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The Physiologist

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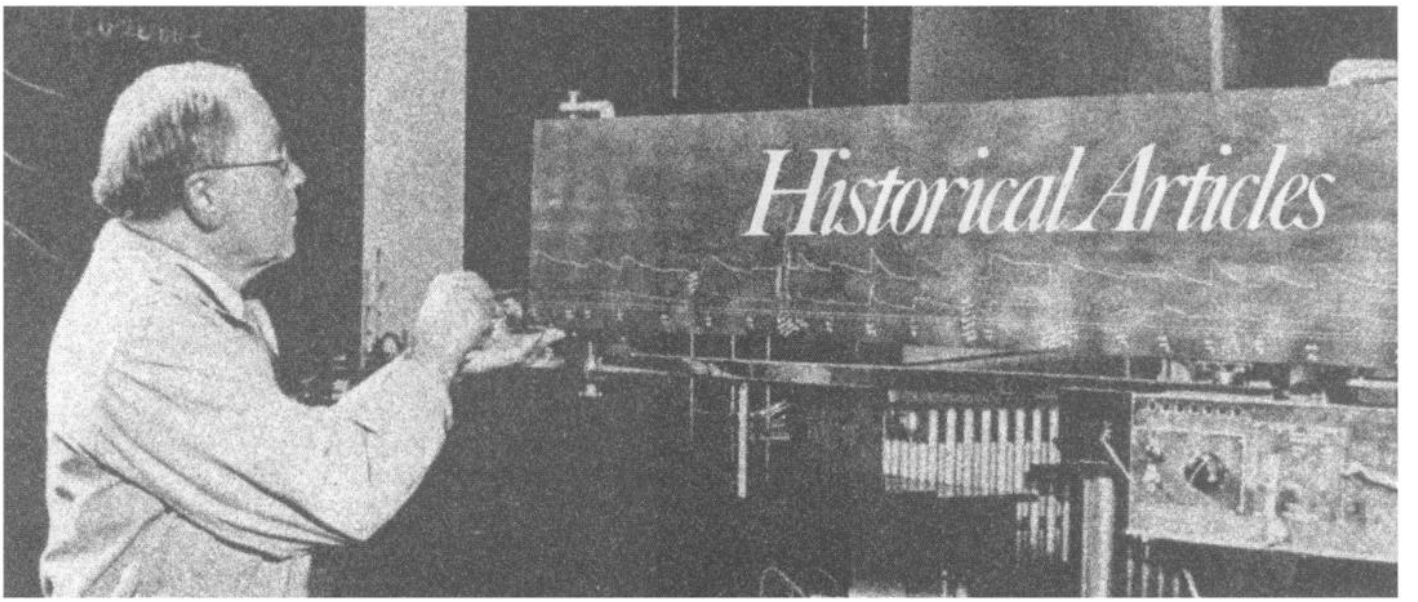

Ida Henrietta Hyde: The First Woman Member of the Society

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In the early years of this century the involvement of women in academic and medical science was surprisingly widespread (1,2). Membership in organizations such as the Sigma Xi was always open to qualified women (3), even though other associations of scientists were less quick to invite women to join in sharing their intellectual pursuits and functions. Initially (1887-1895) the American Physiological Society was of this conservative view, a view which apparently changed with little difficulty once the impetus was initiated in 1895 (4). Drs. S.J. Meltzer of New York and F.S. Lee of Columbia University nominated Ida Henrietta Hyde to membership in 1902 (5). The nomination was considered by the Council of the Society at its Fifteenth Annual Business Meeting held in Washington, DC on December 30, 1902. Upon their recommendation, *IHH* (Associate Professor of Physiology and Head of the Department of Physiology at the University of Kansas) was elected to membership, the first woman to be so honored by the American Physiological Society. The British Society did not admit women to membership until 1915, and even then the outcome was controversial and divisive. The minutes of the American Physiological Society meeting in 1902 indicate no controversy or discord over the election of a woman to membership, although the membership at large was asked to consider in full the question of women in the Society. Although *IHH* was the second woman *nominated* to membership, she remained the only female member until 1913 (4,6).

The membership of *IHH* in the Society was one of the many firsts which she achieved as a woman scientist. Today we can readily recognize the difficulties attendant upon pursuing a scientific career in that period – especially if one was a woman. Handicapped by the difficulty of obtaining training and by their restrictive clothing, hounded by families to pursue a more feminine calling (7), and choosing instead to become members of an elite group of achievers, these women left their names and influence on American science. For example, they took an active part in early coursework at the Marine Biological Laboratory (MBL) at Woods Hole (Fig. 1). Women, such as Florence Peebles, Katharine Foote, and Cornelia Clapp (1), worked side by side with noteworthy male researchers of the period, such as C.O. Whitman, T.H. Morgan, and Jacques Loeb. Women researchers' publications were well received by their peers, and they were included in all aspects of the work and the administration of such prestigious institutions as the MBL. Susan Minns, the first woman trustee of the MBL, was also one of its founders in 1888, and the archives of the MBL list women elected as trustees throughout the nineteenth century.

What follows is the result of an eight-year avocation, the search for details about and continuity in the life of Ida Henrietta Hyde (8). The research preceding her nomination to membership in the Society was diverse as can be seen by perusal of her bibliography (APPENDIX I). Her personal attributes have been provided by careful examination of her diaries at the AAUW Archives Library, an interview with one of her student assistants at the University of Kansas, letters housed at the University of Kansas Archives, letters and memorabilia of some of her students, and from personal recollections and letters in the possession of Dr. Arthur Pardee, her grandnephew.

Ida Henrietta Hyde was born in Davenport, Iowa in 1857 and was one of five children of German immigrant parents. When *IHH*

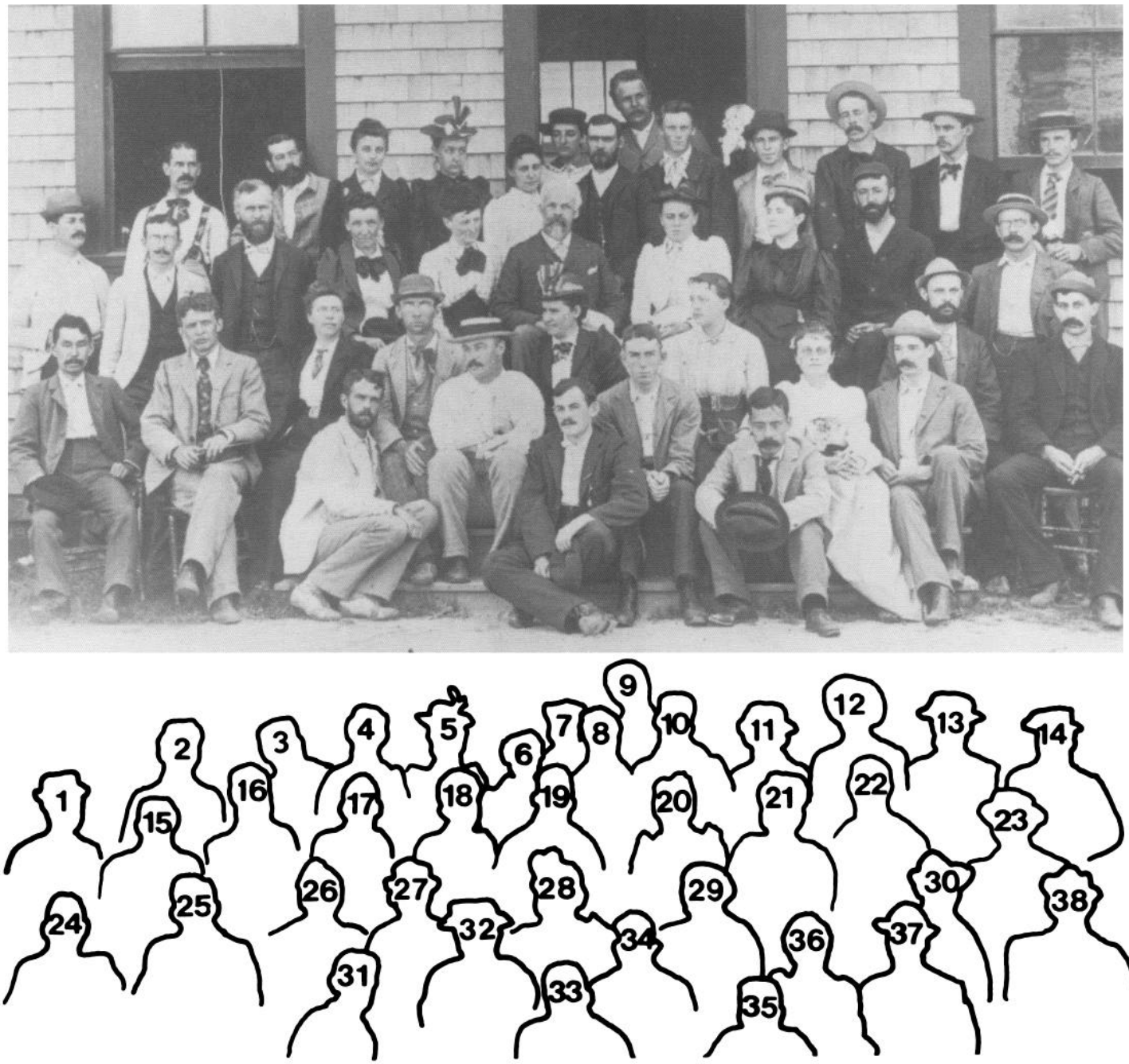

Fig. 1. Ida Henrietta Hyde with several faculty and some fellow students at the MBL, Woods Hole, ca. 1891. The schematic drawing is a numerical key to those in the photograph. *Key:* 1) C.L. Bristol (Fellow, University of Chicago), 2) Eycleshymer (Fellow, University of Chicago), 3) Lombard (Ann Arbor), 4) Wallace (Mt. Holyoke), 5) Mary A. Schively (Philadelphia Woman's Medical), 6) *IDA HENRIETTA HYDE* (Bryn Mawr), 7) Wollstein (New York M.D.), 8) Mitchell (Chicago High School, Hyde Park), 9) Russel (Johns Hopkins), 10) Mathews (MIT, Boston), 11) Albert D. Mead (Fellow, University of Chicago), 12) Wheeler (Fellow, University of Chicago), 13) Dexter (Brown University), 14) *Frank R. Lillie* (Fellow, University of Chicago), 15) Dodge (Rochester, New York), 16) Pilsbury (Smith College), 17) *Cornelia M. Clapp* (Mt. Holyoke), 18) *Katherine Foote* (Evanston, Illinois), 19) *C.O. Whitman* (University of Chicago), 20) Anne Evans (Bryn Mawr), O'Grady (Vassar), 22) Setchell (Yale, New Haven; Instructor, Botany), 23) Lingle (Baltimore), 24) Takano (Artist, University of Chicago), 25) Lee (Columbia University, New York), 26) *Martha Bunting* (Bryn Mawr), 27) Norris (Grinnell, Iowa), 28) Cooley (Wellesley), 29) Byrus (Vassar), 30) Pickford (Cornell, Instructor), 31) *Thomas Hunt Morgan* (Bryn Mawr), 32) Edward G. Gardiner (MIT, Boston), 33) Peabody (Williamson, Massachusetts), 34) Goran (Brown University, student), 35) Watase (University of Chicago, Reader), 36) Pickford (Baltimore), 37) Jordan (University of Chicago), 38) Melvin A. Brannon (Fort Wayne High School, Indiana).

Historical Articles

The photograph of Walter B. Cannon used for the masthead was kindly provided by A.C. Barger, Harvard University Medical School.

was quite young her father left the home for an unknown reason and was not heard from again. *IHH* does not refer to her father in any of her personal writings. To support the family, *IHH's* mother took in mending and cleaning and eventually opened a small business in Chicago, Illinois (9,10). The family prospered due to the mother's excellent abilities as a businesswoman, and they lived comfortably in Chicago for many years. The children attended public school and were educated appropriately for middle-class young people, although only *IHH's* brother Ben was expected to attend university. *IHH's* life changed drastically when her family was left destitute by the Chicago Fire of 1870 in which their home and business were destroyed. *IHH* became the breadwinner of the family, helping to support her mother and unmarried sisters while her brother attended public school and later the University of Illinois. She became a milliner's apprentice but eventually advanced herself to become a buyer and saleslady for the clothing factory in which she did her apprenticeship. The dressmaking skills she learned enabled her to make her own clothes even in later years, and the financial stress she experienced during these early years left her with a lifelong habit of frugality. Although her family often accused her of miserliness, she appears to have been quite generous with them throughout her life (11). In her first few months of menial labor as a teenager, her pride in her position as a proper middle-class young lady was badly shaken, and she would cover her face with a scarf upon leaving for or arriving home from work (she wrote, "In 1873, it was not customary for girls of sixteen from 'families of comfortable circumstances' to work for a living"; Fig. 2). She hoped that none of her acquaintances would recognize her and know that she was a working person.

Quite by accident she discovered a book on natural science by Alexander von Humbolt (12) in a packing box stored at the factory where she worked. She began to read during her lunch hours, stimulating the development of a fascination for natural science and biology. She was encouraged to complete her education after reading Humbolt's book. To this end, she began to save carfare by walking the two and one-half miles to and from work each day and by carrying her lunch and supper. Walking home alone at night was a terrifying experience for this Victorian young lady. After several months she enrolled in night school at the Chicago Athenaeum, which was housed in a building near her factory job. She attended classes in arithmetic, grammar, bookkeeping, stenography, German, American history, and geography (1875-1876).

Fig. 2. Ida Hyde, age 14.

Several years later her strong desire for intellectual development was to receive direction. In 1881 she attended her brother's graduation from the University of Illinois at Champaign. While there she met other young women who were studying for their bachelor's degrees, and she became enamoured of academic life. She felt that she had found the elusive element which had been missing from her life up to that time. Her brother introduced her to President Gregory of the University, and characteristically she stated to him her suddenly realized determination and longing for a university education. Her brother Ben responded by upbraiding her for telling the President a falsehood, "You know very well that you have not had even the preliminary subjects for entrance to high school; how could you expect to pass the examination of the subjects required for admission to the University? Besides, where are you going to get the money to pay your expenses?" Later that day, *IHH* learned that if she passed the entrance examinations to be given that fall, she would be allowed to attend the College Preparatory Course at the University. Several of her newfound friends encouraged her to prepare for the examinations and offered her assistance in finding seamstress work to support herself while she attended the University. Her mother viewed this plan as a whim which would pass, but *IHH* had returned home to Chicago determined to study intensively for the entrance examinations. As the Summer weeks passed, *IHH*'s mother told her that she would not grant her permission to leave the family home (one must remember that this was a Victorian parent, although *IHH* was 24 years old at the time). As the day of her departure for the University approached, *IHH*'s mother would not relent and *IHH* became quite anxious and ill in her disappointment. Her recovery was quite rapid, as described in her diary, when her mother agreed to allow her to go to Champaign "rather than have her continue to mope in this mood of despair." *IHH* replied, "You have said it!" Her trunk had been packed, and she rushed immediately to the train station with barely enough time to arrive at the University and register for the examinations. *IHH* passed the examinations and was admitted to the College Preparatory School and later to the freshman class at the University. In 1882, her brother became ill, making it necessary for *IHH* to return to Chicago to care for him and help support her family. *IHH* had obtained a teaching position in a country school in Elmhurst, Illinois, a suburb of Chicago, but was forced to resign because of her family obligations. She then taught in the Chicago public school system for seven years (1882-1889) as a second- and third-grade teacher.

IHH's persistence in her own education was followed by an equal dedication and creativity in educating others. To this end she constantly sought and perfected new approaches in the classroom. In 1882 Colonel Parker came to the Chicago Normal School to promulgate development of "individualistic qualities of the mind, body and character of the children" (13). *IHH* attended his seminars in Chicago and the Summer School of Natural History in Martha's Vineyard. The Superintendent of Schools became interested in the introduction of Nature Studies in the Public Schools. *IHH* was instrumental in establishing the Science in the Schools program in Chicago. She demonstrated her classroom methods for other teachers and "had the satisfaction of seeing the nature study become a part of the course of study of the Chicago Public Schools."

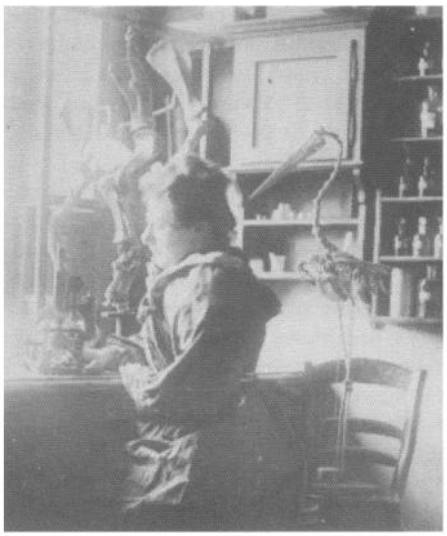

Fig. 3. Ida Hyde in her laboratory at Heidelberg, 1896.

Fig. 4. Ida Hyde in the lecture hall at Heidelberg University, ca. 1896.

Even with her success as a science teacher, *IHH* was dissatisfied with her ability to teach at even the elementary school level and felt compelled to return to academic life. She enrolled at Cornell University in 1888, and received her AB degree in Biological Science from Sage College after only three years of study. At that time, she began quite seriously to consider a career in clinical medicine. She then received a scholarship to Bryn Mawr College, where she was appointed an Assistant in Biology. She decided to pursue these funded studies rather than to attend Medical School at Johns Hopkins. She began graduate studies with T.H. Morgan and Jacques Loeb (14). Under their tutelage she conducted research at Woods Hole. In 1891 *IHH* was named a member of the Corporation of the MBL. The following year she is listed as an investigator receiving instruction (15) and on at least one occasion as a guest lecturer (16). In 1893 *IHH* attained some fame, since the results of her observations on the embryology of Scyphomedusae (17) settled a controversy between Goette at Strassburg and Klaus at Vienna which had gone unresolved for many years (18). This work had been done with T.H. Morgan at the Laboratory of the United States Fish Commission in Woods Hole (*IHH* was the first woman to conduct research at that laboratory; 19). In 1893 *IHH* was invited by Goette to Strassburg to continue her research in his laboratory. Her financial needs were assumed by the Association of Collegiate Alumnae (the ACA is now called the American Association of University Women, AAUW). She was named European Fellow and accepted Professor Goette's offer to work with him at Strassburg. Difficulties arose there, since no woman had ever been permitted to do research or to matriculate for the Ph.D. The events following *IHH*'s arrival at Strassburg and her subsequent experiences with the German University system have been presented by *IHH* (20) and in this issue of *The Physiologist* (4). She eventually obtained the Ph.D. from Heidelberg University (Figs. 3 and 4), became the first woman to do research at the Medical School, and was selected as their Investigator-in-residence at the Naples Marine Station. *IHH*'s lifelong involvement at Naples has been related elsewhere (21).

At Naples *IHH* and her assistant became involved in an amusing imbroglio with Kaiser Wilhelm II. The two researchers had prepared an experiment to study salivary gland function using the octopus (22), unaware that that very morning the Kaiser was to visit the Marine Station. The anesthetized specimen was restrained on an operating table. At the very instant when IHH began her dissection, the Kaiser and his retinue entered the laboratory and the octopus began a series of reflex movements of its arms "in twisting coils in all possible directions, accompanied by eruptions of inky jets . . ." (23). The Kaiser became infuriated at what appeared for him to be the torture of a helpless creature. He exclaimed, "It is my duty as President of the Prussian Society for the Prevention of Cruelty to Animals to insist that experiments that cause pain to any kind of animals must be prohibited in the Naples Zoological Station if you expect to have the financial support of German Institutions. We may tolerate heartless research in American women, but our sympathetic German women would refrain from such cruel occupations." Fortunately, the Director of the Laboratory, Dr. Anton Dohrn, provided an explanation to the Kaiser of the importance, painlessness, and necessity of the procedure *IHH* had developed, and she was permitted to complete her work at the Laboratory.

