
Biomedical engineering	34	2	1	2		39
Comparative	22			1		23
Teaching	9	1	1			11
History						
Total	1,447	234	33	104	22	1,840
% Societal contribution	78.64	12.72	1.79	5.65	1.20	100

TABLE 3 **APS Scientific Sessions at FASEB '86**

	Volunteered Papers				Sessions					
	Slide	Poster	Poster discussion	Total	Slide	Poster	Poster discussion	Symposia	Special	Total
pH theme		48		48		2		7		9
Clinical								3		3
Cardiovascular	163	281		444	15	14		3		32
Cell & general		116		116		10		2		12
Comparative	12	11		23	1	1				2
Endocrinology & metabolism	60	137		197	5	5		2		12
Environ, thermal, & exercise	55	61		116	5	4		2	1	12
Epithelial transport	24	59		83	2	2		2		6
Gastrointestinal	23	45		68	2	2		1		5
History										
Muscle		86		86		4		4		8
Nervous system	10	32		42	1	1		3		5
Neural control & autonomic regulation	36	37		73	3	2				5
Renal	24	63		87	2	6		2		10
Respiration	164	140	53	357	16	9	3	4		32
Water & electrolyte	31	19		50	3	2		1		6
Biomedical engineering	12	27		39	1	2		5		8
Teaching		9		9		1		1		2
Total	614	1,173	53	1,840	56	67	3	42	3	171

TABLE 4 **Affiliations of 1,705 Authors Who Volunteered Papers**

Department	No. of Papers	% Total
Physiology	570	33.43
Medicine	389	22.82
Physiology/biophysics	125	7.33
Pharmacology	78	4.57
Biology	77	4.52
Surgery	65	3.81
Anesthesiology	53	3.11
Veterinary medicine	41	2.40
Joint disciplinary	37	2.17
Pediatrics	32	1.88
Public health	31	1.82
Biochemistry	25	1.47
Anatomy	24	1.41
Subtotal	1,547	90.74
Engineering	51	2.99
Subtotal	1,598	93.73
Other (23)	107	6.27

into 56 slide sessions, 67 poster sessions, and 3 poster discussions.

The PAC-Program Executive Committee (PEC) was also responsible for the development of 36 of the 42 symposium sessions at FASEB '86. The APS-managed theme for this year consisted of 7 symposium sessions on "pH." Overall, there was a total of 171 physiology sessions during FASEB '86 (Table 3).

Table 3 also reveals the number of papers and symposia contributed by each of the sections of the society. Relative to FASEB '85, the volunteered papers assigned to each section were down roughly in proportion to the decline in the total number of papers programmed for FASEB 86. The only section experiencing an increase in papers was water and electrolyte homeostasis, from 38 in 1985 to 50 in 1986.

Table 4 addressed the question "where do APS-submitted abstracts come from?" As indicated, 33.45% of the volunteered papers originated in departments of physiology, with an additional 7.33% coming from departments of physiology and biophysics. In addition, departments of medicine contributed 22.82% of the volunteered papers.

Overall, the APS contribution to FASEB '86 was significant as well as scientifically rewarding. However, without the support of the APS membership, the scientific meeting program would not have come to fruition. Special thanks must go to members of the PEC and PAC, to Carl Gisolfi, Chairman of both the PAC and PEC, the symposia organizers, and the staff of the Membership Services Department. In addition, I would like to thank Joseph Saunders for preparing the tables in this report prior to his move to AAI.

Martin Frank

Contributors to 1986 APS Spring Meeting Program

The American Physiological Society gratefully acknowledges the support provided for its Spring Meeting Program by the following organizations: National Cystic Fibrosis Foundation; Cardiac Muscle Society, Royal Society of Medicine Foundation; Abbott Laboratories; American Cyanimid Company; Ayerst Laboratories; Bayer AG/ Miles Laboratories; Burroughs Wellcome Company; Ciba Geigy Corporation; Gould, Inc.; Hoffman-La Roche, Inc.; MedPacific Corporation; Merck and Company; Monanto Company; Pfizer Corporation; Pharmaceia Corporation; Revlon Health Care Group; Schering Corporation; G. D. Searle and Company; Smith Kline Beckman; Sterling Winthrop Research Institute; Stuart Pharmaceuticals; Triton Bioscience, Inc.; TSI, Inc.; and Upjohn Company.

1986 APS Caroline tum Suden Professional Opportunity Awards

The Caroline tum Suden Professional Opportunity Awards, established by APS in 1982, are funded by the bequest of Dr. Caroline tum Suden, an early member of the Society. Born in San Francisco in 1900, she received a B.A. from Berkeley, an M.A. from Columbia, and a Ph.D. in Physiology from Boston University in 1933. Until 1947 she was an Evans Fellow and instructor in the Department of Physiology, Boston University, where she worked with Dr. Leland Wyman on problems of adrenal function. After 3 years of teaching physiology at Mount Holyoke College, she was invited by Dr. Bruce Dill to join the staff of the Army Chemical Center at Edgewood Arsenal, MD, where she carried on exemplary research in neurophysiology and neuropharmacology. Her career was one of devotion to physiological research, for which she, like many women in APS, received inadequate recognition. The awards honor her and symbolize APS' concern with encouraging the careers of both young women and young men.

The Caroline tum Suden Professional Opportunity Award is to provide funds for junior physiologists, graduate students, or postdoctoral fellows; to present a paper at the APS/ FASEB Meeting; and to utilize the FASEB Placement Service. The awards are open to both women and men whether or not they are FASEB members.