With Kuehne's recommendations, *IHH* went from Naples to the University of Bern, Switzerland to collaborate in research in muscle physiology with Dr. Kronecker. At Bern, she met Dr. H.P. Bowditch of Harvard whose letter of introduction subsequently admitted her to the research laboratories of the Harvard Medical School under the guidance of Dr. W.T. Porter. She became the first woman to do research at Harvard Medical School (24; see cover photograph, Harvard Medical School Faculty Archives, ca. 1897). In 1897 *IHH* conducted summer school at Woods Hole, Hyannis (The Ingall's School) and at several preparatory schools in Cambridge, Massachusetts. She also took some medical studies, including bacteriology at Harvard Medical School (1898). *IHH* tired of this irregular existence (25), and in her search for a satisfying professional position she was advised by C.O. Whitman and Jacques Loeb at Woods Hole (26). She learned from a friend that a position was available at the University of Kansas (KU) and wrote a letter of inquiry to Chancellor Snow to apply for that position. KU was an established land-grant University in the Humanities that had begun to develop its Medical School program and was badly in need of a well-structured curriculum in basic physiology. *IHH*'s credentials were excellent, and she was highly recommended by Butschli, Loeb, and others. She was appointed Associate Professor of Physiology at KU in 1899 (27). This position became for her, the dedicated and hard-working teacher-researcher, a lifelong occupation.

During her tenure at KU, her interest in public health and hygiene were shown repeatedly by her lectures and articles. With the voluntary assistance of area physicians she established a program of public medical examination of school children for communicable diseases such as tuberculosis and spinal meningitis (28). Although she was not a medical doctor, she was elected to membership in the Kansas Medical Society because of her expertise in the control of infectious disease. In 1918 she was appointed State Chairman of the Kansas Women's Committee on Health, Sanitation and National Defense by Governor Arthur Capper of Kansas (29).

IHH epitomized the energetic and dedicated scientist whose involvement in the practical application of basic principles of physiology was demonstrated by her public work in addition to her research interests. Her research and her involvement in advancing the cause of the right of women to an education and to professional equity with their male colleagues became her life's work. As a Professor of Physiology at KU, she influenced many young women to pursue careers in the sciences (Figs. 5 and 6).

Her energy and dedication as well as her insistence on excellence are frequently attested to in the student newspaper and in *The Graduate Magazine* (an early publication of the Alumni Association of the University of Kansas). Anecdotes about her physiology demonstrations, class socials, involvement on scholarship committees, and general interest in education were presented repeatedly by these student journalists. One of her former assistants described her (30): she was severe and autocratic and had her assistants "under her thumb"; she was always neatly dressed; small in stature and heavy set; "spoke her mind out" quite dogmatically. Her nephew recalls (31), "On Sundays we boys, my brother and I, used to be dragged with Aunt Ida and our folks for a ride into the country. I remember on one such occasion Aunt Ida, who was rather pudgy by that time, could not decide exactly which dessert she wanted with a meal we were having in a restaurant. Finally, she asked the waitress if she could have a little bit of each of four desserts. She was eccentric in that way. . . . I was a young boy who saw Aunt Ida as a kindly old lady. My impression of her is based on, "Here, Arthur, have a cookie "; and also "I was too young to share much with her when she was still active in research, although later I did feel that she was somewhat of a role model." Her independent spirit and sense of humor are attested to in an article published at KU. In that story *IHH* engaged in a foot race with a friend, Dr. M. Johnson of the Department of Physical Culture. It appears that a discussion arose between the two women concerning the distance to their boarding house, thus precipitating a race to see whose route was the shortest. "In the spirit of banter, the two decided to test the exact distance." Unfortunately, *IHH* fell down on the ice and broke her arm. The report continues, "Dr. Hyde says she doesn't know who won!" (32). *IHH*'s interests were at once humanitarian and intellectual. She lectured on hygiene throughout Kansas and internationally. These lectures were rather courageous in that she spoke openly about human sexuality and its involvement in the spread of disease, and she was an ardent promotor of public health education. From the outlines of her hygiene lectures one is impressed with her candor, understanding of human nature, and desire to educate both men and women about their own bodies. She used poetry to describe physical love; she used visual aids in the form of ancient Greek and Roman nude statuary; she stressed human responsibility for the prevention and transmission of venereal disease. She adhered to theories of cleanliness and its importance in disease prevention and control. When her audience consisted of housewives she spoke of cleanliness in the home; when it was factory girls she discussed human sexuality in terms of the similarities of responses of male and female rather than the differences; she attempted to remove the mystique of the act without destroying its impact on human relationships (33).

Fig. 5. Ida Hyde with her physiology class at University of Kansas (*left to right:* Carrie Weaver, Irene Howat, Gladys Beck, unknown, Helen Rigby, Elmer Whitney, *IDA HYDE,* Eva Bechtell, Florence Ferris).

Fig. 6. *IHH*'s physiology class, University of Kansas (back row, left to right: Irene Howat, Eulalia Walling, Winifred Fisher, Ruth Spray Griffin, Hugh Adain, Grace Russell Frink; *front row, left to right:* Elmer Whitney, Kenneth Munsen, Fay Halloway).

Her interest in public health led her to demand adequate toilet facilities for the young women who were students at the University. The chemistry and other science buildings lacked such facilities, since it was expected that only young men would study these subjects. This issue is not separable from her efforts to make equal facilities and opportunities available to women in all professions and lifestyles. She agitated for and got women janitors hired by the University; initiated a drive to hire women corrections' officers in Lawrence, Kansas; repeatedly pressed for equal salary with her male colleagues; and promoted educational opportunities for women by initiating the formation of the Sarah Robinson Research Table at Woods Hole, the ACA Research Tables at Naples, and scholarships at KU (of which I was a recipient), with the ACA (now AAUW), Bryn Mawr (these records have now been lost), and Cornell University. *IHH* became involved in a statewide controversy when she initiated a program of public inspection of school children for tuberculosis and spinal meningitis. Her opponent, F.B. Wheeler, wrote to the Chancellor (APPENDIX II). The Chancellor, recognizing that controversy was deadly for a state-supported university, withdrew his support of Ida's program. Had he been more farseeing and courageous or recognized *IHH*'s expertise, he could have avoided that blunder. A reading of the decisive letter from a lawyer representing less knowledgeable citizens is educational both as an historical document and in viewing current controversies over applied medical science.

Her experimental work was varied but dealt with the effects of the environment and nutrition on functioning in the nervous

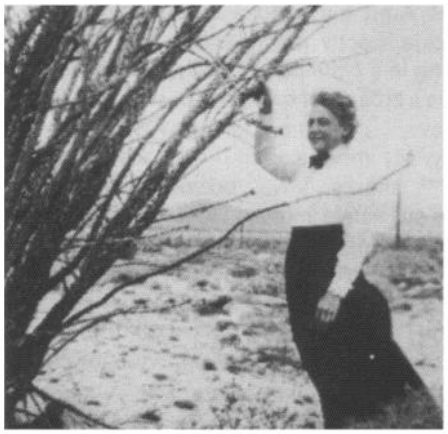

Fig. 7. Ida Hyde upon retirement, Imperial Valley, California, May 1920.

Fig. 8. Ida Hyde in old age, ca. 1930's.

system. She was inventive. For example, she developed an apparatus for monitoring physiological parameters in a marine animal which permitted the investigator to maintain the specimen in a seawater medium (34). She developed one of the earliest stimulating electrodes for intracellular excitation of single cells (35). This electrode work was recalled by K.S. Cole in conversation at the MBL in 1971 as a breakthrough in the annals of neurophysiology. Her work demonstrated differences in the effects of music on the cardiovascular system in athletes, musicians, Indians (Western), and farmers and implicated caffeine as a cause of decreased efficiency in physical work. Her studies in cellular physiology demonstrated the effects of drugs, alcohol, gases, and stress in a variety of animal species, thus documenting the universality of the effects of such agents.

The personal side of this woman is best assessed by reference to her diaries (Figs. 7 and 8). From her diaries one views the life of the academician, teacher, researcher, faculty member, mentor, author, speaker, politicians, and humanitarian and realizes the enormity of the job well done in our profession. It is no wonder then that she expresses her frustration with administrators and male colleagues with whom she never achieves equal salary and opportunity, with her own personal weaknesses, her impatience (by which she verbalizes too much to the wrong people at the wrong time), and with her helpers and students who do not fulfill her expectations—expectations derived from what *she* had achieved rather than what the average person achieves. She was unhappy with herself during adversity, but rarely blamed others for what she saw as her own failings and lack of ability. At other times her joy at completing a research project or paper, or experiencing a kindness from another, or doing a kindness herself are expressed simply and unabashedly.

Her niece, Elizabeth, sent *IHH* a birthday poem after she had retired and settled in California (Figs. 7 and 8). The poem points out *IHH*'s dedication to science and her family's dependence on her over the years.

The bulk of her life
She's devoted to science
The laws of biology
Preserved from defiance,
By submerging herself
She has reaped her reward
She's received the warm thanks
Of the animal horde.
Fulfilled in her vision
As natures' technician,
Her soul craves expression
Outside her profession,
She responds to its urge;
As a moth doth emerge
From the chrysalis tight
To embrace the good light
So our Ida, now freed
From her family's grave need
Takes her place in the sun
And is having fun.

Concerning research, *IHH* wrote, "All research requires patience and inspiration, and the results in themselves are difficult to estimate. They lead to other problems, and may inspire others with new ideas" (36).

In 1939 Ida wrote the following whimsical poem to her nephew, Arthur, as a Christmas greeting. It expresses her sense of oneness with the natural world and it is a fitting way to end her story.

In the Universe, it is Matter,
that matters.
As a Matter of Facts:
It is the Matter of Thought, Belief,
Faith, Reason, of cause, founded
on the Universe's truth,
that matters!

who through thought, belief, faith, reason, and the search for Universal truths left us all a legacy of which we can be proud and inspired.

I thank Dr. Arthur Pardee for his kindnesses and enthusiasm in seeing Ida Hyde's story told, the story of his aunt and his scientific role model.

I also thank John Nugent at the University of Kansas Kenneth Spencer Archives and Ned Keyde who was superb in pinpointing just the right file or storage case that was most helpful along the way; Mary Jordan at the AAUW Archives Library in Washington, DC for her assistance in helping me to understand the period and sort through all of the personal papers left by Dr. Hyde to the AAUW; Dr. Margaret Lehr at Bryn Mawr who helped to search out information in their files; Dr. Ruth Sager (Pardee) for her leads at Harvard Medical School; Jane Fessenden and Dr. John Fuseler for their help in examination of the historical records at the Marine Biological Laboratory, Woods Hole and in assembling *IHH*'s full bibliography; Charlaine Rowlette for patience and care in preparing this manuscript; the staff at Heidelberg University for helping me to locate the very lecture hall pictured here; and Ida Hyde for living a fascinating and productive life, for having the courage to be a woman in science when that in itself was a challenge, and for providing a role model for men and women research scientists of future decades.

NOTES

1. Rossiter, M. Women scientists in America before 1920. *Am. Sci.* 62: 312-323, 1974.
2. Walsh, M.R. *Doctors Wanted: No Women Need Apply*. New Haven, CT: Yale Univ. Press, 1977.
3. *IHH* was nominated on October 19, 1899 by C.E. McClung and elected to membership at a subsequent meeting. In a letter to *IHH* dated May 10, 1923 Professor E.H.S. Bailey states that at the first convention of the Sigma Xi (1893 at Ithaca; only four chapters were then in existence: Cornell, Union, Renssalaer, and KU), "An attempt was made . . . to declare women ineligible to election to Sigma Xi, but this met with little favor, and we are glad to number many illustrious women today, as our companions in zealous research. Thus, it has become a group of 'large-brained women and large-hearted men'."
4. Johnson, E.E. Ida Henrietta Hyde: early experiments. *Physiologist* 24(6): 10-11, 1981.
5. American Physiological Society. Soc. Bus. Meet. Min. 15th Annu. Meet. 3rd Sess. Washington, DC, 1902, p. 229. (Courtesy of Dr. Orr E. Reynolds.)
6. *History of the American Physiological Society Semicentennial, 1887-1937.* Baltimore, MD, 1938, p. 71.
7. Autobiographical sketch of IHH. *Am. Assoc. Univ. Women Arch.*, p.8-9.
8. In 1971 I was the recipient of the Ida H. Hyde Grant-in-Aid at the University of Kansas. The proceeds of an endowment which she established for young women researchers of the University allowed me to spend the Summer in residence at the MBL at Woods Hole.
9. *IHH. Diaries.* Book 1, May 29, 1898.
10. *IHH. Autobiography.* This and the balance of the family history are from her autobiographical sketch unless otherwise stipulated.
11. In her diaries, frequent entries specify gifts given to family members on all occasions.
12. *Humbolt's Views of Nature. IHH* writes, "As I read on, it not only aroused deep interest but ushered in a new fascinating world full of unheard and undreamt wonders."
13. Samuel Chester Parker (1880-1924) was an educator of some reknown.
14. *IHH. Diaries.* Book 1, Nov 13, 1898, "Then got scholarship of $500.00 at Bryn Mawr College. That changed my plan to go to Medical College (Rush); where I had offer of assistantship in a doctor's laboratory for room and board and work for M.D. But I needed the money first (from the Bryn Mawr scholarship)." She had also been considered by Johns Hopkins Medical School.
15. Hyde, I.H. An investigator receiving instruction at MBL-Summer. *Biol. Bull.* 1892.
16. Bumpus, H.C. List of Moening Lectures. *Biol. Bull. 5th Annu. Rep.* 22 July 1892.
17. Hyde, I.H. *The Anatomy and Embryology of the Scyphomedusae.* Morning Lecture, Jul 22, 1892, MBL.
18. *IHH* had investigated the embryological development of the Scyphomedusan independent of Professors Goette and Klause. Her results confirmed those of Goette, thus resolving a controversy that had found its way into print.
19. *IHH. Autobiography.*
20. Hyde, I.H. Before women were human beings. Adventures of an American fellow in German Universities of the 90's. *J. Am. Assoc. Univ. Women.* 31: 226-236, 1938.
21. Sloan, J.B. The founding of the Naples Table Association for promoting scientific research by women, 1897. *Signs.* 4:208-216, 1978.
22. Hyde, I.H. Beobachtungen ueber die Secretion der sogenannten Speicheldruesen von *Octopus macropus. Z. Biol.* 35: 459-477, 1895.
23. Hyde, I.H. The Kaiser and the Devilfish. Not a fable, but a true story of what happened when the two met in Naples. *The Evening Post Magazine,* New York, Saturday, May 25, 1918.
24. Tryon, R.W. Ida H. Hyde, 1857-1945. *Names Remembered Through AAUW Fellowships.* AAUW Fellowship Foundation, 1958, p. 15.
25. Diary Entries, 1898. *IHH* documents her search for a satisfying professional life.
26. *IHH. Diaries.* Book 1, Aug 17, 1898. C.O. Whitman and J. Loeb advise *IHH* on job choice. Also, Sep 11, 1898.
27. *IHH. Diaries.* Book 1, May 21, 1899.
28. Apr 30, 1912; Chancellor Frank Strong to F.B. Wheeler, Esq., Letter. Kenneth Spencer Archives Library.
29. *IHH. Diaries.* Nov 21, 1918.
30. Interview with Dr. Cora M. Downs, Professor Emeritus of Microbiology, University of Kansas, May, 1976.
31. Interview with Dr. Arthur Pardee, January 22, 1979.
32. *University Daily Kansan.* 25 Nov. 1911.
33. Class notes of *IHH,* University of Kansas, Kenneth Spencer Research Library, Faculty Archives.
34. Mark Anniversary Volume. 1903, Art 24, p. 471-482.
35. Hyde, I.H. A micro-electrode and unicellar stimulation. *Biol. Bull.* 40: 130-133, 1921.
36. Letter to *IHH*'s nephew, Dr. Arthur B. Pardee.

APPENDIX I

Annotated bibliography of Ida Henrietta Hyde, Ph.D. and Her Students

1. Hyde, I.H. Notes on the hearts of certain mammals. *Med. News Assoc. Am. Anat.* p. 467, 1891.
2. Hyde, I.H. Notes on the hearts of certain mammals. *Am. Nat.* Oct. p. 861-863, 1891.

   IHH discovered the coronary valve in the hearts of the species examined (sheep, oat, human, monkey, panther, raccoon, hyena, dog, deer, cat, horse, donkey, and rabbit). The valve is located over the orifice of the middle cardiac vein. The middle cardiac vein runs in the posterior interventricular sulcus and ascends to the coronary sinus. The coronary valve is distinct from the valve of the coronary sinus, and the controversial naming of the valve of the coronary sinus is discussed and clarified. This work represents *IHH* bachelor's thesis research done at Sage College, Cornell University.
3. Hyde, I.H. The nervous mechanism of the respiratory movements in *Limulus polyphemus. J. Morphol.* 9: 431-446 + plates, 1894.

   Work conducted at the MBL, Woods Holl (Note: Holl became Hole years later) in 1892 under the direction of Dr. Jacques Loeb, asking where and in what manner is respiration controlled in *Limulus.* Using classical defect experiments she noted a reflex relationship between food swallowing and the cessation of respiratory movements, changes in respiratory patterns of dying animals which resembled Cheyne-Stokes breathing, and an unrelated observation that mating behavior continued following removal of the olfactory vessels. She showed that the gill plates are controlled by an abdominal ganglion. The internal signals were found to be transmitted both by nerves and by the blood to the effector organs.
4. Hyde, I.H. Entwicklungsgeschichte einiger Scyphomedusen. *Z. Wiss. Zool.* 58: 531-564 + Figs, 1894.

   This classical study on three species of scyphozoans settled the controversy between Goette and Klaus concerning the development of the medusa. The work was initiated at Bryn Mawr and conducted at the United States Fish Commission Laboratory with Dr. Thomas H. Morgan and at the University of Strassburg (then a German city) under Dr. Goette. The early phases of the work netted *IHH* an invitation to work with Goette in the German University system and ultimately to obtain the Ph.D.
5. Hyde, I.H. Beobachtungen ueber die Secretion der sogenannten Speichel druesen von *Octopus macropus. Z. Biol.* 35: 459-477, 1895.

   In this study *IHH* designed an apparatus for restraining the octopus in order to collect secretions from the oral cavity without the arms flailing around. The study was done at the Zoological Station at Naples, Italy and is referred to in a humorous way by *IHH* in an encounter with Kaiser Wilhelm II of Germany.
6. Hyde, I.H., and Ewald. Zur Physiologie des Labyrinths. IV. Mittheilung Die beziehungen des Grosshirns zum Tonuslabyrinth. *Pflugers Arch.* 492-508, 1895.
7. Hyde, I.H. The effect of distention of the ventricle on the flow of blood through the walls of the heart. *Am. J. Physiol.* 1: 215-225, 1898.

   IHH described the contraction of the ventricle in association with increased blood volume during forced influx of fluid into the heart. She was the first to point out that the coronary blood vessels are compressed by this muscular action, thus diminishing the flow of blood through them. The consequence of this is an increase in heart rate and in the force and degree of ventricular contraction. The cause of this response was unclear—either mechanical or vasomotor and was not determined by *IHH.* This work was done in the laboratory of Drs. H.P. Bowditch and W.T. Porter at Harvard Medical School Laboratory of Physiology. It is thought to be one of *IHH*'s most important findings. Frank, in the 1880's, had described the tendency of the ventricle to eject whatever volume is put into it, but *IHH* showed the importance of that response to the heart tissue itself. This issue is relevant today in terms of sudden deaths in athletes in whom the coronary vessels are deeply embedded congenitally in the cardiac muscle.
8. Hyde, I.H. Collateral circulation in the cat after ligation of the post cava. *Kansas Univ. Q. Ser. A* 9: 167-171 + plates, 1900.

   The cat has only a right azygos, and thus the postcava and azygos are mutually dependent and supplementary. The blood can be rerouted to the heart via either vessel if the other is ligated. Ligation was done in young kittens, and *IHH* found that the postcava developed collateral branches above and below the ligature and that the azygos became enlarged relative to its usual size. *IHH* suggests that in cases where pathology or injury damages the postcava, such as in cirrhosis of the liver, the azygos must then be left intact to ensure appropriate blood flow around the damage site in the inferior vena cava. This work was an offshoot of her thesis work at Cornell University but was done in her laboratory at the University of Kansas, Department of Medical Physiology.
9. Hyde, I.H. The nervous system of *Gonionema murbachii. Biol. Bull.* 4: 40-45, 1902.

   This study of whole-mounted and osmicated material gives a brief overview of the innervation of the manubrium of the hydromedusan. Distinctions between the marginal nerve rings and the radial nerve system are discussed. Finally, *IHH* notes the presence of "most peculiar nerve tissue" in the sense organs. This study was conducted at the MBL and instigated a conflict between *IHH* and Jacques Loeb concerning authorship of work subsequently published

from Loeb's laboratory. This is mentioned in *IHH*'s diary but apparently was not expressed in print. It tempered the relationship between *IHH* and Loeb during succeeding years.

10. Hyde, I.H. The nerve distribution in the eye of *Pecten irradians*. New York: Holt, 1903, Mark Anniv. Vol., Art. 24, p. 471-482.

    This elegant description of the neuronal elements in the eye of *Pecten* predicted much of what is known today, using electron microscopy, about that retina. This volume was published to honor E.L. Mark of Harvard University and included other works by former students of the Zoological Laboratory. *IHH* was an invited author because of the time she spent at Harvard with Bowditch and Porter.

11. Hyde, I.H. Localization of the respiratory centre in the skate. *Am. J. Physiol.* 10: 236-258, 1904.

    IHH showed that neither medial transaction nor severing the medulla of the skate interfered with the functioning of the respiratory center. Each half of the medulla can sustain coordinated respiratory movements. An initial period of respiratory irrythmia was compensated for using a respirometer, but soon after the surgery was performed the animal was able to function independently of that device. *IHH*'s conclusion was that in the skate, the respiratory center is intermediate in type being advanced beyond a simple segmental arrangement seen in the typical invertebrate and the complex center in higher vertebrates. Her diaries indicate that this work was done at the MBL, but it is attributed to the KU Physiological Laboratory.

12. Ewing, H.Z. The functions of the nervous system, with special regard to respiration in Acrididam. *Kansas Univ. Sci. Bull.* 2: 305-319, 1904.

    In thts study, *IHH*'s student determined experimentally the site of the respiratory center in the grasshopper. Systematic removal of known ganglia pinpointed the separation of control of the various components of respiratory function. When the supra- and subesophageal ganglia are removed by decapitation, the respiratory movements are slowed; thoracic ganglia are shown to be segmentally arranged in controlling spiracle opening and closing and movement of the legs of that segment, but they have no effect on opening and closing of the air sacs or abdominal walls. Function is possible only if at least three segments of the ventral nerve cord are attached; similar results were described by *IHH* for *Limulus*. In this study, *IHH* showed that inspiration was the result of an active contraction of the voluntary abdominal muscles. Upon the application of curare, the abdomen relaxed in the expiratory phase. The anterior brain mediated forward movement and swallowing movements. Decapitation had no major effect other than maintaining the animal in a single location and, subsequently, starvation. The subesophageal ganglion controls the sense of equilibrium and gives the animal its sense of location in space.

13. Hyde, I.H. Differences in electrical potential in developing eggs. *Am. J. Physiol.* 12: 241-275, 1904.

    In her study of the Scyphomedusae *IHH* noted that development proceeded abnormally when the seawater happened to evaporate from one of her specimen dishes. In particular, multinuclear cells were formed in the embryos. She reasoned that the presence of electrolytes in high concentrations might prevent cytokinesis without effecting karyokinesis. Others had associated cytoplasmic streaming during cell division with electrical charge differences and consequent changes in surface tension.

    IHH sought to measure minute electrical charges at different stages in the eggs of the turtle and *Fundulus*. She concluded that the ionic imbalances in concentrated salt solutions resulted in viscosity changes which then affected the division of the cell in question. Her description of the results may be compared with those of more recent investigators studying the mechanisms of spindle formation and chromosome movements, "It is possible that changes in osmotic pressure, solution tension, mass, and enzyme action, as well as surface tension obtain during the egg's history. These produce alterations in the viscosity of the cytoplasm, absorption of liquid by the chromatin or cytoplasmic particles, and a shrinkage in the one or the other during definite phases of cleavage, the index for the variations of changes being the difference of electrical potential." The current controversies concerning the effect of electrical potential on development were foreshadowed by her conclusions (Jaffe et al., *2nd Int. Congr. Cell Biol.*, 1980).

14. Hyde, I.H. *Outlines of Experimental Physiology*. Lawrence, KN: Univ. Kans. Press, 94 pp. 1905.

    The laboratory manual was written and published by *IHH*. The Kansas Board of Regents declined to fund its publication (although other such manuals were so funded). It was used in the Medical Physiology class throughout her tenure at KU.

15. Loeser, W. A study of the functions of different parts of the frog's brain. *J. Comp. Neurol. Psychol.* 15(5): 355-373, 1905.

    This study by *IHH* documents classical experiments on localization of function in the brain. Specimens were followed behaviorally and allowed to survive for several months after the ablation surgery had been done. In addition to examining and localizing the centers for the animal's croak, turning-over (righting reflex), swallowing, heart action, equilibrium, respiration, and various other movements, the experiments demonstrated the centers for very specific components of vision. However, histology was not done to determine the accuracy of the surgical results or to eliminate the possibility of postsurgical recovery due to regeneration.

16. Hyde, I.H. Recent scientific contributions to social welfare. Modern aspects of physiology. *Chautauquan* 41: 244-250, 1905.

    IHH was very interested in theories of disease and pathology that involved the electrolytic control of bodily changes. She recognized the importance of ions in physiological functioning from digestion to development and muscle function. She was certain of seeing the creation of substances that could be injected into the body as antitoxins and in diseases such as diabetes (predating the isolation of insulin!). This paper was written as part of her public work – required of faculty at KU in order to justify the existence of research on the campuses. The complexity of the ideas, which she expresses simply and eloquently, is remarkable when one compares this with the level of scientific information presented to the general public today.

17. Hyde, I.H. A reflex respiratory centre. *Am. J. Physiol.* 16: 368-377, 1906.

18. Walling, E.V. The influences of gases and temperature on the cardiac and respiratory movements in the grasshopper. *J. Exp. Zool.* 3: 621-629, 1906.

    One of the opening sentences of this paper gives the reader the scope of *IHH*'s dedication to accuracy, "More than a thousand grasshoppers of different species were employed in this investigation. Besides normal, decapitated and deviscerated specimens, abdominal segments and isolated heart pieces were employed." It was determined that the absence of oxygen was not so dangerous to these animals' hearts and nervous tissue as in higher forms. There was some suggestion of the presence of ganglia in the carapace overlying the heart, which was to be investigated histologically. These have not been described, however.

19. Roller, L.W. Respiratory responses in the grasshopper to variations in pressure. *Kans. Univ. Sci. Bull.* 3: 211-221, 1906.

    The grasshopper was selected in order to determine whether high pressure effects the nervous system, the respiratory tissue, or circulatory system. It is possible in the grasshopper to surgically ablate and isolate these components and examine the functional results independently of each other. Following exposure to a high pressure atmosphere, "While the grasshoppers were under the pressure they did not have spasms; they appeared when the animals were very gradually removed from the pressure. It was also noticed that the first effect of the high pressure was an acceleration of the respiratory movements and then the rhythm decreases very much in force and rate." Thus this experiment showed that it is the *change* in pressure which is most damaging, and in the case of caisson disease or the bends, the toxicity of the pressure change was first described by this study. Currently, the council for National Cooperation in Aquatics states, "It is suggested that [in the bends], the [nitrogen] bubbles cut off circulation to the area reacting [with an inflammatory response], or damage that area directly."

20. Hyde, I.H. The educational importance of physiology. *Interstate Schoolman,* p. 18-20, 1907.

21. Hyde, I.H. The effect of salt solutions on the respiration, heart beat, and blood pressure in the skate. *Am. J. Physiol.* 23: 201-213, 1908.

    This work was conducted at KU, Stanford University, and the MBL. The interrelationships of cardiac activity, respiratory activity, and blood pressure are examined under conditions of varying salt solutions infused into the heart and circulation. This thorough investigation of the responses of the skate cardiovascular system to chemical insult includes an analysis of the effects of barium, sodium, urea, calcium, and magnesium salts as well as acids and bases. *IHH* designed an aparatus for infusion of the salts and for securing stable respiration and function of the skate for this study. In addition, the many uses of the skate in research experiments at the MBL necessitated a thorough investigation of its physiological functioning.

22. Hyndman, H.F., and W.E. Michener. The influence of magnesium sulphate on the motor cells of the cerebral cortex. *Univ. Kans. Sci. Bull.* 5: 25-26, 1909.

    The rabbit was used to determine whether paralysis of the motor cortex could be achieved with magnesium sulfate. The results were negative.

23. Russell, The action of salt solutions on strips of the frog's intestines. *Kans. Univ. Sci. Bull.* 6:383-386 + Figs., 1912.

    This standard smooth muscle preparation was still in use for the rabbit at KU in the mammalian physiology class in 1970! Barium, potassium, and calcium chlorides were found to result in contraction; sodium chloride and magnesium sulfate were found to result in relaxation. It was through such methodical studies of ion action that the functional requirements of muscle cells for the contraction-relaxation response were eventually determined by others. *IHH*'s understanding of their implication for enzyme function and involvement in muscle action is presented in her *Chautaquan* paper (16 above).

24. Gruber, C.M. A comparison of naturally and artificially aroused impulses under the influence of nerve blocks. *Q. J. Exp. Physiol.* 6: 21-23, 1913.

    The purpose of the paper was to demonstrate the presence, in the frog phrenic nerve, of both efferent and afferent impulses. At that time the contents of the phrenic nerve had not yet been clearly demonstrated. *IHH* had begun this study with Sherrington in England and suggested that *CMG* repeat and finish the study at KU. Anesthetized rabbits were used. The phrenic nerves and portions of the diaphragm were exposed surgically with suitable physiological monitoring. Electrodes were used to stimulate the phrenic nerve and the diaphragm segments. Blocks were imposed to ascertain whether stimulation of the diaphragm on one side could result in contraction of a diaphragm slip on the contralateral side. This was the case, and the conclusion was that afferents through the opposite phrenic nerve were responsible for the contraction of the contralateral diaphragm. It is now known that sensory afferents in the phrenic nerve derive from the peritoneum of the undersurface of the diaphragm, the pleura overlying the diaphragm and other portions of the

pleura. Thus, electrical stimulation of the diaphragm might be expected to result in a contralateral response acting via the sympathetic nervous system.

25. Gruber, C.M. Blocking nerve impulses in cut and intact nerves and in strychninized and normal frogs. *Kans. Univ. Sci. Bull.* 7: 211-215, 1913.

    The testing of a tripolar galvanic blocking current was found to be superior to standard techniques because it acted on both intact and cut nerves and was instantaneous, reversible, and left no residual damage to the nerve. It is suggested that, in fact, this method might be of use in surgery and for experimental purposes. *IHH* was constantly on the alert for experimental results with clinical application and probably imparted this desire to her research students.

26. Gruber, C.M. The blocking of nerve impulses in the frog. *Am. J. Physiol.* 31: 413-420, 1912-1913.

    The purpose of the experiments was to evaluate the strength of current required in tripolar block against stimuli from different sources. It was found that tripolar block can inhibit strychnine tetanus as well as the contraction resulting from stimulation of intact and severed nerves. Efferent impulses require stronger currents than do afferent impulses. Tripolar block was found to inhibit all other impulses investigated without impairing nerve function and also to exclude afferent impulses selectively in a mixed nerve trunk. This last finding provided an excellent tool for the identification of mixed and unmixed nerves.

27. Hyde, I.H., R. Spray, and I. Howat. The influence of alcohol upon the reflex action of some cutaneous sense organs in the frog. *Kans. Univ. Sci. Bull.* 7: 229-238, 1913.

    In this study, *IHH* and her students examined the dynamics of cutaneous sensory loss as it relates to alcohol intoxication. An acid stimulus was applied and various reflex responses monitored. Alcohol was injected via the lateral lymph sac. It was found that central reflexes were effectively slowed by quantitites of alcohol that had no effect on general behavior. The degree of irritability and rate of response varied in different parts of the body. They concluded "dosages [which cause depression of reflex time in the cutaneous sensory organs of the frog] . . . would be equivalent to one pint of sherry or orange or port wine; 1.13 pints of claret; or 2 pints of strong beer for a man of average weight"! *IHH* was interested in the effects of imbibed materials on human physiology and was one of the few early investigators to recognize the influence of smoking, coffee, and alcohol on human physiology.

28. Hyde, I.H. *Laboratory Outlines of Physiology.* 1914, 51 pp.

29. Hyde, I.H. The development of a tunicate without nerves. *Kans. Univ. Sci. Bull.* 177-179, 1915.

    The tunicate *Ammaroecia* was studied to determine how denervation effects development of the heart and other tissues. The tissues developed normally following ablation of the nervous system in a young embryo but reacted abnormally to stimuli. Thus *IHH* showed that the nervous system may modify the functioning of developing organ systems without influencing their formation.

30. Hyde, I.H., and C. Spreier. The influence of light upon reproduction in *Vorticella. Kans. Univ. Sci. Bull.* 9: 398-399, 1915.

    Vorticella was shown to reproduce more effectively in bright sunlight or in light derived from sunlight filtered using gelatin films and colored glass. Yellow and green are most effective as monochromatic sources of light in the development of *Vorticella.*

31. Hyde, I.H., C.B. Root, and H. Curl. A comparison of the effects of breakfast, of no breakfast and of caffeine on work in an athlete and a non-athlete. *Am. J. Physiol.* 43: 371-394, 1917.

    An ergometer was used to measure the amount of work done by two individuals in lifting a weight. The tests continued daily for three months and included a regular training session. The conclusions of this study were, "An optimum dose of caffeine increases the capacity for muscular work and inhibits the sense of fatigue and that a larger dose decreases the power for muscular contraction." In addition it was found that this effect was enhanced following a substantial breakfast. The work efficiency increased with time between breakfast and the work session. The blood pressure and heart rate under working conditions were greater for the athlete (a physical education instructor) than for the nonathlete throughout the experiment. Their resting heart rates were similar. These results are at odds with some of the findings of today's sports medicine research, but it appears that the physical education instructor may have been unusual physiologically for a trained athlete, since resting and working heart rate are usually lower in a trained athlete.

32. Hyde, I.H., and W. Scalopino. The influence of music upon electrocardiograms and blood pressure. *Am. J. Physiol.* 46: 35-38, 1918.

33. Hyde, I.H. A micro-electrode and unicellular stimulation. *Biol. Bull.* 40: 130-133, 1921.

    Unicellular organisms and echinoderm eggs were studied electrophysiologically using a micropipette stimulating electrode modified by *IHH* after Chamber. The contractile substance of the stalk of *Vorticella* differed in its response to internal stimulation from the contractile substance of frog striated muscle. *Vorticella* stalk substance does not follow the all-or-none response. The results for the echinoderm egg are not discussed. The purpose of the paper was to provide a description of the micropipette with possible uses suggested.

34. Hyde, I.H. Effects of music upon electrocardiograms and blood pressure. *J. Exp. Psychol.* 7: 213-224, 1924.

    In this study *IHH* demonstrates the efficacy of music in reducing blood pressure and cardiovascular functions. She suggests music in reducing blood pressure and cardiovascular functions, saying "music may be [selectively] prescribed and thus a scientific employment of the power inherent in music may prove a valuable adjunct to psychotherapy in the treatment of convalescent or other patients sensitive to music." It is amusing to note that among the pieces of music tested was an Indian war dance sung and whooped to the accompaniment of a drum by the composer of the music! This study is currently thought to have been the first of its kind and may thus be the founding work for music therapy, as currently practiced today. The paper was awarded a prize by the American Psychological Association.

35. Hyde, I.H. Before women were human beings. *J. Am. Assoc. Univ. Women* 31: 226-236, 1938.

    This autobiographical paper traces *IHH*'s difficulties in attending the German university system and in obtaining her degree there. It is both inspirational to anyone facing discrimination for any reason when attempting to achieve ones' goals, and an historical record of the education of women in Germany.

36. Burket, I.R. The influence of adrenalin, modified by salts, on the blood pressure in the cat. *Am. J. Physiol.* 30: 382-387, 1912.

    This paper studies the aftereffect of depressed heart activity following administration of adrenalin. The authors found that several salts antagonize the initial rise in blood pressure, whereas others may counteract the paradoxical reduction in blood pressure that occurs later in the course of adrenalin administration. This study was important in assessing clinical means of compensating for the paradoxical effect and enhancing the initial effect of adrenalin administration during cardiac arrest.

37. Howat. The effect of nicotine upon the reflex action of some cutaneous sense organs in the frog. *Am. J. Physiol.* 39: 447-454, 1915-1916.

    In this study, nicotine was shown to effect cutaneous reflexes, ciliary muscle reaction, respiratory activity, and bulbar centers of the brain more severely than alcohol (see 26 described above). In addition, ever increasing dosages of nicotine could result in the development of tolerance for the drug. Thus a milder response might occur to a given dosage if the animal was first "habituated" to the drug. Nicotine causes loss of skin reflexes followed by depressed sensitivity and can reduce respiration or cause forced breathing. Effects on the musculature include initial tetanic contraction followed by relaxation and loss of tonus. These results were indicative of the effects of cigarette smoking on the basic physiological functions of the body. *IHH* in her diaries often comments unfavorably about men *and* women who smoke.

38. Burket, I.R. The influence of adrenalin, modified by salt solutions, on blood-pressure in the frog. *Kans. Univ. Sci. Bull.* 7: 216-226, 1913.

    This study duplicates that done in the cat in 1912 (36 above). However, in searching for a less expensive and more easily obtained specimen for standarizing adrenalin administration, it was found that blood pressure in the frog is not a reliable parameter to use. The results parallel those in the cat. Tabular data from the cat study are given in this paper but not in the cat study. This study again epitomizes *IHH*'s primary desire: to achieve results in the laboratory which are of use to the clinician.

APPENDIX II

"Dear Sir:

I have your letter of April 30th relative to Dr. Ida H. Hyde's work in the schools of Lawrence and am very much interested. I suppose there is no question but what Dr. Hyde is qualified and competent along the line of her special work.

I have been reading for some time the work that is being done for children afflicted with tuberculosis and other pulmonary diseases in different states of the Union. . . . I do not believe there is any state in the Union wherein children are subjected to inspection except where it is supposed that they have some contagious or infectious disease. And *what diseases are contagious and infectious has now become purely a matter of opinion as in tuberculosis and in spinal meningitis.*

One of our physicians in Pittsburg (Kansas) was arrested a few days ago . . . for failing to report a case of spinal meningitis. . . . He produced some fifteen physicians who all swore . . . that spinal meningitis was not a contagious or infectious disease. . . .