Of the 28 applications received, the Women in Physiology Committee selected **Mark S. Alsberge, Cathy A. Bruner, Katherine J. Lucchesi, Rick G. Schnellman, Kathleen A. Thompson, and Margaret R. Warner** to receive the 1986 Caroline tum Suden Professional Opportunities Award.

APS Perkins Fellowship Awards

The John F. Perkins, Jr. Memorial Fellowship Fund was established to provide supplementary support to the families of foreign physiologists who have arranged for fellowships or sabbatical leave to carry out scientific work in the United States. US physiologists who require supplementary assistance to work abroad are also considered. The interest of the Perkins Fund is to develop the full potentialities for cultural benefit associated with scientific exchange. Preference is given to physiologists working in the fields of respiratory physiology, neurophysiology, and temperature regulation. Awards are made in February and July of each year. For the period of July 1985 to January 1986, the five awardees were selected as follows:

Yoshihiro Kikuchi, Tohoku Univ., Japan (wife and 2 children)
Stephen H. Loring, Harvard Univ., Boston, MA
Pierre Meyrand, Univ. de Bordeaux 1, France (wife and 3 children)
Eve Marder, Brandeis University, Waltham, MA
John Reed, Univ. of Newcastle Upon Tyne, UK (wife and 2 children)
John B. West, Univ. of California, San Diego, La Jolla, CA
Constantinos Christakos, Univ. of Goettingen, West Germany (wife and 1 child)
Morton Cohen, Albert Einstein College of Medicine, Bronx, NY
Ido Perlman, Israel Inst. of Technology, Haifa, Israel (wife and 3 children)
John E. Dowling, Harvard University, Cambridge, MA

G. Edgar Folk, Jr. Senior Physiologist Fund

APS is pleased to announce the establishment of the G. Edgar Folk, Jr. Senior Physiologist Fund. This fund has been set up through the generosity of family and former graduate students and post-docs in order to provide modest but helpful assistance to senior physiologists 70 years or older who no longer have grant funds available to them. The awards might be used for such purposes as attending an APS meeting to present a paper, engaging in a series of modest experiments, or completing a manuscript (paying for typists or perhaps for page charges). Recipients will be selected with the assistance of the Senior Physiologists Committee throughout the year. Names of awardees will not be made public. Mary Folk writes that the purpose of the fund is for the Senior Physiologists Committee "to have *fun* assisting colleagues and for Emeritus APS members to keep in closer touch with APS."

G. Edgar Folk, Jr., Professor of Physiology, Emeritus, at the University of Iowa, is one of the country's foremost authorities on cold-weather physiology. He began his studies on acclimatization to cold during World War II at the Harvard Fatigue Laboratory and received his Ph.D. from Harvard in 1947. Since 1953 he has been associated with the Department of Physiology at the University of Iowa. With his wife, a medical illustrator, he spent 17 summers and many winters at the former Point Barrow Naval Arctic Research Laboratory, Alaska, located 350 miles inside the Arctic Circle, studying the response of Arctic animals to cold. Dr. Folk is the author of *Textbook of Environmental Physiology* (he is now preparing the 3rd edition), as well as author or co-author of 150 papers and 137 preliminary reports. Dr. and Mrs. Folk recently edited a volume in celebration of the centennial of the birth of Vilhjalmur Stefansson (1879–1962), an alumnus of the University of Iowa and a pioneer Arctic scientist. Dr. Folk has been a member of APS since 1953.

Inquiries concerning the G. Edgar Folk, Jr. Senior Physiologist Fund should be made to Martin Frank, Executive Secretary-Treasurer, APS.

News From Senior Physiologists

Letter to E. B. Brown:

Stephen Hadju reports that he has made a clean break with physiological research "for I do not believe research can be anything but a full-time very intensive occupation"; he keeps up with physiology through his son and colleagues when they seek his views on their findings. He writes, "According to the Greeks the perfect man should master 12 fields." He has turned to astronomy for which his present location (Marco Island, FL) is well suited, has taken up Greek again, and is discovering all manner of nuances in the New Testament and is besides that a jack-of-all-trades.

Letters to Arthur Otis:

John P. Mixner writes that, after his retirement as Research Professor of Animal Physiology and Chairman of the Department of Animal Sciences at Rutgers, he and his wife, Exa, moved to Hendersonville in the mountains of North Carolina, where he has become interested in gardening. They have traveled to Russia, China, Japan, Turkey, the Balkans, Egypt, Morocco, and Southern Europe. "Incidentally," he comments, "I have had no problem in adjusting to retirement and can recommend it thoroughly."

Leslie E. Edwards writes that he hoped to have seen Dr. Otis at the Civilian Public Service Unit 115-R 40th reunion at Rochester in 1984. He and his wife, Carolyn, a former student of Fenn, visited with Dr. Rahn, Dr. Adolph, and Drs. Frank and Lucille Hegeness. "The reunion made me realize again what outstanding scientists (Dr. Adolph, Dr. Fenn, and Dr. Murlin) we had the opportunity to work with. The OSRD could not have selected better people . . . ." He retired from Medical College of Virginia in 1979 after teaching and doing research there for 31 years. His main activity has been operating a small beef cattle farm owned by the Edwards family since 1951, which is often used for picnics by students and departments of the Medical College of Virginia. He and his wife have organized a symposium at Virginia Commonwealth University to be held in April 1986 on human rights and the detention of individuals under emotional stress.