There is a very large part of the people in the State of Kansas who do not believe in this medical inspection. . . .

You are doubtless familiar with the fact that there is an organization known as the National League for Medical Freedom. This League has over one hundred thousand members; that it is not a league composed of people adversed to medicine but it is adversed to compulsory medicine. I suspect that Dr. Hyde and others who desire to introduce any measures in the Kansas Legislation along this line will find it pretty hard for their proposition.

I am sending you . . . a speech made by Senator John D. Works of California in the National Senate, also a speech made by Hon. John Bates, Ex-governor of Massachusetts . . . in order that you may know something of the work that is being done in defense of the people who are at the mercy of the medical association who are trying to force through such measures as Dr. Hyde's work.

As a graduate of the State University, as a citizen and taxpayer, I simply am interested in the proposition of the University backing such a proposition which I believe will be very obnoxious to the people generally."

[F.B. Wheeler]

Ida Henrietta Hyde: Early Experiments

Elsie Ernest Johnson

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At the eighth annual meeting of the American Physiological Society in 1895, a female physiologist was proposed for membership. This application was rejected by the Council not on the score that the candidate was a woman but because the publications submitted by the candidate did not fulfill, from the standpoint of original research, the qualifications of membership demanded by the Society. Seven years later, in 1902, among the candidates for membership proposed to the Council was "Miss" Ida Henrietta Hyde. Her nomination was approved by the Council who recommended that in connection with her candidacy the Society "be asked to consider specifically the question of admission of women to membership." After a full discussion at the business meeting it was voted that the president be requested to cast the ballot of the Society in favor of the admission of Miss Hyde, and the Society was then formally open to both men and women of suitable qualifications. The publications of Ida Henrietta Hyde, which included a paper entitled "The Effect of Distention of the Ventricle on the Flow of Blood Through the Walls of the Heart" in the first volume of the *American Journal of Physiology,* must have been very good indeed because it was eleven years before another woman was able to satisfy the criteria for admission to the Society.

In 1822, in his book *De l'Amour,* Stendhal championed the education of women on the grounds that ultimately men would be happier in their company. However, "Such a revolution would only take place over several centuries because by extremely bad luck all the early experiments would be bound to suggest the opposite of the true facts. Enlighten a girl, shape her character, give her in fact a good education in the true sense of the word and sooner or later she will perceive her superiority over other women and become a prig, the most unpleasant and degraded creature in the world. Plant a young tree in the middle of a thick forest and, deprived of air and light by its neighbors, its leaves will be etiolated: it will grow spindly and ridiculous, developing unnaturally. The whole forest must be planted at the same time."

Ida Henrietta Hyde, born in Davenport, Iowa, in 1857 would be classified as an early experiment and a young tree. Dr. Hyde was born in the Midwest of immigrant German parents. Up until the age of 24 she worked as a seamstress in order that her brother obtain a degree in engineering. Then after one year at the University of Illinois, she taught in the Chicago public schools for seven years to save enough money for her own education. After receiving her AB in Zoological Science from Cornell University in 1891, Ida was awarded a graduate scholarship to Bryn Mawr where she was an assistant in Biology and spent her summers doing research in the laboratories of the US Fish Commission at Woods Hole.

In 1896, at the age of 39, Ida Henrietta Hyde was the first woman to receive the Ph.D. from Heidelberg University. It wasn't easy!

A bitter controversy was raging in Germany between two famous scientists (Goette at Strassburg and Claus at Vienna). Ida's results at Woods Hole corroborated those of Dr. Goette, and he became so interested in her work that he invited her to come to Strassburg to work with him even though no woman had ever been permitted to do research or matriculate there for a degree. Ida, who had never allowed herself to dream of such an opportunity, was ecstatic. A European fellowship from the Association of Collegiate Alumnae enabled her to go to Strassburg where Dr. Goette provided her with excellent facilities in the Department of Zoology.

Although there was some initial coolness, i.e., Professor Goltz, one of the most distinguished physiologists in Europe at the time, apologized for the snarls and growls of his bulldog by informing her that the dog disliked women, Ida gained acceptance in the Department of Physiology as well. Things were going smoothly with Ida dividing her time between work in the Zoological and Physiological Laboratories when Dr. Goette, greatly pleased by her work, offered to accept it for a doctor's thesis. Since up until that time in Germany no woman had ever petitioned to matriculate for an advanced degree in natural science or mathematics, it was necessary to petition the government and to obtain permission from the faculty. The storm of outcry and dissension that arose caused Ida to become concerned that the disagreement aroused in the faculty at Strassburg might prejudice the cause of women students in Germany, and concerned, she withdrew her petition.

It was suggested that the climate in Heidelberg might be more favorable, and after months of formal petitions and letters this turned out to be the case. Faculty support at Heidelberg was gained through recommendations from scientists at Strassburg, not only from Dr. Goette but also from the aforementioned physiologist Professor Goltz. Finally, the official ruling from the government of Baden and the faculty of Heidelberg was that "women are admitted to the examination for the degree, under the same conditions outlined in the official regulations for men candidates."

The rules at Heidelberg were that Ida had to obtain consent from the head of each department to allow her to take the subject and an agreement by him to be present at her examination. The directors of Zoology and Chemistry welcomed her. Physiology? Never! Dr. Kühne, professor of Physiology who believed in Kinder und Küche, was adamant. No "skirt" would ever enter his lecture room or laboratories. Ida was advised by friends to take Botany instead. Ida Henrietta Hyde was a physiologist. The Department of Physiology at Heidelberg was an outstanding one. What could she do? Ida tried to impress Dr. Kühne with her scholarship. She asked to borrow his books and invited him to quiz her. He quizzed her on everything but what was covered in the books. She told him she was working in chemistry and

zoology and asked if after she had mastered physiology he would examine her in that subject for the degree. What a joke! No lectures—no labs. "Certainly, if that time should ever come." But Ida wasn't joking. She and the faculty council held him to it, and a furious Dr. Kühne agreed that "as a gentleman he would keep his word." He hadn't promised to allow her into the lecture room or laboratory, however, and that he would never do. What he did do was introduce her to his two laboratory technicians and suggest that she learn from them. They, as dumbfounded as she, said that with his consent they would try. This gesture of contempt for Ida also backfired.

It has been said that Dr. Hyde was a gifted and inspiring teacher. She must have been. Dr. Kühne's assistants who had never attended a lecture of his in their lives audited six semesters of lectures in Physiology, and it was from their notes that Ida prepared for her examination.

Was trailblazing in Heidelberg fun? All that attention—the star of the show so to speak? Here, in her own words, is a description of what it felt like for a 37-year-old mature woman who had been self-supporting since her early teens to enter her first lecture in chemistry. "The door of the lecture room was closed. As I stood before it, the chills ran up and down me, and my courage failed. It was impossible for me to face the excited crowd of noisy students. Turning to leave as quickly as possible, I saw students rushing upstairs. I realized that if I failed then it would require more courage the next day. The students jostled each other and hastened by, leaving me standing in the open doorway. A silence followed, so profound you could hear a pin drop. The men stood seemingly transfixed in their various attitudes. I never knew how I got to my seat, the blood was rushing in my head, and in the hush I distinctly heard an American voice say, 'We shall next have them in the jury box'."

And so it went for two years of lectures, research, and constant study. In response to a first petition for permission for Ida to take the examination, Dr. Kühne announced that owing to ill health he was leaving for Italy for an indefinite period. In response to a second petition, Dr. Kühne replied that the date was noted and that he would be there. Ida couldn't make it; she was too sick with neuralgia. A third date was set. Ida was in a wretched state. She couldn't eat, think, or act and thought she might have to cancel again. However, she somehow managed to get herself together, put on the dress she had made especially for the occasion, and walk into the room where they were all waiting for her. The atmosphere was very jovial, and a lot of wine was consumed except by Ida who under the circumstances preferred water. Dr. Kühne, most jocular of all, enjoyed the test so much that he entirely forgot the time. They grilled her for four hours and asked her to wait outside while a decision was made. Behind closed doors the atmosphere was no longer jovial. Sounds of discordant voices could be heard, and Ida feared the worst. But she had passed irrefutably. The fighting was about the distinction. Dr. Kühne again. Not summa cum laude! Ida Henrietta Hyde was not only the first woman to receive the title Doctor of Philosophy and the Natural Sciences from Heidelberg University, she was the first person ever to receive the distinction multa cum laude superavit, a term coined especially for her (just a shade below summa). Dr. Kühne, who had never permitted Ida to enter any area of his department, then extended an invitation to his home for a celebration dinner. Dr. Hyde declined on the grounds of a previous engagement, which was true. The next thing that happened says a little bit about-soul searching and a lot about Dr. Kühne. Not only did he extend a formal invitation to Dr. Hyde to conduct research in his own laboratories at the Medical School in Heidelberg, but he also got her what was probably the most prestigious and exciting postdoctoral position in the world at that time, a year occupying the Heidelberg-supported Research Table at Naples Marine Biological Laboratory, an international laboratory of far-reaching scientific and educational benefits. Dr. Kühne also obtained a subsequent invitation for Dr. Hyde from the Director of Physiology to conduct research at the University of Bern. One of the visitors at the laboratory in Bern was Professor Bowditch, who said that if Heidelberg and Bern opened their doors to women there was no reason why Harvard Medical School should not admit them also. Dr. Bowditch gave her a letter of introduction to his colleague Dr. William Townsend Porter. It was from the Department of Physiology at Harvard that Dr. Hyde published the paper that appeared in the first volume of the *American Journal of Physiology*.

The superb quality of her creativity and her imaginative research can be seen by a simple partial listing of titles of her publications. Titles from papers written in the early 1900's would not be out of place in the *Current Contents* of today, i.e., "The Air as a Carrier of Infection"; "Differences in Electrical Potential in Developing Eggs"; "The Influence of Alcohol Upon Reflex Action in the Frog"; "The Influence of Light on Reproduction in *Vorticella*"; "A Micro-Electrode and Unicellular Stimulation"; "A Comparison of the Effects of Breakfast or No Breakfast and of Caffeine on Work in an Athlete and a Non-Athlete"; "The Influence of Music upon Electrocardiograms and Blood Pressure."

The concern for her female colleagues which Dr. Hyde showed in Strassburg by withdrawing her petition for matriculation was clearly demonstrated throughout her lifetime. Because she had suffered so much and wasted so much time in Germany in order to gain recognition as a serious student, Dr. Hyde served on an accreditation board established by the Association of Collegiate Alumnae to pass on the qualifications of American women applicants for study abroad and worked to get this "certificate" accepted by the major universities in Europe. Because she experienced the Naples Marine Biological Laboratory as "in truth a haven of bliss" where valuable benefits were offered to men and women alike, she expended considerable time and energy in founding the association which established an "American Women's Table" at the Naples Zoological Station.

From Harvard, Dr. Hyde went to the University of Kansas, where she eventually became Chairman of the Department of Physiology and where she remained for 22 years. She had a long and productive career with many distinctions and many firsts. A consistent pattern was followed. That of trailblazing and then extending a hand to help others along the path. Ida Henrietta Hyde was a genuinely educated, genuinely useful human being. She looked around her, saw a lot to be done, and did what she could. She did a lot. A more extensive coverage of the extraordinary life and achievements of this early scientist appears in this issue of *The Physiologist*. Before she died, at the age of 88, Dr. Hyde gave the American Association of University Women a $25,000 endowment to support a Woman's International Fellowship.

THIRTY-NINTH ANNUAL MEETING OF THE AMERICAN PSYCHOSOMATIC SOCIETY

The 39th Annual Meeting of the American Psychosomatic Society will be held at the Brown Palace Hotel, Denver, CO, on March 25-28, 1982. Topics will come from the entire spectrum of the basic and clinical sciences related to psychosomatic medicine: these include findings from the behavioral or social sciences and from psychiatry or medicine. This year we again plan to include a poster session as well as presented papers, brief communications, workshops, symposia, and an invited address.

A section of brief communications of 10 min each has been designed to permit participants to present up-to-date findings. The deadline for these is Febuary 1, 1982. See instructions for their preparation and submission in *Psychosomatic Medicine.*

Robert M. Rose, Chairman

SYMPOSIUM ON ELECTROGENIC TRANSPORT: FUNDAMENTAL PRINCIPLES AND PHYSIOLOGICAL IMPLICATIONS

A Symposium on Electrogenic Transport: Fundamental Principles and Physiological Implications, organized by M.P. Blaustein and M. Lieberman, will be held on September 9-12, 1982, at the Marine Biological Laboratory,Woods Hole, MA.

Sessions I and II: Fundamental Principles of Electrogenic Transport. Speakers: P. DeWeer, B. Chapman, A. Scarpa, E. Heinz, I.M. Glynn, M. Lieberman, and M.P. Blaustein.

Session III: Physiological Role of Electrogenic Pumps in Excitable Cells. Speakers: D.O. Carpenter, D.A. Eisner, L.J. Mullins, and J. Connor.

Session IV: Physiological Role of Electrogenic Pumps in Non-Excitable Cells. Speakers: H.-P. Meisner, H.R. Kaback, C. Slayman, and R. Spanswick.

Workshop on Measurements of Electrogenic Transport: Organized by R. Thomas and W.J. Lederer.

There will be three open poster sessions. The Society invites workers in the field of electrogenic transport to present posters at the meeting. Potential contributors write to M. P. Blaustein, Dept. of Physiology, University of Maryland School of Medicine, Baltimore MD 21202, for information about the submission of abstracts for poster presentation.

The Institute Archives and Special Collections Department of the Massachusetts Institute of Technology Libraries has just completed a Processing Manual (57 pages). The manual outlines procedures designed to handle contemporary archival and manuscript collections. It is available for $5 from Institute Archives and Special Collections, Room 14N-118, Massachusetts Institute of Technology, Cambridge, MA 02139. Checks should be made payable to the Massachusetts Institute of Technology.

HONORS AND AWARDS

On June 3, 1981, the Association for Women in Science, Metropolitan New York Chapter, honored four Outstanding Women Scientists at a reception held at the New York Academy of Sciences. Among the honorees was **Audrey E.V. Haschemeyer,** who is a member of APS and is currently serving on the Membership Commitee.

The Institute of Medicine-National Academy of Sciences elected 50 new members, their terms to begin on January 1, 1982. Six APS members were recipients of this honor: **Mary Ellen Avery,** Professor of Pediatrics, Harvard Medical School; **Floyd E. Bloom,** Director, Arthur V. Davis Center for Behavior Neurobiology, The Salk Institute; **Alfred P. Fishman,** Director, Cardiovascular-Pulmonary Division, Hospital of the University of Pennsylvania; **Barbara C. Hansen,** Assistant Professor of Physiology, University of Michigan; **Charles R. Kleeman,** Professor of Nephrology and Medicine, University of California, Los Angeles; and **Thomas W. Langfitt,** Vice President for Health Affairs, University of Pennsylvania.

After 23 years of service with the American Physiological Society, Myra "Kelly" Byars has retired to pursue other endeavors. She has spent most of her career working as Editorial Assistant responsible for *The Physiologist.* Since its inception in February 1958 as a small quarterly publication of abstracts, it has increased in size and stature as a bimonthly, publishing Society and international news, information for the physiology teachers, historical articles and notes, letters of senior physiologists, special lectures, and other items of general interest to physiologists. Kelly will be missed by her many friends and colleagues, both in the headquarters office and throughout the Society membership.

PUBLIC AFFAIRS

Congressional Hearings on the Use of Animals in Medical Research and Testing

As announced in the Business Meeting, APS has obtained professional assistance in dealing with current threats to experimental use of animals. The services of William Samuels have been retained by APS for this purpose. Also, a request was made at the Business Meeting for members to receive information on this subject.

A regular column by William Samuels will appear in *The Physiologist* to keep the membership informed of legislative and other issues affecting animal experimentation.

The Congressional panel considering proposed animal welfare legislation has narrowed its focus to the areas of peer review and alternative methods.

Questions concerning the effectiveness of the current peer review mechanism and the need to develop alternatives to laboratory animals were explored with researchers by the House Subcommittee on Science, Research and Technology during two days of public hearings in October. A total of 28 witnesses from governmental and private agencies appeared before the panel.

(The Federation of American Societies for Experimental Biology did not testify, but Federation President E. H. Wood did submit a written statement for the record.)

The hearings originally were called to solicit comments on seven animal welfare reform bills pending before the House. The Senate has not introduced such legislation.

The concern for the current peer review system and development of alternative methods, however, became the primary issues of the panel as a result of a September police raid on a Silver Spring, MD, behavioral research laboratory where 17 monkeys were seized for alleged misuse.

The panel, headed by Rep. Doug Walgren (D-PA), questioned the witnesses representing the research community, the National Institutes of Health, and the US Department of Agriculture as to why the peer review system had failed to trigger a warning of the alleged animal abuse at the Silver Spring laboratory and requested the researchers to provide the Subcommittee with new concepts on how peer review can be improved.

Witnesses representing humane organizations and animal rights groups pushed for representation on peer review panels as a means for curbing alleged animal abuse in research along with the mandates for the development and use of alternative methods.

The interests of research from the private sector were presented by Ernst Knobil, Ph.D., University of Pittsburgh, representing the American Physiological Society and the Endocrine Society; John P. Jordan, Ph.D., Colorado State University, representing the American Institute of Biological Sciences; Sheldon M. Wolff, M.D., Tufts-New England Medical Center, representing the National Society for Medical Research; Gerald Levey, M.D., University of Pittsburgh, representing the Association of American Medical Colleges and the American Federation for Clinical Research; Edward C. Melby, D.V.M., Cornell University, representing the Association for Biomedical Research; Edward C. Melby, D.V.M., Cornell University, representing the Association for Biomedical Research; Nathaniel Pallone, Ph.D., Rutgers University, representing the Association of American Universities, National Association of State Universities and Land Grant Colleges, and the American Council on Education; and Perrie M. Adams, Ph.D., University of Texas Medical Branch at Galveston, representing the American Psychological Association.

The researchers told the panel that they oppose generally any measures that would restrict by Federal regulations or divert research money to the development of alternative methods.

The reference was directed at H.R. 556, a bill that would require a diversion of 30-50% of all Federal funds supporting research involving the use of animals to be spent for the development of alternative methods for such experiments. This would include all research funds from the National Institutes of Health, National Science Foundation, Food and Drug Administration, Department of Defense, Department of Agriculture, Department of Interior, Environmental Protection Agency, Veterans Administration, and military medical centers.

"We are simply in no position to absorb additional costs out of our current funds without doing further harm to the university research base," Dr. Pallone told the panel. "Some of the proposed legislation, therefore, would put us in double jeopardy. It would curtail our research-support base by reducing the availability of federal funds at a time of shrinking resources, and it would simultaneously force us to stop much of our most valuable research."

The researchers agreed that every investigator tries to use alternative methods whenever possible because such methods usually are cheaper than research with live animals. To help support this claim was a National Academy of Sciences report showing a 40% decrease in the use of animals from 1968 to 1978 – from 33 million mammals and birds to 20 million.

The researchers also noted that there is very little misuse of animals in research inasmuch as it is in the best interest of the scientist to treat laboratory animals humanely to obtain valid

results. It was stated that whatever the extent of abuse of animals in the laboratory, it is far less than the number of animals killed or mistreated in cities and on farms. In 1980, as an example, 189,000 dogs were used in research while 13 million dogs that year were killed as unclaimed by public pounds and humane societies.

"Congress cannot legislate human kindness, but it should continue its vigilance in the treatment of animals," Dr. Knobil told the panel. "The most restrictive laws will not insure the perfection of human behavior. They (laws) may, however, severly obstruct the very efforts designed to benefit mankind by the eradicating of disease and the relief of suffering."

In a discussion of live animals studies and the duplication of research in some experiments to verify previous results and to perform accurate studies, Dr. Knobil added, "In the testing of polio vaccine, where a small error could paralyze hundred of children, I would not want to have my child or grandchild innoculated with a product that had not been submitted to the most rigorous testing procedures which include administration of the vaccine to rhesus monkeys and the careful examination of their brains and spinal cords afterwards."

In its statement, the American Physiological Society supported the concept of the use of alternative methods, but questioned the wisdom of H.R. 556 as being the proper approach.

"The APS supports the concept of the use of alternative research methods whenever possible to replace the use of live animals and still obtain new knowledge to improve the health and well being of both humans and animals. However, the use of animals is essential to the continuous advancement of biomedical research, and in many instances alternatives to the use of animals have not been developed, e.g. research in cardiovascular disease, hypertension, liver disease, nervous system damage, brain function, alcohol and drug abuse, nutrition, reproduction and genetics, the development of life saving medicine, and surgical procedures for animals as well as humans.

"However, the APS questions the establishment of an entire NIH Institute to study one type of research methodology. All institutes utilize a variety of research techniques which include those mentioned specifically in H.R. 556 as well as whole animal experiments; it is quite common for research to include tissue culture, modeling, animal use, isolated organ systems, computer simulations, etc.

"The modern biological scientist is taught and already uses the latest methods of chemistry, physics, electronics, mathematics, statistics, and computer technology to solve many problems and develop new procedures without the use of animal experimentation. In fact, the modern biological scientist...is able to perform fewer animal experiments and to extrapolate his findings from a limited number of experiments to new working hypotheses that need not employ continous animal experiments.

"The APS questions the value of the Center, as proposed in H.R. 556, to further research accomplishments, and is concerned that the methods proposed by the sponsors of H.R. 556 may be detrimental to the progress of biological and medical science, and to the betterment of all animal life. To support the Center, the bill proposes to redirect 30-50% of appropriations for all research and testing programs involving the use of live animals.

"Although only a small part of the national budget supports biological research, diverting such a large percentage of monies from animal research would hinder those programs established to improve human health, environmental quality, and agriculture animal production and also those which assure the safety of food as well as human and animal drugs."

As a result of the hearing the Subcommittee is proposing to draft a single bill that would respond to the concerns of the Subcommittee. Such a proposal, however, is not expected until after the first of the year.

William Samuels

Testimony of

ERNST KNOBIL

Presented before the Science, Research and Technology Subcommittee House of Representatives October 14, 1981

DR. KNOBIL: Mr. Chairman and members of the subcommittee: I am Ernst Knobil, the Chairman of the Department of Physiology of the University of Pittsburgh School of Medicine and the Past President of the American Physiological Society and of the Endocrine Society.

On this panel I represent the University of Pittsburgh, the American Physiological Society and the Endocrine Society, but I appear before you also as a concerned citzen, a husband, and a father and one who has had animals in his household since boyhood.

As such I am profoundly concerned about the health and safety of my family, as well as about the welfare of animals.

I am most grateful, therefore, Mr. Chairman, for this opportunity to comment on legislation which, if enacted, will, I believe, have dire consequences on the health and safety of our people without significant impact on animal welfare.

This is not because the so-called Research Modernization Act, H.R. 556 proposes alernatives to the use of live animals in research and testing, but because it is the intent of this bill to divert as much as 50 percent of appropriations for biomedical research using animals, to other purposes. And this comes at a time when support for biomedical research is already diminishing at an alarming rate and our highly successful enterprise in this realm is being seriously compromised.

I remind the subcommittee that the alternatives to whole animal research, such as the use of isolated cells in culture or computer simulations which are mentioned in the Research Modernization Act have been developed and validated by

biomedical scientists because they are simpler to use as has already been said, are less liable to variability, and are far less expensive.

For these reasons scientists employ them enthusiastically whenever possible and appropriate, but unfortunately they do not serve many of our needs at the present time.

In the testing of polio vacine, for example, where a small error could paralyze hundreds of children, I would not want to have my child or grandchild inoculated with a product that had been submitted to the most rigorous testing procedures which include the administration of the vaccine to rhesus monkeys and the careful examination of their brains and spinal cords afterwards.

The issue here, as in many others like it, is not whether to use animals or nonliving alternatives in toxicity testing of this kind, but whether to test powerful drugs and vaccines in animals or in human beings.

We all remember the tragic consequences of thalidomide as administration to pregnant women in Europe some years ago. This drug produces the same deformities in animals as it does in human infants. Because we paid attention to this fact in the United States our children were spared these unforeseen catastrophic effects of a supposedly harmless drug. How could a drug prevent the development of arms and legs of a computer, or an isolated cell system?

In seeking remedies for high blood pressure, as Dr. Levey has already mentioned, and other cardiovascular diseases, including stroke, for example, one must first understand the normal functioning of the circulation of the blood and how it is controlled. Then various drugs must be administered and other procedures utilized to alter the system.

Animals must be used to conduct this type of vital medical research. Clearly, the alternative here is not a mathematical model or a cell culture system, although these might help, but the use of human beings as experimental animals.

The need to develop, refine and perfect new surgical procedures in experimental animals before applying them to humans is almost too obvious to mention. Again, the only other alternative is not to use humans for this purpose.

Much has been said about the unnecessary duplications of animal studies and the performing of unnecessary or poorly designed experiments. As you know, in research supported by the National Institutes of Health and by the National Science Foundation, all proposals are subjected to rigorous peer review mechanisms, and less than 20 percent of approved projects are funded because of severe budgetary constraints.

These review mechanisms albeit not perfect do eliminate in large measure unneccessary research or poorly-thought-through experimental designs. Research proposals involving animals which are excessive, unnecessary, uneconomic or inappropriate have essentially no chance of being funded, although some do slip through. The system is not perfect.

In fact, the ever increasing cost of animal research has caused a reduction in the use of animals by some 40 percent in the last 10 years as estimated by the National Research Council – the same information that Mr. Weber mentioned.

But it must be remembered that some experimental duplication and replication is actually required by the scientific process. Fundamental new observations must be repeated and confirmed in other laboratories to rule out the possibility that some unsuspected factor may have influenced the results of a particular experiment.

As already stated the scientific community is hard at work in developing alternatives to the use of whole animals. But it can use some help in moving forward at a more rapid rate. For this reason we support legislation such as H.R. 220 and H.R. 930 which have been introduced to provide additional support for the development and validation of these new research methodologies.

They do not now exist in other than very limited areas of medical research and testing and then only as adjuncts, which eventually require confirmation in animals.

Lastly, we abhor as much as anyone the abuse and neglect of animals as well as the infliction of pain and suffering. Each granting agency and each major scientific society and most scientific journals have explicit guidelines for the care and use of experimental animals.

The Animal Welfare Act has stringent provisions for the overseeing of animal facilites, and in my view no new legislation will provide significant new protection against abuse. Although the current activity, as pointed out by Mrs. Stevens, is indeed woefully underfunded. Scientists are only human, and far from perfect.

Some, like the occasional physician or nurse or clergyman, become callous and negligent and insensitive, but peer and societal pressures, as well as the the actions of Animal Care Committees usually rectify the problem.

Unfortunately, Mr. Chairman, the Congress cannot legislate human kindness and compassion, but it should continue its vigilance in the treatment of animals. As in all other human activities, however, the most restrictive laws will not ensure the perfection of human behavior. They may, however, severly obstruct the very efforts designed to benefit mankind by the eradication of disease and the relief of suffering.

The Congress must also be vigilant that this does not come to pass.

Thank you, Mr. Chairman.

MR. WALGREN: Thank you very much, Dr. Knobil.

FASEB PRESIDENT EARL H. WOOD IN STATEMENT DECLARES RESEARCH ANIMALS NECESSARY IN WAR ON DISEASE

Earl H. Wood, President of FASEB, presented written testimony to the House Subcommittee on Science, Research and Technology. See *FASEB Newsletter* 14(6): 2-4, 1981.

Career Opportunities In Physiology

AN ACADEMIC CAREER IN A BASIC MEDICAL SCIENCE DEPARTMENT OF PHYSIOLOGY

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The Careers Committee on Physiology has been charged by the Council of the American Physiological Society with evaluating the status of graduate and postgraduate training in phyiology and its possible impact on careers for physiologists. To do this, the Committee has examined career opportunities available to physiologists and presented information on those in "basic science" physiology departments; in clinical departments within a medical school; at government facilities such as the National Institutes of Health; in biological sciences on an undergraduate campus; and in industry.

The speakers at this Symposium have been asked to further define selected aspects of career opportunities in the various areas identified. Obviously each area is vast, allowing at best generalizations for which exceptions can clearly be documented. My topic relates to the opportunities available and the development of an academic career in a physiology department within a medical school or so-called basic science department setting as may be selected by individuals who have a Ph.D., M.D., or M.D.-Ph.D. and intend to participate in physiology on a full-time basis. To a great extent, some of these views can be applied equally to other basic science disciplines, such as biochemistry, microbiology, and pharmacology. This report describes the background of a "typical" full-time physiologist in a physiology department and the professional responsibilities that must be assumed in such a career. Emphasis is placed on the relationship of past training to career development, especially as it may influence basic science careers in the future. Most important are the priorities that need to be emphasized by junior faculty members in basic sciences if they are to develop successful careers in a future that focuses on biomedical research and teaching in a physiology department. This topic is important because as pointed out by the Careers Committee (1) physiology departments are the major area for both training and employment of physiologists.

Presented in Fig. 1 is the typical training of an individual who enters a full-time career in a physiology department. It is usual to have undergraduate training in biology, chemistry, or physics and graduate training in physiology or related disciplines such as biophysics or biomedical engineering. This may also include M.D. training with or without residency for those who have elected to pursue graduate or postgraduate studies in physiology. As might be expected, most of the current staff of physiology departments in medical schools have been trained within physiology departments. Most individuals oriented toward a career in academic physiology have completed two to three years of postdoctoral fellowship training before assuming full-time academic responsibilities.

Presented in Fig. 2 is a flow diagram of the multiple training pathways leading to a full-time position in a physiology department. These pathways typically include either Ph.D. graduate level or M.D. training and sometimes a combined program (Ph.D.-M.D.). Thereafter, the paths tend to converge at the level of postdoctoral trainee or research associate. Such postdoctoral training is often undertaken in an active research setting where the primary commitment is to benchwork research. In this setting, an individual begins to rapidly gain the experience necessary for developing an independent research program. Though not relevant to the current topic, for completeness other career pathways, such as those directed toward private practice as well as industry, are identified. Careers in research in a private institute and academic research in a clinical department are also indicated. Many of these other aspects have been covered by separate reports in this Symposium. Accordingly this report focuses on the logical progression from assistant to full professor of physiology. In terms of career opportunities, mobility is greatest at the level of assistant professor and decreases with increasing rank. Thus more openings are available for assistant professors in physiology than for professors. Normally postdoctoral or research associate experience lasts for two to three years and that of assistant professor for a minimum of three to four years. Thereafter, the time required for promotion to professor usually varies from four to eight years, depending on many factors, such as teaching ability, research productivity, and general contributions to the department and institution.

Presented in Fig. 3 is the typical structure of a physiology department in a four-year medical school. This "idealized department" has also been characterized as a department of physiology and biophysics, a name often associated with many department. There are approximately 110 physiology departments having an average staff of 13-14 full-time faculty members not including joint appointments. Departments usually include an individual designated as professor and chairman (chairperson) and various staff members as professors, associate professors, or assistant professors. In active research programs established senior members of the faculty have postdoctoral fellows, research associates, Ph.D. students, research technicians, and perhaps

Presented at the Symposium on "Career Opportunities for Young Physiologists," 13 April 1981, FASEB, Atlanta, GA.

1. **BACCALAUREATE DEGREE IN BIOLOGY, CHEMISTRY, etc.**

2. **MASTER'S DEGREE IN A SCIENTIFIC DISCIPLINE.**

3. **PH.D. IN PHYSIOLGY (BIOPHYSICS OR BIOMEDICAL ENG.)**
   OR
   M.D. WITH OR WITHOUT RESIDENCY TRAINING

4. **POSTDOCTORAL FELLOW AND/OR RESEARCH ASSOCIATE IN RESEARCH SETTING (PHYSIOLOGY DEPARTMENT; RESEARCH INSTITUTE; NIH; CLINICAL DIVISION).**

Fig. 1. Typical training of full-time physiologists in physiology departments.

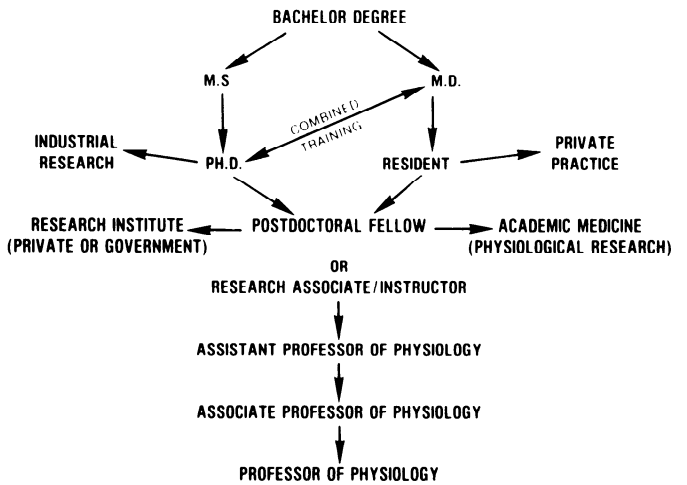

Fig. 2. Flow diagram of multiple pathways of training leading to a full-time position in a physiology department.

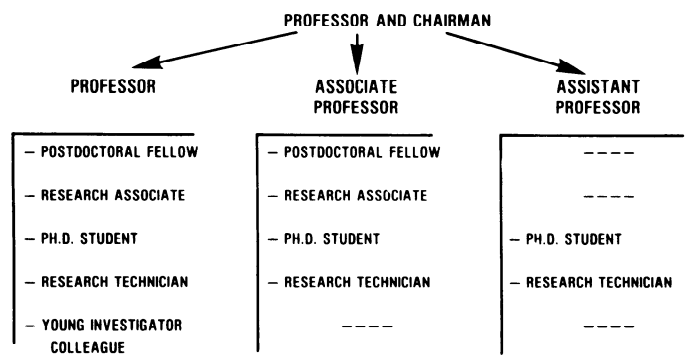

Fig. 3. Structure of typical physiology department (physiology and biophysics) in a medical school (no. of depts, 110; avg full-time staff, 13-14).

"young investigators" working with them. A somewhat similar hierarchy is identified for established associate professors, whereas the staff of the laboratory of an assistant professor will usually include primarily Ph.D. students and research technicians and possibly a few postdoctoral fellows. Even though administrative responsibilities can often be very time-consuming, where possible it is desirable for the stability and growth of the department that the chairperson also maintain an active research laboratory. Very few physiology departments have divisions such as those in clinical departments, and responsibilities for various program tasks are often delegated to faculty members.

Although there is some participation by joint-appointment faculty, the responsibilities of a physiology department (Fig. 4) are mainly carried out by the full-time faculty. General activities are categorized as teaching, research, and service. Teaching usually involves medical physiology as well as physiology for dental, pharmacy, and nursing students. In most departments there are also parallel teaching responsibilities in the graduate program. These may vary from department to department depending on the scope of the program and include supervision of graduate students and postdoctoral fellows. In terms of research, the idealized model or goal of departments is for each faculty member to have an independent program. In addition department stability is often enhanced by collaborative or interdisciplinary research. In terms of service, many universities and/or departments have committees such as a student admissions committee, a promotions committee, an education committee, and so forth. Outside services often include editorial boards, grant reviews, and activities related to societies such as FASEB and APS. The point to be made is the obvious need for individuals to be able to assume multiple responsibilities simultaneously. Indeed, in many physiology departments, faculty must be able to cover both teaching and committee responsibilities and still maintain an active research program. Balanced involvement is ideal for the department, the institution, and often the career of the faculty member.

Presented in Fig. 5 are the three main activities of research, teaching, and service redistributed and emphasized with respect to academic rank. Since departments usually have no formal rules about the distribution of effort, my personal view of the ideal distribution is presented. The closed box emphasizes maximal effort. It is my belief that individuals at the assistant professor level, especially for the first one or two years, should devote most of their effort toward developing an independent research program. Their teaching responsibilities should be well focused and delineated to allow them to develop a research laboratory. Past experience suggests that limited involvement in committee assignments, which is often time-consuming, is in the best interest of the young scientist. With increasing rank, individuals should assume greater responsibilities in the teaching program and institutional committee assignments. The chairperson and the new faculty members must all work toward this goal, and it should have the support of others in the department. As will be emphasized later in this report, it is becoming increasingly critical that faculty members teaching in the professional physiology courses (e.g., medical and dental) execute that responsibility to the best of their ability. Thus a full-time faculty member in physiology who has to maintain an independent funded research

GENERAL ACTIVITY SPECIFIC RESPONSIBILITIES

TEACHING:	**Medical (lecture, laboratory, conference)** **Dental (lecture, laboratory, conference)** **Pharmacy (lecture, laboratory, conference)** **Nursing (lecture, conference)** **Graduate (lecture, laboratory, conference)**
RESEARCH:	**Independent funded research programs** **Collaborative research with faculty** **Interdisciplinary research (program project, etc)** **Supervision of Ph.D. students** **Supervision of Postdoctoral Fellows**
SERVICE:	**Admissions Committee** **Students' Promotion Committee** **Faculty Appointments and Promotions** **Education Committee** **Grant Reviews and Editorial Activities** **Society Activities (APS, FASEB, Endocrine, etc.)**

Fig. 4. Examples of responsibilities of full-time faculty members in physiology departments.

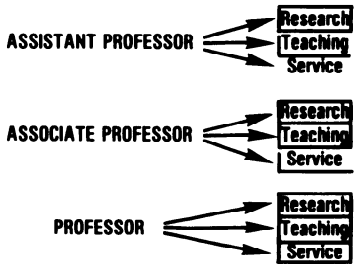

Fig. 5. General activity-related involvement with respect to academic rank.

RESEARCH – Development of Independent Research Programs

1. Active in "hands on" bench research
2. Obtaining preliminary supportive data
3. Consultation with established faculty in department
4. Preparation of well-focused research grant

TEACHING – Executing Defined Teaching Activities

1. Preparation of Lectures and Conferences
2. Integration of Specific teaching with General course

SERVICE – Minimal Participation in Committee activities

1. Chairman must "shelter" junior faculty research time
2. Established faculty have major committee responsibilities

Fig. 6. Priorities of new assistant professors (first 1-2 years) in basic science departments.

program as well as execute his/her professional teaching duties with skill has a difficult but challenging task. The Careers Committee has emphasized this point to young physiologists who are considering a career in a physiology department.

Presented in Fig. 6 is a priority view for assistant professors in basic science departments. Though it is my personal view, it is also shared by many members of the Careers Committee. In essence, during the first one or two years an individual should devote as much time as possible to research. This means obtaining support data for outside grant applications and active involvement in actual research. Past experience indicates that if a faculty member does not develop an independent and funded research program within the first two or three years as an assistant professor, he will seldom be able to develop such a program at a later date. Working in association with a more established investigator has its positive features, but a sense of autonomy and independence in terms of research should be the goal. During this period individuals need to have defined teaching responsibilities and to integrate them with general department teaching goals. It is the chairperson's responsibility to counsel junior faculty members and help them allocate the time necessary to do this.