Letters to Roy Greep:

Thomas P. Almy writes, "After a 3-year term in the post of Distinguished Physician of the Veterans Administration, I have retired to part-time teaching activities and community responsibilities. With colleagues in the Department of Community Medicine I have developed for 4th year students at Dartmouth Medical School a required course in the social sciences and humanities in clinical medicine, based upon the active independent study of decision making in complex cases. I am involved in a regional initiative for the organization of long-term care for the frail and dependent elderly. If I am granted a few more years before I myself become one of them, I hope to extend a bit further these atypical applications of the discipline I owe to so many distinguished members, past and present, of the APS."

D. Harold Copp recently completed a history of the Department of Physiology at the University of British Columbia, where he served as head from 1950 until his retirement in 1980. The departmental building, recently enlarged, has been renamed the D. Harold Copp Building. He writes, "I still occupy my old office (of 25 years) and continue my research on calcium homeostasis in fish in my old laboratory, assisted by a postdoctoral fellow, Graham Wagner, and a very efficient technician, Maggie Hampong. We are currently trying to characterize a hormone from the corpuscles of Stannius which we have dubbed "teleocalcin." His next task is a history of calcitonin and a chapter on calcitonin for a text on vertebrate endocrinology. "As you have found, retirement can be a very busy and rewarding time."

George F. Koepf is recovering from a coronary bypass last year and is now back in his office. He continues to participate in administrative affairs of the Medical Foundation of Buffalo, which he founded in 1956. This past year has been especially rewarding in that Herbert Hauptman, Vice-president and Research Director, was the corecipient of the 1985 Nobel Prize in Chemistry. Dr. Koepf and his wife look forward to spending the summer of 1986 on their Georgian Bay Island.

PUBLIC AFFAIRS

Transformation of Society's Beliefs Is Goal of Animal Rights Movement

The following excerpt is from presentations by APS Public Affairs Consultant William M. Samuels in September before The Physiology Society in Cambridge, England, and in November before the Association of Chairmen of Departments of Physiology in Houston, Texas.

The question of using live animals as laboratory models has been a continuing issue in Europe for centuries, but it only has been within the last half-dozen years that the issue has resurfaced in the United States.

What I regret to have to tell you at the outset of my remarks is that many of your colleagues have yet to grasp the seriousness of this international conspiracy that would deny them their privilege to continue to use laboratory animals in the conduct of their work.

Many researchers and educators view the animal rights movement as nothing more than a blip on society's radar screen, while the animal advocates see their goal as a permanent transformation of society's respect for the rights of all animals.

The message is clear: the animal advocates are playing a game of realignment politics.

For the animal advocates to win a political realignment in today's society, a shift in public interest and involvement is required. Opinion polls do indicate that the American public is showing an increased interest in animal welfare, but there is no corresponding evidence at this time that society is ready to adopt a new set of beliefs.

Moreover, opinion polls always are volatile, often reflecting reactions stimulated by nothing more than a few days of good or bad television coverage of a particular incident. So far, the incidents of alleged animal abuse created by the Animal Liberation Front have not sent people into the streets yelling at their neighbors, "Good God, look what's happened now!"

This lack of continuing interest and involvement by the public in celebrated cases of animal abuse devalues such incidents over the long term. This is not to imply in any way, however, that we have a stalemate with the animal advocates in their efforts to attain a political realignment.

The truth of the matter is that the animal advocates are winning by default, because the scientific community has yet to provide a "Look what's happened now" story of its own. Instead of taking the initiative, American scientists, by and large, are only reacting to charges and incidents, thus presenting to the public a defensive posture that, at best, is a negative posture.

The longer the scientific community stays in a negative posture, the easier it will be for the animal advocates to achieve their goals.

Perhaps the primary reason for this negative posture is the fact that the scientific community is being forced to counter the animal rights movement in three distinct political arenas, each with a different target. These targets are the source of laboratory animals; the housing and care of animals waiting to be used in research or educational projects; and the treatment of animals when they are being used in experimentation, testing, or demonstration.

In each of the targeted areas specific animal protection groups have been designated to coordinate and unify these efforts as separate campaigns. Thus, scientists are being assaulted on three fronts.

The humane societies, headed by The Humane Society of the United States, are leading the assault to cut off the source of laboratory animals, especially unclaimed pound animals.

The animal welfare organizations, such as the Society for Animal Protective Legislation, are attacking the housing and daily-care requirements for laboratory animals.

The animal rights groups, led by People for the Ethical Treatment of Animals (PETA), are dedicated to abolishing the use of all animal models in the laboratory.

To better understand the political motives of these three groups and their assigned targets, we need to examine each one separately.

First, the campaign to dry up the source of laboratory animals. The key to this effort, as is the key to all efforts within the animal rights movement, is the play on human emotions. In this case the emotions are focused on unclaimed cats and dogs provided by local pounds, animal shelters, and dealers because virtually everyone can relate to a dog or cat, especially if they are told that the animal is to be abused by some kind of experiment.

The Humane Society of the United States has announced that its principal goal for the decade of the 1980s is the enactment of laws in each of the 50 states that would prohibit the release of any animal for any purpose other than pet adoption.

The humane societies, operating under an umbrella called the "National Coalition to Protect Our Pets," are confident that 40% of this goal will be attained by the year 1990 and that 100% of the goal will be attained before the year 2000.

Through last year nine states have adopted such laws, and this year the humane societies have had legislation introduced in more than 30 state general assemblies.

The political tactic for this particular effort is obvious: win first the point in the largest city in the state through municipal ordinance and then move the issue to the state capitol. This tactic effectively has split the scientific community to where it continually is confronted by as many as 50 separate, grassroot actions at the state and local levels, each action focusing on the issue that the animal advocates are saving *local* pets from death by researchers.

The irony of this is that the educational and research institutions in the United States use fewer than 500,000 unclaimed dogs annually, and the humane societies and municipal pounds are destroying between 13 and 15 million unwanted dogs each year.

The second targeted area—the housing and care of laboratory animals—is the goal assigned to the animal welfare groups, which are the most moderate of all of the animal rights organizations.

Unlike the humane societies, which are concentrating their efforts in the agencies of state and municipal governments, the animal welfare groups are seeking federal reforms.

In the last 6 years more than three dozen bills and resolutions were introduced in the US Congress calling for reforms and restrictions on the care and treatment of laboratory animals. To date, none have become law.

However, during this same period several major regulatory agencies of the federal government have revised their animal care policies, and guidelines for research and educational institutions receiving federal funds for projects involving the use of laboratory animals. By and large, these policy revisions—promulgated prior to enactment of any legislation—accede to the demands of the animal welfare organizations, including a requirement that each institution must establish an animal care committee that includes at least one person not affiliated with the institution and who is to be responsible for the community's concern for the welfare of the animal subjects.

Four bills were introduced in the cur-

rent Congress, two of which APS suggested.

One of the bills suggested by the Society would make it a federal crime to break into any federally funded institution and disrupt the research or steal research data, equipment, or laboratory animals. The other APS-suggested bill would amend the Animal Welfare Act, the only legislative authority in the United States regarding the care and use of animals.

The other two bills pending before the Congress were suggested by animal welfare groups. One, the Walgren bill, would create a second legislative authority for animal care and use in projects supported by the US Department of Health and Human Services. The other bill would create a presidential committee to review all approved federal grants involving the use of laboratory animals. This committee would have the power to veto grant approval should the committee find that the animal work has been done elsewhere in the world or if a similar project already is in progress somewhere in the world.

The fate of these measures is yet to be determined. However, the successes of the animal welfare organizations in gaining changes of policy within federal regulatory agencies prior to legislative actions give a strong hint that other legislative successes still can be gained by this faction.

The third target area—to abolish the use of all laboratory animals—I consider to be the most serious of the three because of the destruction and the threats of violence that have accompanied the efforts thus far to achieve this end.

The campaign to abolish the use of any and all laboratory animals is being waged by both overt and covert militant groups within the animal rights movement.

Unlike the humane societies and the animal welfare groups, which will confront you in the halls of government, the Animal Liberation Front remains a faceless force that breaks into research facilities and vandalizes, destroys, and steals millions of dollars worth of equipment and laboratory animals.

Although the Animal Liberation Front has been an active force in the United States since 1979, it only has been in the last 36 months that its efforts have intensified. Within that time frame the Animal Liberation Front has issued more than a dozen threats of death or violence to individual scientists and has raided 15 research institutions, including two separate raids at the University of Pennsylvania.

There is a noticeable difference, however, between the Animal Liberation Front in the United States and its counterpart in Great Britain. In the United States all of the threats of death or violence, as well as the raiding and vandalizing of laboratories, have been targeted only to the academic community.

Commercial laboratories, probably because of their industrial security precautions, never have been targets for raids by any of the animal advocate groups. Moreover, this shunning of the industrial laboratories has had its effect on the academic community. Pharmaceutical houses, for example, are keeping a low profile and providing virtually no support of any kind, thus forcing the academic community to wage the political battles and absorb the brunt of the attacks on the use of laboratory animals.

Fortunately, the academic community in the United States has not as yet experienced some of the violence experienced in Great Britain, such as letter bombs, petrol bombings of homes, and the like. Unfortunately, many of us believe that the days of such violence will come to the United States as the Animal Liberation Front escalates its campaign of intimidation.

From what I have illustrated you can readily see that the animal rights movement in the United States is one that is carefully planned, well coordinated, and as of this moment can be graded as effective. Whether the movement can achieve from society the political realignment it seeks remains to be seen.

The order of battle has been established by the animal advocates, and the scientific community is forced to respond to the separate challenges of state and local laws, federal legislation and regulations, and intimidation.

Furthermore, the scientific community will have to prevail in all these areas of challenge while the animal advocates need only to prevail in one, inasmuch as legislation at one level or successful campaigns of intimidation can offset the imperative need to accomplish the goals of the other challenges.

National associations, such as APS, are effective in blunting the proposed federal restrictions against the use of laboratory animals. National associations, however, are not effective at the state and local levels in meeting grassroot challenges of proposed laws and intimidation. It is here where the local scientific communities must meet the challenges hurled at local institutions.

While this may sound bleak, let me assure you that this in no way is to imply that the issue is lost. The scientific community has the advantage of knowing the three political arenas where the actions are taking place and knowing both the tactics and the strategies being used.

Additionally, the demographics of the animal rights activists are known. A recent survey of animal rights groups and individuals, published in *Animals' Agenda*, March/April 1985, revealed that the movement is 70% female, overwhelmingly white, and that four out of five activists are between the ages of 21 and 49 years. Also, 80% live in urban or suburban areas and 84% are college graduates, with 25% of that group holding advanced degrees. Financially, 80% hold business or professional occupations with annual incomes of between $25,000 and $50,000.