Assuming that one major responsibility of young physiologists is to develop an independent research program and assuming that this often requires outside funding, what characteristics are usually associated with the ability to achieve this goal? Figure 7 presents ten general characteristics, from my perspective, typical of such individuals. First, they are highly motivated and interested in research. Second, they are well trained and often have in-depth postdoctoral research experience. They are able to formulate a new hypothesis, write a clearly focused grant, and design a well-controlled and realistic experiment. They also keep up-to-date with the current literature and methods. Such faculty members are usually very willing to accept constructive criticism. They may put in many extra evening and weekend hours. They are often determined individuals who are willing to "try and try again" in the preparation of competitive research applications. Their curriculum vitae usually reflects papers of good quality published in peer review journals. Exactly why some individuals have these characteristics is very difficult to determine. It obviously reflects their inherent intellectual capabilities but also the quality of their graduate and/or postdoctoral research training. In essence they have been trained to be independent scientists and couple this training with maturity and motivation.

In contrast, Fig. 8 presents characteristics typical of junior faculty members who have difficulty in developing independent research programs. Even though to a certain degree these characteristics are essentially the opposite of those presented in Fig. 7, there are some unique aspects worthy of emphasis. First, such individuals appear to have been trained to fulfill a supportive or technical role rather than an independent one. They have difficulty in developing, designing, and executing an experiment by themselves. They also have great difficulty in writing a well-focused grant application or a research manuscript. Often they view a basic science career as either not very competitive or in many cases too competitive. In this latter sense they often view the availability of research funds as so limited that it is not worth the effort to write a research application. Most important, such individuals usually have great difficulty, even in subsequent years, in assuming simultaneously the multiple tasks of teaching, research, and committee assignments. If confronted with multiple responsibilities, they tend to neglect their research programs. In essence their commitment to laboratory research is questionable, and often they cannot mix teaching and research responsibilities.

For completeness, it is appropriate to point out important assumptions and/or potential realities that may influence career opportunities and development in physiology and perhaps in any basic science department in the next decade. Figure 9 emphasizes our view that physiology departments or functionally analogous units are of importance to tertiary academic medical

1. HIGHLY MOTIVATED AND ENTHUSIASTIC ABOUT BIOMEDICAL RESEARCH.
2. WELL–TRAINED TO BE INDEPENDENT WITH POSTDOCTORAL RESEARCH.
3. ABILITY TO FORMULATE NEW HYPOTHESIS.
4. ABILITY TO WRITE A FOCUSED GRANT WITH SUPPORTIVE DATA.
5. ABILITY TO DESIGN WELL–CONTROLLED AND REALISTIC EXPERIMENTS.
6. FAMILIAR WITH CURRENT LITERATURE AND TECHNIQUES.
7. WILLING TO ACCEPT CONSTRUCTIVE CRITICISM FROM ESTABLISHED FACULTY.
8. CAPACITY TO WORK "EXTRA HOURS" IN A COMPETITIVE PROFESSION.
9. WILLING TO ACCEPT FAILURE AND "TRY AGAIN" WITH REFERENCE TO GRANTS.
10. HAS PUBLISHED SCHOLARLY PAPERS IN PEER–REVIEW JOURNALS.

Fig. 7. Characteristics of typical junior faculty member who will be most likely to develop an independent research program.

1. NOT HIGHLY MOTIVATED TOWARD EXPERIMENTAL RESEARCH.
2. TRAINED TO BE SUPPORTIVE RATHER THAN INDEPENDENT.
3. LIMITED EXPERIENCE IN WRITING A GRANT.
4. DIFFICULTY IN DESIGNING A WELL–FOCUSED PROPOSAL.
5. DIFFICULTY IN WRITING FULL MANUSCRIPTS FOR PUBLICATION.
6. QUESTIONS THE VALUE OF POSTDOCTORAL RESEARCH EXPERIENCE.
7. LIMITED KNOWLEDGE OF CURRENT INVESTIGATIVE TECHNIQUES.
8. VIEWS BASIC SCIENCE CAREER AS NOT COMPETITIVE OR TOO COMPETITIVE.
9. PREFERS COMMITTEE RESPONSIBILITIES TO RESEARCH.
10. DIFFICULTY IN ASSUMING MULTIPLE TASKS, i.e., TEACHING, RESEARCH AND SERVICE.

Fig. 8. Characteristics of a typical junior faculty member who may have difficulty developing an independent research program.

centers and that biomedical research is the cornerstone for advancement in medicine. Indeed, such departments and their research programs form the base of our training programs for future scientists. There will most probably continue to be a national commitment to basic biomedical research, although the level of that commitment can change greatly, causing frustration in the scientific community. However, more meaningful is the fact that, in the near future, medical schools will probably not expand nor will the number of schools increase as they have in the past ten to twenty years. Along with this trend of limited school size, it is most likely that all basic science departments, including physiology departments, will also experience a limited rate of growth in the future. Internal institutional funds for support of research in both private and state medical schools are declining, and outside research support is becoming increasingly competitive. Outside program support for graduate Ph.D. training is available, but policies regarding its long-term stability and future keep changing. Also, institutional tuition for professional programs such as medical schools is rising rapidly. The leveling off in the size of many physiology departments, the increased tuition, which will justifiably result in greater demands for quality instruction, the competition for research grants, and the potential reduction in funds to support graduate training grants collectively suggest that basic science departments will have to be even more productive as a unit in both research and teaching.

In essence, there are many exciting, rewarding, and excellent career opportunities for physiologists in basic science departments in medical schools, but these opportunities will only be available to those who are very talented, well motivated, and well trained. Great emphasis must be placed on attracting highly motivated and qualified students to physiology training programs and providing them with superior training at both the pre- and postdoctoral levels. The marginally qualified will have great difficulty in developing a satisfying or exciting career in physiology in the 1980s. In all basic medical science areas, biochemistry, physiology, immunology, neurosciences, and pharmacology, we must consider the number of individuals we train in relationship to the positions and/or opportunities available. Indeed, this supply-and-demand balance will greatly influence salary levels for scientists on a long-term basis. It will also influence the quality of each discipline both directly and indirectly in attracting young talent to the profession.

1. PHYSIOLOGY DEPARTMENTS ARE OF IMPORTANCE TO ACADEMIC MEDICAL CENTERS.
2. BIOMEDICAL RESEARCH IS THE CORNERSTONE FOR ADVANCES IN MEDICINE.
3. BIOMEDICAL RESEARCH WILL CONTINUE TO REPRESENT A NATIONAL COMMITMENT.
4. MEDICAL CLASS AND MEDICAL SCHOOLS WILL NOT EXPAND.
5. PHYSIOLOGY DEPARTMENTS RATE OF GROWTH WILL DECREASE.
6. INSTITUTIONAL FUNDS FOR SUPPORT OF RESEARCH WILL DECLINE.
7. OUTSIDE RESEARCH SUPPORT WILL BECOME MORE COMPETITIVE.
8. SUPPORT FOR GRADUATE RESEARCH TRAINING MAY UNFORTUNATELY DECLINE.
9. TUITION FOR MD AND DDS PROGRAMS WILL RISE AND QUALITY OF INSTRUCTION WILL BE OF GREAT CONCERN.
10. GREATER PRODUCTIVITY OF DEPARTMENTS WILL BE EXPECTED IN RESEARCH AND TEACHING AT THE SAME TIME.

Fig. 9. Assumptions and potential realities influencing career development in physiology (basic science) departments.

EDUCATIONAL ASPECTS

—Integrated core curriculum; curtailment of teaching laboratories; and compression of basic science curriculum has had limited success and a reversal might develop

FINANCIAL ASPECTS

—Medical schools increasing dependence on clinical practice plan income for fiscal stability will limit clinical faculty time for basic science teaching or research.

CAREER ASPECTS

—Vanishing "clinician—scientist" emphasizes role of basic scientist (physiologists) in performing research in an academic medical center.

TECHNICAL ASPECTS

—Complexity of research techniques requires participation of individuals with appropriate scientific training and past experience.

Fig. 10. Pressures emphasizing the need for physiology departments.

Indeed, there is a true need for physiology departments in most medical schools in the present and future. In addition, there are at least four points that reemphasize the need for physiology departments (Fig. 10). First, there is the educational aspect. Over the past four or five years, there has been growing unhappiness with the many changes in basic medical science curriculum structure that have developed in medical schools over the previous decade. Earlier, when national priorities seemed to emphasize the need to train more medical students and to perhaps shorten the curriculum from four to three years, there was great pressure on medical schools to curtail the basic science experience and "integrate the basic science curriculum." In addition, in many schools responsibility for organization and even quality control of basic science medical courses (e.g., physiology) were given to a "multidisciplinary committee" and taken away from the departments. A parallel decline in the physiology teaching laboratories also developed. Many have come to realize that such a compressed and theoretically integrated curriculum with limited laboratory and conference teaching has not been as rewarding as anticipated. A reversal in this trend is clearly visible with a greater emphasis on departmental management of the course and redevelopment where possible of the teaching laboratories. The second aspect is financial. Most academic medical centers are becoming increasingly dependent on income from the clinical practice plan to maintain fiscal stability. This leads to a gradual but progressive encroachment on the time and effort that full-time clinical faculty members are able to devote to research and in some cases teaching as opposed to patient care. As a result, there will be a greater need for physiologists not only to assume teaching responsibilities in preclinical subjects but also to conduct research related to both basic and clinical studies. A third point relates to career choices. The clinician-scientists, who in the past have been actively involved in research, are decreasing in numbers. There is becoming a shortage of M.D.-trained investigators working within either basic or clinical departments in pursuit of biomedical research careers. This is partly related to competition for funding, time to devote to laboratory research, personal motivation toward research, and salaries in private practice. Well-trained physiologists may be needed to assume leadership responsibility and to be involved in either basic or clinical research in the typical academic center which is trying to maintain an appropriate balance between teaching, patient care, and research in order to achieve its stated goals. Finally, there are technical considerations. Research is becoming more complex, techniques are sophisticated, and there is an explosive growth of literature on each subject. Graduate Ph.D. level training and/or active postdoctoral research experience will provide an increasingly valuable foundation for individuals whose responsibilities as scientists will be to keep up with the technical complexities of their selected field of investigation.

Thus, there are exciting opportunities for physiologists as professionals in basic medical science physiology departments. They must, however, be very well trained, highly motivated, and

1. **Exciting opportunities for well trained and motivated professionals exist in Physiology.**
2. **Interests in both teaching and research is most ideal for full time faculty.**
3. **Physiologists should be capable of assuming multiple responsiblities simultaneously.**
4. **Emphasis must be placed on attracting the most gifted individuals to physiology.**
5. **Physiology departments can contribute to postdoctoral training of "clinician–scientist."**
6. **Uniformly higher standards for graduate training in Physiology would be valuable.**
7. **Programmatic diversity which distinguishes various departments must be preserved.**

Fig. 11. Career opportunities in physiology: goals and conclusions.

capable of assuming multiple responsibilities (Fig. 11). A sincere interest in both teaching and research appears to be ideal for the full-time faculty member in a department of physiology. We must increase our efforts both as individuals and as a society (i.e., APS) to attract the most gifted individuals to the discipline of physiology and provide them with rigorous in-depth training. We should also remember that physiology departments provide unique opportunities for the training not only of Ph.D. fellows but also of postdoctoral fellows who have M.D. backgrounds and are interested in developing academic careers. The technical complexities of research and the increased competition for funds make it necessary for M.D.-trained individuals interested in academic careers to pursue fundamental research. It would be in our best interests to have uniformly higher standards for Ph.D. training in physiology and to provide training in graduate programs appropriate for a full-time career. Training to assume full-time responsibilities in a basic science department should perhaps be a reference point, since it is within this setting that most professional physiologists find career opportunities and/or seek an alternate career at a later time. Our Committee clearly recognizes that although higher standards and perhaps more uniform training may be a ideal goal, we must not undermine the unique program diversity which distinguishes the different physiology departments, since this is vital to the strength of the discipline of physiology as well as the stability of many departments.

In summary, it is hoped that this presentation provides another dimension of career opportunities for those selecting physiology as a discipline with the goal of joining a physiology department. This opportunity coupled with other opportunities in industry, government, undergraduate departments, and clinical departments discussed in other reports in *The Physiologist* provide a broad array of career choices for the professional physiologist.

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THE ROLE OF THE Ph.D. PHYSIOLOGIST IN A CLINICAL DEPARTMENT

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It is of considerable interest and importance that approximately 53% of the total Ph.D. faculty members in medical schools are in *clinical* departments (2), that some 20% of *clinical* scientists receiving salaries from National Institutes of Health research grants are Ph.D. holders (8), and that some 31% of Ph.D. recipients in basic biomedical fields view their research as *clinical* in nature (9).

Furthermore, the American Physiological Society (APS) has found (4) that of its membership employed in medical schools about 33% are in clinical departments. This represents approximately 1,100 individuals, 189 of whom (17%) hold the Ph.D. degree only and 152 of whom (14%) have the Ph.D. and M.D. degrees. Thus almost one-fifth of the APS members in clinical departments of medical schools have received the Ph.D. only. Of the total of about 3,300 Ph.D. members of APS in all job categories, at least 6% are located in a clinical setting. These findings indicate that the physiologist with traditional Ph.D. training has a rich potential for contributions in a clinical department. Since it is also true that the numbers of M.D.'s actually doing clinical research are at an alarming low (5-7), could this suggest enhanced employment opportunities for the Ph.D. physiologist in clinical departments? And what is the nature of the role played by basic scientists in the clinical setting?

Data are not presently available to ascertain whether the probabilities for employment opportunities in clinical departments will improve significantly over the next few years, but important indications for this exist. There are now some 1,000 ($\pm$200) Ph.D. faculty members with clinical appointments in all US medical schools combined (2). The rate at which this number will change, up or down, depends on a host of factors. Three of the more important are decreases in training funds and increased competition for research funds may reduce all types of research manpower; disproportionate funding (federal and local) may influence the increase or attrition of Ph.D.'s in basic vs. clinical research; and the critical decrease in clinical investigators with the M.D. degree may trigger a response by clinical departments to fill the gap with

greater numbers of Ph.D. holders. It is known (8) that budgeted faculty vacancies for *clinical* departments have increased 11% between 1972 and 1977, whereas basic science departments showed an increase in such slots of only 4%. How many of these clinical vacancies might be for Ph.D.'s is not known.

The need for better understanding and analysis of these factors is clearly recognized by the National Research Council's Committee on a Study of National Needs for Biomedical and Behavioral Research Personnel (9), and this committee will be examining these issues in detail over the coming year.

It is now probably correct to assume that, at least for the near future, the prospects for Ph.D. recipients for positions in clinical research are bright. More specific and up-to-date information is most critically needed for a number of reasons. First, quantitative information about numbers of Ph.D.'s in clinical research is not available beyond 1977. Virtually no breakdown by field or discipline is available; thus it is not clear which Ph.D. discipline(s) is most attractive to the clinical department. The recent results of APS membership statistics are most helpful in this regard (4). Assuming that APS members are by broad definition physiologists, we can see that this discipline is well represented in clinical departments. Casual informal observation indicates that some clusters of basic science disciplines that would be attractive to clinical departments include *1)* biochemistry, cell biology, genetics, and molecular biology; *2)* physiology, pharmacology, neuroscience, and behavioral science; and *3)* pathology, epidemiology (including physical anthropology), and toxicology. Second, the numbers of nonfaculty (nontenure track) positions for Ph.D.'s as "research" scientists or other unique titles are not avaiable (2), but this category of researcher in the clinical setting is likely to be of significant size (9). The 189 Ph.D.'s in the APS in clinical departments are equally divided between tenure and nontenure track positions; this is in contrast to the fact that about 80% of APS Ph.D.'s in basic science departments are tenured (4). The stability of such appointments for young Ph.D.'s seeking long-term career appointments should be investigated. Third, none of the sources of quantitative information provides, as yet, quite the proper set of data needed for the conventional physiology department to train and advise its Ph.D. graduate. We have a rough approximation of the number or proportion of Ph.D.'s doing clinical research compared with the total number of clinical researchers (perhaps 10-20%), but these data cannot be extrapolated to determine what proportion of new Ph.D. graduates will be likely to enter a clinical department. Of the roughtly 3,250 new Ph.D. graduates in biomedical sciences each year (8), how many can be expected to enter clinical departments?

This type of information can be obtained most reliably from at least the following sources: *1)* an independent survey of clinical departments by APS or in conjunction with the Association of American Medical Colleges or Association of Chairmen of Departments of Physiology to determine current and anticipated requirements for Ph.D.'s; *2)* organizations such as the American Federation of Clinical Research, which already publishes in *Clinical Research* three times a year a listing of available positions in clinical departments nationwide (this survey might be modified to include a Ph.D. category); *3)* data from the National Research Council, which will investigate this issue in detail in the coming year (9).

Assuming that there will continue to be positions available for Ph.D.'s in clinical departments, what are the characteristic functions of the basic scientist in the clinical research environment? Some helpful insights are provided in the 1979 FASEB symposium report (2) on the subject (see also 3). From the positive point of view the functional role of the Ph.D. in a clinical department can include any or all of the following. First, the Ph.D. investigator can act as a collaborator in critically valuable research and act an an important catalyst for initiating and stimulating interdisciplinary investigations. Second, he or she can provide highly developed or specialized skills for complex or technically difficult tests, techniques, equipment, and so forth, which can add power and sophistication to ongoing clinical research. Third, the basic scientist can perform a broad range of "teaching" functions for clinicians and their trainee students and housestaff: by helping design, analyze, and interpret experiments; by relating latest developments in the field through seminars and conferences; and by assisting with grant proposal development. Fourth, the Ph.D. holder can serve an important function as a "role model" for research to clinicians, setting the tone and atmosphere for a scholarly, critical, and planned approach to clinical problems. Finally, to the Ph.D. there are direct rewards: he may expect to have a *productive* research career; he can obtain new insights into human biology and psychology and gain satisfaction from working in "applied" research; he may experience direct application of the results of his research to human patients under the responsible management of cooperative physician colleagues; and he may participate personally in diagnosis and therapy through direct application of his specific area of expertise.

The basic scientist may also find negative aspects in a clinically related job. He may be regarded and "used" as a walking encyclopeida or as an advanced laboratory technician, effectively making the collaboration one-way, and he may lose his professional identity. It is probably very important for the Ph.D. to have a joint appointment as a full faculty member in a clinical and a basic science department, with both contributing to his salary. He should obtain assurance of time and opportunity to independently pursue his own research interests, retain the right to be principal investigator on research grants, and maintain a continuing membership in basic science societies and a concurrent scientific reputation as a basic scientist. Problems may arise concerning administrative recognition of basic scientists in clinical departments as legitimate aspirants for senior faculty rank and tenure, even though their presence clearly enhances the posture and productivity of the clinical research unit. Certainly the clinical chairman and senior clinical faculty need to be cognizant of and sympathetic to the mutually beneficial relationships from collaborative interactions between M.D.'s and Ph.D.'s.

It should also be recognized that added financial remuneration to compensate for negative factors such as those discussed above is not necessarily an adequate or satisfactory solution; for this may eventually deter the Ph.D. from pursuing usual academic opportunities for advancement or undermine his essential relationships with other basic scientists.

It may also be advisable for young Ph.D. recipients with interests in a clinically related career to acquire clinical exposure by attending and participating in ward rounds, clinical conferences, seminars, and related activities with clinical colleagues. Such procedures serve to clarify goals and improve vocabulary and communications.