The survey from which these data were drawn also revealed a schism in that 50% of the activists have an absolute opposition to the use of any animal in research, whereas 45% indicated that animal research is acceptable under supervised conditions. By contrast, all of the organizations surveyed reported that they have stated policies against the use of animals in research and experimentation.

To conclude my remarks I would like to leave one thought. Now that we have begun an exchange of information, we cannot afford to allow this dialogue to stop here.

Should the scientific community fail to prevail, we surely will see some kind of political realignment of society that will take centuries to repeal.

We are confronted with an international conspiracy and to combat it will require an international effort that must involve all individuals who believe in the need to use laboratory animals as well as individuals who are beneficiaries of animal research.

The task before each of us is the task of education. The education of colleagues, the lawmakers, the press and media, and, perhaps most important of all, the public-at-large.

William M. Samuels, CAE

APS Membership Applications

Membership applications may be obtained from APS Membership Services, 9650 Rockville Pike, Bethesda, MD 20814. Applications received between February 1 and July 1 are considered for nomination by Council at the Fall Meeting, and those received between July 1 and February 1 are considered for nomination at the Spring Meeting of the Society.

OPINIONS

On Teaching Physiology to Medical Students

For the first 200 years medical education in this country was primarily a system of apprenticeship, with the result that most physicians had no scientific basis for treating their patients. Then, about 60 years ago, in response to the findings in the Flexner report, the basic sciences required to understand the functioning of the human body were incorporated into medical school curricula throughout the country, and competence in the natural sciences became a requirement for medical school admission. Twenty years after this modification of medical school curricula US medicine began to lead the world in scientific medical research and innovation. Then, 20 years ago another upheaval in medical education occurred. In response to student interest and demand the emphasis in basic science teaching in the medical schools shifted to the identification of a "core" of essential facts to be memorized. This core was meant to be supplemented by individual study of elected subjects. Most students elected the most relevant subjects, i.e., apprenticeship with a practicing physician. This brings us back to the turn of the century, when doctors were perceived by the public as purveyors of snake oil.

Just as a scientific basis for the understanding of how the human body functions became available, we began training physicians who do not know this classic physiology. In recent years many attempts have been made to remedy the situation by using computers to replace the time-consuming and often exasperating experiments on animals and the students themselves, which were the occasion for real learning in the curricula 40 and 30 years ago. However, computer programs are hard wired; they cannot incorporate the complexity and variability of the living organism. At best, they can be used to review simple core material in terms of simple models that represent individual processes in some organ systems. At worst, the use of computer models leads the student to believe that physiology can be reduced to such models and that understanding and diagnosis can be delegated to machines. Even the engineers who pushed the "artificial intelligence" of computers and tried to demonstrate it now realize that this can't work (H. Dreyfus and S. T. Dreyfus. Mindless machines. *Sciences* Nov/Dec: 18–22, 1984). After 35 years of "learning" the best of the computer systems that concentrated on the simple game of checkers still cannot beat the human world-champion checkers player.

Since there are many practical reasons that prevent us from seriously considering the reintroduction of old-fashioned student laboratories into the physiology curriculum, I have tried to identify the essential parts of the classical curriculum and to understand how our contemporaries learned the physiology that is the basis of medical practice. It is often said that, because of the explosion of new knowledge, no one can be expected to be proficient in all areas and that there is not enough time in medical schools to do anything but memorize all essential facts. While it is true that there has been an explosion of new knowledge of how the body functions at the cellular and subcellular level, a detailed understanding of processes at that level is not essential for an understanding of how the body functions at the level of the organ systems. Most of the medical problems primary-care physicians encounter are malfunctions of the organ systems and of the interactions between them. This is so even when the underlying cause of organ malfunction is at the cellular level. For this reason physiology teaching to medical undergraduates should concentrate on the level of organization of the organ systems and their interactions.

At the level of organization of the organ systems, the simple 19th century laws of physics and chemistry can adequately explain everything that can be grossly observed and measured. The relevant laws can generally be expressed in terms of simple algebra and solved by arithmetic. Moreover, an introductory course in human physiology has only one major function to explore and that is the maintenance of a healthy body, i.e., how the body keeps all systems in the steady state. This is accomplished by a number of transport systems and two systems that regulate the transport systems (the neural and endocrine systems). When this is kept in mind, the essentials of organ physiology can be taught didactically in a third to a half of the time generally allotted to the medical physiology course in the preclinical years. Even more time can be saved in the mastery of didactic material that must be memorized if the same vocabulary and symbols are used throughout the course. The physiological society should catalyze such standardization by organizing standardization conferences. A standardization of symbols was successfully introduced into pulmonary physiology in 1950 and played an important role in making this scientific material accessible to physicians and paramedical personnel. The major component of the physiology course, however, must be that in which the student acquires a thorough understanding of the application of basic physical-chemical processes to the functioning of the intact awake human being.

As I said above, in the past this learning experience occurred in all-day laboratory sessions. Physiology is a biological science, and accurate, precise observation of the living organism is its core. When confronted with a rabbit, cat, or dog, students saw not only basic principles illustrated but also that the details of the response were different in each individual. It was the attempt to explain the individual response that was the true learning experience. How did students arrive at a specific diagnosis? By applying the method of asking a series of questions, each of which had several plausible answers that led to more questions. Gradually the wrong answers were discarded, and the students were left with the most plausible explanation of what was observed. This is precisely what physicians must do every time they are confronted with a patient. Experienced doctors are no longer conscious of the reasoning process and may come up with an instantaneous diagnosis, but the beginning physician must analyze and systematize his observations. This type of analysis of observed data is best taught to small groups of students because it is essential that each individual learns what questions to ask and how to sequence them as well as the fact that there are multiple ways of tackling every real problem. In the absence of test animals in the student laboratory, hypothetical experiments must be introduced and a series of such experiments with a few questions to begin the analysis of hypothetical observations could be compiled by the physiological society. However, the real values of this type of teaching are in the interactions between students and teacher and in the stimulation of each student to think logically and productively. Every group studying a given hypothetical case will use somewhat different analyses and may even arrive at different conclusions as to the best explanation of the described data, but it is precisely this simulation of real life complexity that is valuable.

Edith Rosenberg

To the Editor

Your recent article [*The Physiologist* 29(1): 1, 1986] on the future of physiology reminded me of our talk when we met in Cambridge. This issue was also the topic of our discussion. I felt then and I still think that the problems associated with the future of physiology are not related to physiology per se but rather to attitudes developed within our society that are then reflected in attitudes of many biological scientists.

In our society far too many people think that our problems are so complex that it is useless to attack any of the larger issues. As a result, people are becoming more and more specialized, i.e., computer programmers vs. computer designers vs. computer system designers vs. computer operators vs. computer installation experts ad infinitum, ad nauseum. The counterpart in biology is that we have molecular biologists divided into chemists, physicists, theoreticians, and even molecular physiologists. At another level we have cell biologists, cellular microscopists, cell subfractionaters, and so on. We see less and less of organ physiologists, organ-system physiologists, and especially whole-animal physiologists.

It is my view that those who are dealing at the "smaller" levels of organization do good work, but they are really attacking the "easy" problems. I say this because they deal with so many fewer variables than individuals working at "higher" levels of organization, and the training that they require is limited, albeit more sophisticated than that of, let us say, organ-system physiologists. Another attribute that is lost is that the "old-time physiologists" could become any one of the specialists we have mentioned. A cardiovascular physiologist, for example, could use physics, chemistry theory, anatomy, molecular biology, or nuclear magnetic resonance in his or her work. This was part of the fun of becoming a physiologist.

Instead of getting angry at the splitting of physiology into so many subareas, I become sad. The new breed of physiologists tends to be restricted in knowledge and approach. Attending and giving seminars to mixed audiences will readily confirm this point. What is worse to me is that these people will not have the fun of synthesizing information from a variety of fields into major concepts. To me the activity of such synthesis is as important as whether a person is right or wrong.

In the future, I cannot see a disappearance of physiology, as we have known it. There may be a time of decreased popularity of general physiologists, but in the long run we will be needed for this major synthetic function. Again, physiology at higher levels of organization will become popular and we will see a return of the "Renaissance people" of biology.

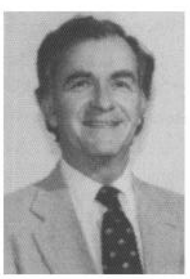
Sidney Solomon
Professor of Physiology

APS Election Results

Dr. **Harvey V. Sparks, Jr.**, Professor and Chairman, Department of Physiology, Michigan State University, East Lansing, MI, was elected President-Elect. The two new Councillors are Dr. **Shu Chien**, Professor of Physiology, Columbia University, College of Physicians and Surgeons, New York, NY, for a 4-year term and Dr. **Jay A. Nadel**, Professor, Cardiovascular Research Institute and Department of Medicine and Physiology, University of California Medical Center, San Francisco, CA, to complete Dr. Sparks' term expiring in 1988.

Harvey V. Sparks, Jr.

Shu Chien



Jay A. Nadel

BOOKS RECEIVED

Appendixes from Laboratory Outlines in Biology. IV. P. Abramoff and R. G. Thomson. New York: Freeman, 1985, 51 pp., illus., $1.95.

The Auditory Midbrain. Structure and Function in the Central Auditory Pathway. L. Aitkin. Clifton, NJ: Humana, 1986, 262 pp., illus., index, $45.00.

Basic Concepts of Neuronal Function. D. L. Jewett and M. D. Rayner. Boston, MA: Little, Brown, 1984, 411 pp., illus., index.

Biochemistry of Macrophages. Ciba Foundation Symposium 118. D. Evered, J. Nugent, and M. O'Connor (Editors). London: Pitman, 1986, 256 pp., illus., index, $35.00.

Chemotherapy in Psychiatry. Principles and Practice. R. J. Baldessarini. Cambridge, MA: Harvard Univ. Press, 1985, 354 pp., illus., index, $25.00.

Clinical Measurement of Taste and Smell. H. L. Meiselman and R. S. Rivlin (Editors). New York: Macmillan, 1986, 602 pp., illus., index, $85.00.

Control of Leaf Growth. N. R. Baker, W. J. Davies, and C. K. Ong (Editors). New York: Cambridge Univ. Press, 1985, 350 pp., illus., index, $39.50.

Current Topics in Neuroendocrinology. Neurobiology of Vasopressin. D. Ganten and D. Pfaff (Editors). New York: Springer-Verlag, 1985, 203 pp., illus., index, $34.50.

Every Girl: Learning About Menstruation. H. McK. Doan and J. M. Morse. Toronto: Stoddart, 1985, 84 pp., illus., index, $7.95.

The Exocrine Pancreas: Biology, Pathobiology, and Diseases. V. L. W. Go, J. D. Gardner, F. P. Brooks, E. Lebenthal, E. P. DiMagno, and G. A. Scheele (Editors). New York: Raven, 1985, 920 pp., illus., index, $135.00.