The demands and opportunities for the basic scientist in a clinical setting are unique and considerable. It is probably true that only the very best, most promising, and creative young Ph.D. graduates should consider this option. Great damage can be inflicted in the clinical environment by poor or incorrect transfer of basic knowledge, by improper extrapolation of limited

scientific facts, by teaching of poorly designed experimental protocols. or by lack of sensitivity for the proximity of human subjects to the research procedures.

There is a broader more fundamental issue concerning the role of the Ph.D. in clinical research. Will the presence of Ph.D. faculty in clinical departments in the long run detract from the "academic excellence" and orientation of the clinical (M.D.) faculty? While no one would argue that the Ph.D.'s research should *substitiute* for the M.D.'s active investigative participation, there is the possibility that the presence of the Ph.D. investigator may lead to a subtle but very real erosion of the pressure for the clinician to think or perform scientifically. There may be pressure to alleviate the recent decline in clinical investigation by hiring Ph.D.'s to do the clinical research (5,7). While the active *collaboration* of M.D.'s and Ph.D.'s can be mutually beneficial, productive, and creative, Ph.D.'s cannot substitute for the M.D. clinical investigator (1). The unique insights, sensitivities, and perspective of the physician-researcher are as important an ingredient to a fruitful collaboration as are the special expertise and experience of the Ph.D. (5-7). The loss of clinical investigators must be corrected by a special set of challenges and incentives that will motivate and reward the M.D. to take up research. The problem cannot be resolved by filling the gap with Ph.D.'s with clinical interests. This might but exacerbate the loss of a unique and necessary cadre of clinical scientists and impose unrealistic expectations on the basic scientists.

There are indications that, in recognition of the simultaneously developing need for and complexity of research in clinical medicine, increasing numbers of clinical departments are establishing separate "divisions" of research or research "teams" with financial support from clinically generated funds. Responsibilities of patient care often prevent devotion of full intellectual and technical abilities to the research laboratory, and yet the vigorously alert physician has much to contribute to focused research. Thus closely integrative collaboration between the trained research scientist and the practicing physician in an academic environment virtually dictates establishment of such divisions or teams within the clinical department framework. Specific instances of such collaborative research historically characterize many of the advances in scientific medicine, and the formal establishment of such functional arrangements may be a timely concept.

It is conceivable that an entirely new professional career opportunity may arise for the young basic scientist with rigorous biomedical research training and a related interest in patient care. Even though anesthesiology departments have recently assumed a leadership role in this effort, there is reason to believe such developments could and should develop in each of the clinical specialties. Since physiology crosses all departmental lines, there should evolve expanding opportunities for physiological scientists in clinical medicine.

To summarize the information available to date, it appears that a significant proportion (10-20%) of clinical faculty positions are held by Ph.D. researchers. This is equivalent to some 1,000 ($\pm$200) such positions in total today. Assuming the increase in such positions is at 2-3% per year (8), some 25 new positions may occur annually. The number may be increased in reaction to the decline in clinical research interests by M.D.'s . It also represents less than 1% of all new Ph.D.'s (~3250) produced annually (8) but is still a viable alternative to provide rewarding and productive research for those Ph.D.'s with such interests. The Ph.D. in the clinical research setting can add important depth and expertise to the clinically oriented research project. but should be cautious to protect his long-term security and advancement by maintaining close ties to the basic sciences and encouraging a *collaborative* enterprise with his clinical colleagues.

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MANPOWER COMMENTS
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"We're teaching our future doctors, lawyers and businessmen exactly the wrong things," says Andrew Hacker in an editorial "Grad School Wastelands" in the August 9, 1981 issue of *The Washington Post.* He points out that although the advent of schools of medicine, law, and business pioneered new methods and launched students on challenging careers, faculty members have now turned the schools into vehicles for their personal pursuits.

Medical schools have made science and research their principal priorities. Since few medical schools now have teaching facilities in the usual sense, physicians who like research know that the best way to get a grant is to have a medical school affiliation. The schools in turn oblige by taking the physician aboard with the title of professor, which he then justifies by scheduling several lectures devoted to esoteric findings from his corner of research. Seldom do medical professors, all specialists, offer students simple hints on how to help someone who comes to a doctor's office with a vague complaint. Medicine is not only a science but also an art, and that fact has been lost.

Hacker has little regard for M.B.A.'s. Business school students spend much of their time playing at being executives, but few business professors ever worked in business except perhaps as consultants.

As for law schools, Hacker says they train students in the memorandum writing done by junior lawyers in their first years with a firm. The talents which make for subsequent success are largely developed in the course of practice. These skills are highly personal, and few law schools try to teach them.

In summary, Hacker notes that our top professional schools have ascended to such heights that they are out of touch with the ordinary conditions that comprise our national life. "... (We) are turning out professionals who tend to look on people as something of a bother. Not surprisingly, more than a few patients, clients, and customers are beginning to rebel," he says.

INTERNATIONAL NEWS

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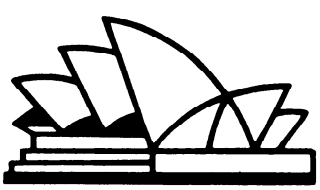
M. Ito (Japan)
P.I. Korner (Aust)
P.G. Kostyuk (USSR)
A.G.B. Kovách (Hungary)
H. Niall (Aust)
D. Noble (UK)
J.R. Pappenheimer (USA)
K. Schmidt-Nielsen (USA)
J.D. Sinclair (NZ)
K. Thurau (GFR)
J.A. Young (Aust)

Australian Scientific Program Committee

W. Burke, Chairman
M.R. Bennett
I. Darian-Smith
D.F. Davey
J.W. Funder
W.E. Glover
A.Z. György
M.E. Holman
P.I. Korner
D.I. McCloskey
H. Niall
J.A. Young



GENERAL INFORMATION

You are invited to attend the XXIX Congress of the International Union of Physiological Sciences to be held at the University of New South Wales in Sydney, Australia, from August 28 to September 3, 1983. The Congress is being held under the auspices of the Australian Academy of Science.

The Congress will commence on Sunday afternoon August 28, 1983 with an opening ceremony and plenary lecture, followed by a reception at the Sydney Opera House. The Congress scientific program will be conducted at the University of New South Wales from Monday to Friday and will end with a closing ceremony on Saturday, September 3, 1983.

The University of New South Wales, with approximately 19,000 students, has a modern campus situated in the suburb of Kensington, only 7 kilometers from the centre of Sydney.

SYDNEY—HOST CITY

Sydney, with its magnificent harbour and nearby Blue Mountains, is one of the world's great cities. It is gracious and yet cosmopolitan. With a population of about 3 million, Sydney has much to offer the visitor in the way of cultural experiences, entertainment, facilities for all sports, 34 nearby golden sanded beaches, and sanctuaries of flora and wildlife.

Sydney has an abundance of museums and art galleries. It is a good place for shopping, with fascinating arcades threaded between busy main streets. There are fashion boutiques for all tastes and pockets and colourful European-style markets offering fare from all over the world. Wining and dining out can be lavish—there are many high-standard restaurants and nightspots; or it can be simple—there are bistros and many smaller restaurants to which patrons can take their own liquor.

The end of August and September is a pleasant period for Sydney. Spring has started and the weather is mild. The average daily maximum temperature is about 19°C (66°F). The days are sunny and it is a period of minimal rainfall.

MEMBERSHIP AND REGISTRATION

Membership of the Congress is open to all persons interested in the basic medical and biological sciences.

The Conference and Travel Section of the Australian Academy of Science will be responsible for the arrangements for registration and accommodation. Full details will be given in the second circular, which will be mailed to you on receipt of the preliminary registration form from this issue of *The Physiologist*. The registration fee is expected to be about $A200.

ACCOMPANYING MEMBERS PROGRAM

Accompanying membership is open to spouses and nonprofessional friends of registered members who wish to participate in the social program but who will not attend the scientific sessions. In addition the social committee is organising a comprehensive and enjoyable daytime program to acquaint you with Sydney and surrounding areas. The registration fee for the accompanying members program will be indicated in the second circular.

PRELIMINARY REGISTRATION

You are asked to return the attached preliminary registration as soon as possible and not later than June 30, 1982. By returning it you will receive the second circular that will include registration forms, an outline of the scientific program, accommodation details, and the appropriate forms on which to submit abstracts for the poster sessions.

FINAL REGISTRATION AND SUBMISSION OF ABSTRACTS

The second circular will be distributed in August, 1982, and it is likely that the deadline for submission of abstracts and final registration will be December 1982. This deadline will be announced in the second circular.

SOCIAL EVENTS AND HOSPITALITY

The Organizing Committee has planned special events for members and accompanying members. The nonscientific program will begin with a reception in the late afternoon and early evening of Sunday, August 28 in the precincts of the Sydney Opera House. Another reception is planned for later in the week. The Sydney Opera House has been reserved on two nights, the first for a special concert by the Sydney Symphony Orchestra and the second for a performance by the Australian Opera Company.

Tours of historic, architectural, and scenic interest in the Sydney area will be available throughout the week. Many of the planned activities will take advantage of Sydney's superb harbour.

OFFICIAL CONGRESS AIRLINES

Qantas Airways, the Australian airline, has been appointed as official international carrier for the Congress. Its offices and agencies around the world will be responsible for coordinating group travel programs for Congress members who require this less expensive form of travel. Group travel or excursion fares, representing a considerable saving on normal fares, exist from most parts of the world to Australia.

Ansett Airlines of Australia has been appointed the official domestic airline. American Express has been appointed as the official in-bound tour organizer and will arrange a number of pre- and post-congress tours to enable delegates to see as much of Australia as possible.

PRE- AND POST-CONGRESS TOURS

These will be available to many areas of interest around Australia, including the Great Barrier Reef (one of the seven wonders of the world), Central Australia (Ayers Rock and Alice Springs), Tasmania (including Hobart and Port Arthur), Melbourne, and the splendid wine-producing areas in the Barossa Valley, South Australia. Full details will be given in the second circular.

ACCOMMODATION

A full range from inexpensive accommodation in university residential colleges through to top-class hotels will be available; 1981 daily prices range from $A20 for a single room to $A80 for single or double hotel rooms. Full details will be given in the second circular.

TRADE DISPLAY

A comprehensive trade exhibition is being planned. For further information about this please write to J.R.S. Hales, Div. of Animal Physiology, CSIRO, PO Box 239, Blacktown, NSW 2148 Australia.

SPONSORSHIP

The Congress is being organised under the auspices of the Australian Academy of Science. Financial assistance for the Congress is being sought from private and public organizations and such assistance will be appropriately publicized in association with the Congress.

MAILING ADDRESS

All communications concerning the Congress should be addressed to:

The Secretariat
XXIX Congress of International Union of Physiological Sciences
PO Box 783
Canberra, ACT 2601, Australia

Additional copies of this circular and preliminary registration forms are available from the above address.

THEMES AND SYMPOSIA

This is the first time the scientific program of an IUPS Congress has been planned by an international committee. The committee was set up by IUPS Council at the Budapest Congress. It met in Sydney in May 1981 and planned the program of themes and symposia described in the following pages. There will also be plenary lectures at the opening and closing sessions and 40 invited lectures during the Congress. Suggestions have been received for invited lectures, but a decision on these will not be made until early in 1982.

The committee examined a large number of proposals for symposia and with regret was unable to accept many excellent suggestions. To avoid overloading the program the number of symposia is to be limited to 90. Nevertheless it is hoped that in this program there will be something for everyone.

A novel feature is the introduction of "themes." A theme is a group of symposia (2 to 6) which focuses on a central area or problem and examines it from different angles. It is an attempt to integrate the contributions of a number of areas, to bring together specialists from different subdisciplines. About 85% of the symposia are grouped into themes, the remainder being single symposia. The accompanying table shows one *possible* arrangement of themes and single symposia. There will be nine concurrent symposia both in mornings and afternoons. For all symposia the closely related free communications will be in the other half of the same day.

The International Committee selected the following program. As will be seen some Symposia are elaborated in detail, whereas others are simply titles. For all symposia a considerable flexibility must exist in working out the details; it is hoped that most of this refinement will have taken place by March 1982 at the latest. The international committee selected a chairman for each symposium and the Australian committee subsequently selected theme co-ordinators and co-chairmen. The names of those selected are shown in the appropriate place. At the time of preparing this brochure most of the invitations to serve had not been issued. We hope that nobody will be offended at this but will regard it as an honour to be selected in one or other capacity.

The International Committee made the radical decision that all free communications should be in the form of posters. While this may displease some, it is probably the best procedure at international meetings at which public speaking for members whose native tongue is not English still presents formidable problems and where attendance of members from certain countries cannot be guaranteed. However, we are mounting a full program of poster discussions. The poster discussion is another relatively new feature, and we have developed techniques to make this a most stimulating experience. The official language for this Congress will be English.

Each registered member will be entitled to submit one abstract for consideration as a poster. The call for abstracts will be made when the second circular is distributed in August 1982.

The information that follows is intended to give some idea of the scope of the Congress. Suggestions for invited lectures, particularly in areas which appear to have been neglected in themes and symposia, will be welcome.

SATELLITE SYMPOSIA

The program committee will consider the granting of official approval only to satellite symposia that are to be held in Australasia. At this stage about 25 satellite symposia have been confirmed. Further information on these satellite symposia will be given in the second circular or can be obtained from I. Darian-Smith, Dept. of Physiology, University of Melbourne, Parkville, Vic. 3052, Australia.

Please note that the second circular will be sent only to persons returning the preliminary registration slip before June 30, 1982. (p. 34)

APS 1983 FALL MEETING IN HAWAII

The 34th Annual Fall Meeting of the American Physiological Society will be held in Hawaii, at the Sheraton Waikiki, August 21, 22, and 23, 1983, with presentation of a refresher course of August 24. The meeting will be hosted by the University of Hawaii at Manoa.

The theme of the meeting is "Man and the Environment." A full program of scientific sessions is planned, including tutorial lectures, symposia, contributed papers, and the refersher course, "The Physiology and Biochemistry of Receptors."

The meeting dates were selected to provide travelers attending the 1983 Congress of the International Union of Physiological Sciences in Australia an opportunity to participate. All scientists registered for the Congress are invited to contribute abstracts and to participate in the meeting. Those who are not APS members and would like to receive the call for abstracts and meeting information should write to Membership Services, APS, 9650 Rockville Pike, Bethesda, MD 20814, USA.

PROPOSAL FOR THEME: PERINATAL EVENTS (A)

Theme Co-Ordinator: Prof. G.D. Thorburn, Department of Physiology, Monash University, Clayton, Vic. 3168

Symposium I: Life before birth

Chairman: M. Liggins (N.Z.)
Co-Chairman: E.M. Wintour-Coghlan (Aust)

1. Lung maturation
2. Respiratory/sleep
3. Control of fluid/adrenal
4. Transplacental exchange
5. Kidney
6. Fetal growth factors
7. Renin/angiotensin/ADH

Symposium II: Birth: the transition

Chairman: A.M. Rudolph (U.S.A.)
Co-Chairman: J.E. Maloney (Aust)

1. Cardiovascular
2. Parturition
3. Metabolism
4. Neonatal respiration
5. Adrenal

PROPOSAL FOR THEME: REPRODUCTION (B)

Theme Co-Ordinator: Prof. D.M. de Kretzer, Department of Anatomy, Monash University, Clayton, Vic. 3168

Symposium I: Differentiation/Speciation/Evolution

Chairman: R. Short (U.K.)
Co-Chairman: J. Shine (Aust)

1. Speciation and reproductive isolation
2. H-Y antigens
3. Differentiation
4. Evolution of peptides
5. Evolution of the mitochondrial genome

Symposium II: Local regulation of gonadal function

Chairman: H. Lindner (Israel)
Co-Chairman: D.M. de Kretser (Aust)

1. Inhibin
2. Gonadocrinins
3. Follicular fluid
4. Ovarian steroidogenesis
5. Ovarian relaxin
6. Sertoli cell function

Symposium III: Fertilization and post-conception event 1

Chairman: R.B. Heap (U.K.)
Co-Chairman: J. Findlay (Aust)

1. Embryo-maternal signals
2. Conception in human female
3. Fertilization in vivo and in vitro
4. Induction of uterine proteins
5. Prostaglandins and uterine implantation

Symposium IV: Central regulation of reproduction

Chairman: E. Knobil (U.S.A.)
Co-Chairman: E. Keogh (Aust)

Topics not specified but should probably include at least one speaker on the pineal gland.

PROPOSAL FOR THEME: EXECUTION OF VOLUNTARY MOVEMENT (C)

Theme Co-Ordinator: Prof. R. Porter, John Curtin School of Medical Research, Aust. National University, P.O. Box 334, Canberra, A.C.T. 2601

Symposium I: Role of afferents in motor control

Chairman: P.B.C. Matthews (U.K.)
Co-Chairman: U. Proske (Aust)

1. Receptors in muscles, joints and skin - morphology and function
2. Afferent pathways for movement control
3. Efferent control of muscle receptors
4. Effects of deafferentation or disturbance of afferent input

Symposium II: Organization of movements at spinal and brain stem levels

Chairman: M.L. Shik (U.S.S.R.)
Co-Chairman: D.J. Burke (Aust)

1. Motoneurone
2. Spinal circuits for motor control
3. Level setting for locomotion
4. Postural mechanisms of the brain stem

Symposium III: Cortical involvement in movement

Chairman: E. Fetz (U.S.A.)
Co-Chairman: J. Brinkman (Aust)

1. Input to motor cortex
2. Output from motor cortex
3. Role of supplementary motor area
4. Cortical function in voluntary movement
5. Disturbances of cortical motor functions

Symposium IV: Programming and coordination of movements

Chairman: M. Ito (Japan)
Co-Chairman: J.W. Lance (Aust)

1. Cerebellar circuitry and connections
2. Cerebellar function in movements
3. Posture and locomotion
4. Basal ganglia function in movements
5. Cerebellar and basal ganglia disturbances

Symposium V: Motor performance and skill

Chairman: E. Bizzi (U.S.A.)
Co-Chairman: R. Porter (Aust.)

1. Perception of movement
2. Motor skills
3. Formulation of voluntary motor command
4. Models for motor control
5. Concepts of voluntary motor control

PROPOSAL FOR THEME: ADAPTATION TO ENVIRONMENT (D)

Theme Co-Ordinator: Prof. G.B. Sharman, School of Biological Sciences, Macquarie University, North Ryde, N.S.W. 2113

Symposium I: Heat

Chairman: J. Bligh (U.S.A.)
Co-Chairman: J.R.S. Hales (Aust)

1. Introductory: mechanisms of regulation
2. Tolerance to heat

3. Comparative aspects
4. Water loss, sweating, panting, etc.
5. Exercise, cardiovascular
6. Brain temperature

Symposium II: Food, starvation in animal and man

Chairman: Le Maho (France)
Co-Chairman: T.J. Dawson (Aust)

1. Penguin, goose
2. Insulin vs. starvation
3. Control of metabolic rate vs starvation
4. Thermogenesis in cold
5. Migration?
6. Hibernation?