Hypothalamic Control of Pituitary Functions. The Growth Hormone Releasing Factor. R. Guillemin. Liverpool: Liverpool Univ. Press, 1986, 73 pp., illus., index, $19.95.

The Menstrual Cycle and Physical Activity. J. L. Puhl and C. H. Brown (Editors). Champaign, IL: Human Kinetics, 1986, 164 pp., illus., index.

Molecule Nerve and Embryo. R. R. Ribchester. New York: Chapman & Hall, 1986, 204 pp., illus., index, $29.95.

The Molecules of Life. New York: Freeman, 1986, 139 pp., illus., index, $21.95 (cloth), $12.95 (paper).

Neurobiology of Vasopressin. D. Ganten and D. Pfaff (Editors). New York: Springer-Verlag, 1985, 203 pp., illus., index, $34.50.

Neuropsychopharmacology of the Trace Amines. Experimental and Clinical Aspects. A. A. Boulton, P. R. Bieck, L. Maitre, and P. Riederer (Editors). Clifton, NJ: Humana, 1986, 510 pp., illus., index, $69.50.

Photoperiodism, Melatonin and the Pineal. Ciba Foundation Symposium 117. D. Evered and S. Clark (Editors). London: Pitman, 1985, 323 pp., illus., index, $35.00.

Problems in Diagnosis and Management of Polycystic Kidney Disease. J. J. Grantham and K. D. Gardner (Editors). Kansas City, KS: PRK Foundation, 1985, 264 pp., illus., index.

Positions Available

There is a $25 charge per issue for each position listed. A check or money order payable to the American Physiological Society must accompany the copy. Purchase orders will not be accepted unless accompanied by payment. Ads not prepaid will not be printed. Copy must be typed double-spaced and limited to 150 words. All copy is subject to the editorial policy of *The Physiologist*. EOAAE indicates Equal Opportunity/Affirmative Action Employer and appears only where given on original copy. Copy deadline: copy must reach the APS office before the 15th of the month, 2 months preceding the month of issue (e.g., before December 15 for the February 1986 issue). Mail copy to APS, 9650 Rockville, Pike, Bethesda, MD 20814.

BOOK REVIEW

The Case for Animal Experimentation: An Evolutionary and Ethical Perspective
Michael Allen Fox
Berkeley, CA: Univ. of California Press, 1986, 262 pp. $18.95

For some years now the two most prominent authors writing about the issues of animal rights have been Peter Singer and Tom Regan, both of whom support the idea that animals do have rights. Now, there is a third author who rates equal billing with the other two in this debate literature.

He is Michael Allen Fox, a name that should not be confused with Michael W. Fox, who frequently writes on similar issues for The Humane Society of the United States. His book is *The Case For Animal Experimentation: An Evolutionary and Etbical Perspective.*

Fox is the first to examine both the status of animals and the research for which animals are used. He concludes that it is permissible to use animals for purposes of experimentation as long as we maintain an attitude of respect for the animals and use them within ethically qualified guidelines. He successfully argues the question, "Can we show respect toward animals and revere nature while still using millions of animals annually for research?" To this, he says, "I think the answer is yes."

Fox's conclusions are derived from the spectra of scientific and philosophical literature, interviews, historical developments, and current issues about the use of laboratory animals. He presents a well-documented case in clear, concise, and readable terms.

The author is Associate Professor of Philosophy at Queens University at Kingston, Ontario, Canada, and his book deserves a place on the bookshelf of anyone who has a question about the use of animals in the laboratory.

W. M. Samuels, CAE

PEOPLE AND PLACES . . .

Effective July 1, APS member **Kenneth I. Shine**, M.D., Professor and Executive Chairman, Department of Medicine, University of California, Los Angeles, UCLA School of Medicine, will succeed Sherman M. Mellinkoff, who has served 24 years as Dean.

Donald P. Becker, M.D., Professor, Department of Neurological Surgery at Virginia Commonwealth University of Medical College of Virginia School of Medicine, has been named Professor and Chairman, Division of Neurosurgery. Dr. Becker has been a Society member since 1972.

APS member **La Val N. Cothran**, D.V.M., Ph.D., Associate Professor, has been appointed Chairman, Department of Physiology and Biophysics, Howard University College of Medicine, Washington, DC.

Howard D. Colby, Ph.D., Professor of Physiology at West Virginia University School of Medicine and APS member since 1973, has been appointed Chairman, Department of Biomedical Sciences, University of Illinois College of Medicine at Rockford.

APS member **Luis Reuss**, M.D., Professor, Department of Cell Biology and Physiology, Washington University School of Medicine, St. Louis, has moved to the University of Texas Medical Branch, Galveston, as Professor and Chairman, Department of Physiology and Biophysics.

Douglas Eaton, Ph.D., APS member and Professor, Department of Physiology and Biophysics, University of Texas Medical Branch, Galveston, has moved to Emory University School of Medicine, Atlanta, as Professor, Department of Physiology.

Alexandre Fabiato, Ph.D., Professor, has been named Professor and Chairman, Department of Physiology, Medical College of Virginia, Richmond. Dr. Fabiato has been a member of the Society since 1973.

APS member, **Kurt Beam**, Ph.D., Associate Professor, Department of Physiology and Biophysics, University of Iowa, Iowa City, has moved to Colorado State University, Fort Collins.

James R. Neely, Professor of Physiology, Milton S. Hershey Medical Center, Pennsylvania State University, Hershey, has been appointed Senior Scientist, Geisinger Research Facility, Geisinger Clinic, Danville, PA. Dr. Neely has been a member of APS since 1970.

Charles W. Shilling, M.D., Executive Secretary of the Undersea Medical Society since 1973 and APS member since 1955, has retired at the age of 84. Leon J. Greenbaum, Jr., an NIH research administrator, has succeeded Dr. Shilling.

Proposed Amendment to Bylaws to Extend APS Membership to Physiologists in All the Americas

The following proposed amendment to the Bylaws was approved in principal by Council pending agreement by the presidents of the various Latin American physiological societies. The proposed amendment will be presented to the membership for vote at the Fall Business Meeting, Wednesday, October 8, 1986.

ARTICLE III. *Membership*

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

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

Section 5. *Associate Members.* Persons who are engaged in research in physiology or related fields and/or teaching physiology shall be eligible for proposal for Associate membership in the Society provided they are residents of ~~North America~~ the Americas.

Section 7. *Student Members.* Any student who is actively engaged in physiological work as attested to by two Regular members of the Society and who is a resident of ~~North America~~ the Americas.

ANNOUNCEMENTS

Research Applications Sought

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) is seeking grant applications for funding of basic and applied research projects on alcoholism and alcohol abuse in 10 major areas.

This innovative research program encourages applications from persons new to research generally as well as those who are established researchers in the alcohol area or other fields.

The 10 major areas of research to be supported are *1)* genetics and molecular biology, *2)* biochemistry and metabolism, *3)* neuroscience, *4)* behavioral and environmental antecedents, *5)* safety and trauma, *6)* alcohol and pregnancy, *7)* alcohol-related medical disorders, *8)* incidence and prevalence, *9)* treatment of alcoholism, and *10)* prevention.

Research applications relating to minority populations are encouraged. One-page summaries of each grant area are available from N. Nadel, National Institute on Alcohol Abuse and Alcoholism's Clearinghouse, PO Box 2345, Rockville, MD 20852. Phone: (301)468-2600.

New LSRO Study Underway

Under terms of a contract with the Center for Food Safety and Applied Nutrition, FDA, the Life Sciences Research Office (LSRO) has recently undertaken a review of the physiological effects and health consequences of dietary fiber complex. This review will summarize the current data available from experimental, clinical, and epidemiological studies on the possible health benefits and risks associated with dietary fiber complex intake. LSRO is appointing an ad hoc expert panel on dietary fiber to provide guidance in the selection of appropriate terminology, review of clinical and epidemiological trials, estimates of current intake, and recommendations for consumption of dietary fiber complex based on available data that pertain to health claims for fiber. Members of the Federated Societies with an interest in dietary fiber are invited to communicate with Dr. Susan M. Pilch, LSRO, 9650 Rockville Pike, Bethesda, MD 20814.

Cell Calcium and Control of Membrane Transport

The 40th Annual Symposium of the Society of General Physiologists, Cell Calcium and the Control of Membrane Transport, will be held at the Marine Biological Laboratory, Woods Hole, MA, on September 4–7, 1986. *Format*: keynote address by Professor Peter F. Baker; invited lectures on regulation of cytosolic free calcium, receptor-mediated changes in intracellular calcium, modulation of membrane transport by intracellular calcium, calcium involvement in intracellular events, and related topics. Poster presentations and workshops will also be held. Apply for limited housing by August 1, 1986. *Information*: Society of General Physiologists, PO Box 257, Wood Hole, MA 02543.

Health Benefits of Animal Research

A newly published book, *Health Benefits of Animal Research*, derived from articles appearing in *The Physiologist*, is now available through the Foundation for Biomedical Research. The six chapters of this book, each on a single species, described medical advances attributable to studies of mice, rats, rabbits, cats, dogs, and nonhuman primates—the six species that account for over 95% of all animal research.

According to William I. Gay, D.V.M., the book's Editor, "It is the intent of the authors of the various sections of this report to convey to the reader a sense of the value of biomedical research as well as the necessity for the use of animals in that research."

The book may be ordered for $7.50 from Foundation for Biomedical Research, 818 Connecticut Ave., N.W., Suite 303, Washington, DC 20006.

ASCB Meeting Update

The dates and site for the 1986 annual meeting of the American Society for Cell Biology (ASCB) have been changed from November 10–14, 1986, in Denver, CO, to December 7–11, 1986, in Washington, DC.

Scientific Meetings and Congresses

Ion-Selective Microelectrode and Excitable Tissue Symposium, Toronto, Canada, July 8–11, 1986.

XXX International Congress of Physiological Sciences, Vancouver, BC, Canada, July 13–18, 1986.

37th AIBS Annual Meeting, Amherst, Massachusetts, August 10–14, 1986.

14th International Cancer Congress, Budapest, Hungary, August 21–27, 1986.

11th International Congress of Electron Microscopy, Kyoto, Japan, August 31–September 5, 1986.

X World Congress on Cardiology, Washington, DC, September 14–19, 1986.

International Physiology of Stressful Environments Symposium, Kitakyushu, Japan, September 21–24, 1986.

31st OHOLO Conference on Model Systems in Neurotoxicology, Tiberias, Israel, November 3–7, 1986.

IUPS Commission on Gravitational Physiology 8th Annual Meeting, Tokyo, Japan, November 4–8, 1986.

Society of Neuroscience Annual Meeting, Washington, DC, November 9–14, 1986.