Symposium III: Reproductive adaptation to environment

Chairman: G.B. Sharman (Aust)
Co-Chairman:

1. Livestock
2. Native fauna
3. Effects of plant oestrogens

Symposium IV: Pressure and diving

Chairman: Saltzman (U.S.A.)
Co-Chairman: S.W. White (Aust)

1. High pressure, human
2. Osteonecrosis
3. Free diving in animals
4. Birds and mammals

Symposium V: Space

Chairman: H. Bjurstedt (Sweden)
Co-Chairman:

Proposal to come from the IUPS Commission on Gravitational Physiology

PROPOSAL FOR THEME: BLOOD FLOW AND FUNCTION (E)

Theme Co-Ordinator: Dr. E.R. Lumbers, School of Physiology & Pharmacology, University of N.S.W., Kensington 2033

Symposium I: Mechanisms involved in relating flow to function in different regions

Chairman: P.M. Vanhoutte (U.S.A.)
Co-Chairman:

1. Brain
2. Muscles
3. Heart
4. Exocrine glands

Symposium II: Local mechanisms controlling blood flow

Chairman: E. Haber (U.S.A.)
Co-Chairman: E.R. Lumbers (Aust)

1. Angiotensin
2. Prostacyclin/Thromboxane
3. Kinins
4. Physical forces

PROPOSAL FOR THEME: PERIPHERAL AUTONOMIC NERVES (F)

Theme Co-Ordinator: Prof. M.E. Holman, Department of Physiology, Monash University, Clayton, Vic. 3052

Symposium I: Neuropeptides

Chairman: G.J. Dockray (U.K.)
Co-Chairman: J.B. Furness (Aust)

1. Chemical identification of peptides
2. Distribution - origin in peripheral nerves
3. Evidence for physiological release (1 & 2 transmitters)
4. Sites of actions - modulations of transmitter release
5. Metabolism/turnover/synthesis
6. Coupled release of peptides and amines

Symposium II: Autonomic neuroeffector transmission

Chairman: M.E. Holman (Aust)
Co-Chairman:

1. & 2. Physiological significance of prejunctional receptors
3. & 4. What is the transmitter of enteric inhibitory neurons
5. Actions of postsynaptic adrenergic receptors

Symposium III: Autonomic control of gastrointestinal function

Chairman: A. North (U.S.A.)
Co-Chairman: M. Costa (Aust)

1. Acid-secretion in stomach
2. Motor functions of gastro-intestinal tract (influence of nerves on myogenic activity)
3. Myogenic activity in gut
4. Sphincters
5. Local modulation of vasculature of gut

PROPOSAL FOR THEME: EXCITATION AND CONTRACTION (G)

Theme Co-Ordinator: Dr. A. Dulhunty, Department of Anatomy, University of Sydney 2006

Symposium I: Cardiac excitation

Chairman: H. Irisawa (Japan)
Co-Chairman: M.E. Holman (Aust)

1. Calcium, sodium and potassium movements in nodal pacemaking
2. A new ionic channel: implications for conducting and ventricular tissue
3. Sarcolemmal calcium movements
4. Autonomic control
   a) action of acetylcholine on calcium and potassium currents
   b) modulation of ion movements by noradrenaline
5. Slow mechanisms of tension control
   a) frequency dependence of Ca-current and Ca release
   b) control via ionic pumps

Symposium II: Excitation-contraction coupling

Chairman: W.K. Chandler (U.S.A.)
Co-Chairman: A.F. Dulhunty (Aust)

1. Charge movement and Ca release
   a) voltage sensitive dyes and the T-system
   b) charge displacement
   c) T-system and sarcoplasmic reticulum

d) Ca-transients

e) voltage dependence of Ca release

2. Calcium and contractile filaments
   a) biochemical
   b) physiology
3. Length dependence of excitation - contraction coupling
4. Insect flight muscle

Symposium III: Contraction

Chairman: A.F. Huxley (U.K.)
Co-Chairman: C.G. dos Remedios (Aust)

1. Fast tension transients
2. Optical methods
3. Cross-bridge dynamics and theories of contraction
4. Biochemical kinetics of cross-bridge action
5. Energy balance

Symposium IV: Myosin

Chairman: D. Hartshorne (U.S.A.)
Co-Chairman: J.F.Y. Hoh (Aust)

1. Correlation of contractile properties with myosin isoenzymes
2. Myosin phosphorylation
3. Modulation of cardiac muscle myosin isoenzyme

Symposium V: Structure and function of non-muscle contractile systems

Chairman:
Co-Chairman:

1. Myosin localization
2. Actin
3. Regulation of motility proteins (troponin, tropomyosin, phosphorylation)
4. Microtubules
5. Working models (including inhibitor studies; synthetic contractile threads)

PROPOSAL FOR THEME: MEMBRANE AND EPITHELIAL TRANSPORT (H)

Theme Co-Ordinator: Prof. J.A. Young, Department of Physiology, University of Sydney, N.S.W. 2006

Symposium I: Ion coupled membrane processes

Chairman: K.J. Ullrich (G.F.R.)
Co-Chairman: S.L. Skinner (Aust)

1. Co-transport systems including Cl^- transport

Symposium II: Expression of transepithelial transport on cellular structure metabolism and ionic composition

Chairman: C.W.Slayman (U.S.A.)
Co-Chairman: T.O. Morgan (Aust)

1. Microelectrodes
2. Electronmicrophobe

Symposium III: Ion translocating ATPases

Chairman: J. Skou (Denmark)
Co-Chairman: J.B. Chapman (Aust)

1. ATPase structure
2. Ca^{++}
3. H-K ATPase
4. Regulation of Na-K ATPase
5. Vanadate

Symposium IV: Fluid transporting epithelia

Chairman: J.A. Young (Aust)
Co-Chairman:

1. Stomach
2. Choroid plexus
3. Electrophysiology
4. Intestine

Symposium V: H^+/HCO_3 transport

Chairman: F. Rector (U.S.A.)
Co-Chairman: P.W. Kuchel (Aust)

Symposium VI: Barriers in transepithelial and transcellular transport

Chairman: E. Wright (U.S.A.)
Co-Chairman: P.H. Barry (Aust)

PROPOSAL FOR THEME: RESPIRATORY GAS TRANSPORT/RESPIRATION (I)

Theme Co-Ordinator: A/Prof. A. Woolcock, Department of Medicine, University of Sydney, 2006

The theme is mainly centred on oxygen

Symposium I: Physiology of maximal exercise

Chairman: C.R. Taylor (U.S.A.)
Co-Chairman: A. Woolcock (Aust)

Symposium II: Comparative physiology of haemoglobins

Chairman: H. Bartels (Germany)
Co-Chairman: R.A.B. Holland (Aust)

Symposium III: Oxygen radicals

Chairman: O. Hayaishi (Japan)
Co-Chairman:

Symposium IV: Intrapulmonary gas flow

Chairman: A.C. Bryan (Canada)
Co-Chairman: L. Engel (Aust)

Symposium V: Anaerobic and aerobic metabolism of vertebrates and invertebrates

Chairman: A. Bennett (U.S.A.)
Co-Chairman: J. Baldwin (Aust)

PROPOSAL FOR THEME: METABOLISM/NUTRITION (J)

Theme Co-Ordinator: Dr. F.J. Ballard, C.S.I.R.O. Division of Human Nutrition, Kintore Avenue, Adelaide, 5000

Symposium I: Regulation of food intake and use

Symposium to be organized by Commission on Food and Fluid Intake
Co-Chairman: G. Singer (Aust)

Symposium II: Integration of intestinal and pancreatic function

Chairman: W. Creutzfeld (G.F.R.)
Co-Chairman:

Symposium III: Metabolic regulation - including thermogenesis

Chairman: W.R. Dawson (U.S.A.)
Co-Chairman: G. Alexander (Aust)

Symposium IV: Cellular regulation of nutrient turnover (including protein turnover)

Chairman: F. John Ballard (Aust)
Co-Chairman:

PROPOSAL FOR THEME: REGULATION OF BODY FLUIDS (K)

Theme Co-Ordinator: Prof. D. Denton, Howard Florey Institute, University of Melbourne, Parkville 3052

Symposium I: Metabolism, hormonal and neuronal control of individual nephron segment transport function

Chairman: F. Morel (France)
Co-Chairman: B.J. Morris (Aust)

1. Enzyme induction
2. Enzyme pattern
3. Segmental function

   Including effects of PTH, aldosterone & prostaglandins? angiotensin?

Symposium II: Regulation of cell volume and cell electrolyte composition

Chairman: A.D.C. MacKnight (N.Z.)
Co-Chairman: Wiley (Aust)

1. Control of cell volume or osmolal adaptation
2. Intracellular ionic composition: content and activities
3. Regulation of osmolyte synthesis and degradation
4. Solute-macromolecule-water interaction

Symposium III: Interaction of cerebral interstitial fluid with brain function and blood flow

Chairman: D.A. Denton (Aust)
Co-Chairman:

1. Ion exchange between blood and ISF
2. Movement of ions in brain tissue
3. Cerebral transport and regulation of breathing
4. Perivascular control of cerebral blood flow

Symposium IV: Haemo- and filtration dynamics

Chairman: K. Thurau (G.F.R.)
Co-Chairman: A.Z. Győry (Aust)

1. Filtration barrier
2. Glomerular-tubular interactions: feed-back/feed-forward
3. Structural analysis of glomerular capillary system
4. Renal blood flow and its compartmentalization and integration
5. Interaction of peritubular haemodynamics and tubular flow on tubular function

Symposium V: ADH and concentrating mechanism

Chairman: H. Valtin (U.S.A.)
Co-Chairman: J.R. Blair-West (Aust)

1. Cellular action of ADH
2. Induction of tubular heterogeneity by ADH
3. Concentrating mechanism
4. Central releasing mechanisms of ADH

Symposium VI: Tubular handling of organic substances

Chairman: Silbernagl (Aust)
Co-Chairman: J. Lingard (Aust)

1. Amino acids
2. Glucose
3. Organic anions

PROPOSAL FOR THEME: CHANNELS IN EXCITABLE MEMBRANES (L)

Theme Co-Ordinator: Prof. P. Gage, School of Physiology & Pharmacology, University of New South Wales, Kensington 2033

Symposium I: Mechanisms of ion permeation through channels

Chairman: B. Hille (U.S.A.)
Co-Chairman: P.H. Barry (Aust)

1. Energy profile and selectivity
   a) monovalent ions
   b) divalent ions
2. Channel models

Symposium II: Mechanisms of gating ion channels

Chairman: P.G. Kostyuk (U.S.S.R.)
Co-Chairman: D. Van Helden (Aust)

1. Gating in sodium channels
2. Gating in calcium channels
3. Gating in potassium channels
4. Chemical modification of the gates

Symposium III: Single channels and noise analysis

Chairman: E. Neher (G.F.R.)
Co-Chairman: P.W. Gage (Aust)

1. Electrically-activated channels
   a) Sodium channels
   b) Ionophore channels
   c) Calcium channels
   d) Potassium channels
2. Chemically-activated channels
   a) Chemically-activated cation channels
      i) acetylcholine ii) amino acids
   b) Chemically-activated anion channels
      i) acetylcholine ii) glutamate

Symposium IV: New gated channels

Chairman: D. Noble (U.K.)
Co-Chairman:

1. New ion channels in rods
2. Hyperpolarizing-activated current in heat
3. Nerve cells (N current)
4. Calcium-activated channels
5. Proton-activated channels

PROPOSAL FOR THEME: PHYSIOLOGICAL BASIS OF PERCEPTION (M)

Theme Co-Ordinator: Prof. I. Darian-Smith, Department of Physiology, University of Melbourne, Parkville 3052

Symposium I: Transduction and coding

Chairman: A.L. Hodgkin (U.K.)
Co-Chairman: A.K. McIntyre (Aust)

1. Cochlea
   a) transduction
   b) coding
2. Eye
   a) transduction
   b) coding
3. Vestibular
4. Tactile
5. Muscle spindle
6. Taste
7. Olfaction

Symposium II: Parallel processing of sensory information

Chairman: Brown
Co-Chairman: B. Dreher (Aust)

1. Vision
2. Hearing
3. Somatosensory
4. Perceptual consequences

Symposium III: Sensory convergence and perception

Chairman: R. Wurtz (U.S.A.)
Co-Chairman: L.M. Aitkin (Aust)

1. S. Colliculus
2. Pulvinar
3. Visual-vestibular
4. S. Colliculus/Cortex
5. Tactile, nociceptive
6. Intramodal somatosensory
7. Skin, joints, muscles
8. Infra-red sense & vision
9. Audition, vision
10. Parietal cortex
11. Somatosensory

Symposium IV: Perception of body orientation

Chairman: P.O. Bishop (Aust)
Co-Chairman:

1. Vision
2. Hearing
3. Somatosensory
4. Integration of input

Symposium V: Neocortex and perception

Chairman: G. Poggio (U.S.A.)
Co-Chairman: I. Darian-Smith (Aust)

1. Vision
2. Audition
3. Somatosensory
4. Olfaction
5. Taste
6. General
   a) anatomy
   b) hemispheric specialization

(N)

PROPOSAL FOR THEME: NEURAL COMMUNICATION

Theme Co-Ordinator: Dr S. Redman, Unit of the Director, J.C.S.M.R., The Australian National University, P.O. Box 334, Canberra, A.C.T. 2601.

Symposium I: Transmission receptor mechanisms

Chairman: J.P. Changeux (France)
Co-Chairman: D.R. Curtis (Aust.)

1. Synthesis of membrane protein
2. Distribution of receptors; control of sub-synaptic and extrasynaptic receptor density
3. Nicotinic receptors
4. Muscarinic receptors
5. Amino acid receptors

Symposium II: Secretion of neurotransmitters

Chairman: M.P. Blaustein (U.S.A.)
Co-Chairman: E. McLachlan (Aust.)

1. Capturing synaptic vesicle exocytosis during quick freezing; active zones; role of microtubules in vesicle discharge
2. Quanta and subquanta
3. Calcium and transmitter secretion
4. Modulation and modification of transmitter secretion

Symposium III: Integrative action of single neurones

Chairman: K. Krnjevic (Canada)
Co-Chairman S. Redman (Aust)

1. Conduction of action potentials in cells with changing geometry
2. Spread of postsynaptic potentials in neurones: relative effectiveness of dendritic and somatic synapses
3. Influence of extracellular ionic changes on activity of neurones
4. Non-spiking neurones
5. Role of gap junctions

(O)

PROPOSAL FOR THEME: STRUCTURE AND FUNCTION OF CIRCADIAN PACEMAKERS

Theme Co-Ordinator: M.C. Moore-Ede (U.S.A.)

Symposium I: Circadian oscillator mechanisms

Chairman: J. Aschoff (G.F.R.)
Co-Chairman:

1. Free-running characteristics and entrainment
2. Phase response curve: pacemaker and slave properties
3. Nuclear and cytoplasmic generation of rhythmicity
4. Membrane components of circadian oscillators
5. Clock mutants: role of 80S ribosome protein synthesis in circadian rhythmicity

Symposium II: Central neural regulation

Chairman: H. Kawamura (Japan)
Co-Chairman:

1. Suprachiasmatic nuclei (SCN): ultrastructure, neurochemistry, afferents and efferents
2. Neurophysiology of SCN visual afferents
3. SCN function in hypothalamic islands
4. SCN-VMH interactions
5. Pineal neurochemistry and pineal-SCN interactions
6. Pineal neuroendocrine regulation of circadian systems

Symposium III: Regulation of circadian sleep-wake cycle

Chairman M.C. Moore-Ede (U.S.A.)
Co-Chairman:

1. Neural regulation of periodic behaviours
2. SCN regulation of sleep-wake cycle
3. Temporal organization of human sleep
4. Separate circadian regulation of rest-activity and temperature rhythm
5. Hypothalamic interactions between sleep and thermo-regulation
6. Humoral mediation of sleep

(P)

PROPOSAL FOR THEME: ENDOCRINOLOGY

Theme Co-Ordinator: Dr. H. Niall, Howard Florey Institute, University of Melbourne, Parkville, Vic. 3052

Symposium I: Molecular localization in hormone secretion and action

Chairman: J.P. Coghlan (Aust)
Co-Chairman:

1. Immuno histochemistry of CNS peptides
2. Hybridization histochemistry with cDNA probes
3. Steroid autoradiography
4. Photo bleaching
5. Deoxyglucose localization

Symposium II: Neuropeptides and opioid peptides

Chairman: J. Habener (U.S.A.)
Co-Chairman: J.W. Funder (Aust)

Symposium III: Receptor modulation/post receptor events

Chairman: P. de Meyts (Belgium)
Co-Chairman: L. Harrison (Aust)

1. Peptides
2. Steroids
3. Adrenergic
4. EGF
5. LDL
6. Insulin action
7. Prolactin
8. Calmodulin

Symposium IV: Insulin

Chairman: D. Steiner (U.S.A.)
Co-Chairman: D. Chisholm (Aust)

1. Insulin receptors
2. Insulin biosynthesis & gene expression
3. Insulin action
4. Islet cell transplantation
5. Insulin delivering systems

Symposium V: Growth factors/inhibitors

Chairman: R. Bradshaw (U.S.A.)
Co-Chairman: A. Herington (Aust)

1. NGF
2. IGF
3. Growth factors in tissue culture
4. Fetal growth factors
5. Leydig cell growth factors
6. Catabolin

PROPOSAL FOR THEME: DEVELOPMENTAL NEUROBIOLOGY (Q)

Theme Co-Ordinator: Dr M. Bennett, Department of Physiology, University of Sydney 2006

Symposium I: The origin of neurons

Chairman: N.M. Le Douarin (France)
Co-Chairman: J. Stone (Aust)

1. Specification of brain compartments
2. Migration of neurons and excitable cells
3. Specification of neuron properties

Symposium II: The growth of axons to targets

Chairman: L. Landmesser (U.S.A.)
Co-Chairman: L. Beazley (Aust)

1. Description of the growth of axons to targets in different systems
   a) motor neurons
   b) upper motor neurons
   c) retinal ganglion cells
2. Role of specific adhesive pathways in the growth of axons to targets
3. Role of specific substrate molecules in the migration of neurons and the growth of axons
4. Specific factors released by target cells that guide neurites

Symposium III: Neuron growth factors

Chairman: S. Varon (U.S.A.)
Co-Chairman: I.A. Hendry (Aust)

1. Nerve growth factor (sympathetic; proprioceptor sensory)
2. Other nerve growth factors (parasympathetic; motorneurons; retinal ganglion cells)
3. Nerve growth factor determination of neurite growth
4. Death of neurons

Symposium IV: Neuronal recognition

Chairman: J. Sanes (U.S.A.)
Co-Chairman: J.D. Pettigrew (Aust)

1. Formation of synaptic sites
2. Recognition between neuron type and post-synaptic cell
3. Polyneuronal innervation of synaptic sites
4. Plasticity in the formation of synaptic connections
5. Maturation and plasticity of nerve terminals

Symposium V: Neurogenic determination of cell properties

Chairman: D. Fambrough (U.S.A.)
Co-Chairman: I.W. Chubb (Aust)

1. Incorporation of ionic channels
2. Incorporation of receptors
3. Incorporation of enzymes
4. Myelin formation by Schwann and Glia determined by neurons

PROPOSAL FOR THEME: CARDIORESPIRATORY CONTROL (R)

Theme Co-Ordinator: Prof. D.I. McCloskey, School of Physiology and Pharmacology, University of New South Wales, Kensington 2033

Symposium I: Central organisation of cardiovascular and respiratory pathways

Chairman: A. Trzebski (Poland)
Co-Chairman: D.I. McCloskey (Aust)

1. Intrinsic cardiac and respiratory activity
2. Interactions between cardiac and respiratory pathways
3. Organisation of autonomic neuronal pools
4. Organisation of neurons projecting to respiratory motor neurons
5. Suprapontine organisation
6. Tractus solitarius/NTS - respiratory circulatory inputs

Symposium II: Chemical factors in cardiorespiratory control

Chairman: J. Coleridge (U.S.A.)
Co-Chairman: R.A.L. Dampney (Aust)

1. Arterial chemoreceptors: transducer characteristics, features of signals
2. Arterial chemoreceptors: oscillations, phase-gating of responses
3. Medullary chemoreceptors: features of signals; CSF v blood
4. Medullary chemoreceptors: cardiovascular and respiratory responses
5. Muscle chemoreceptors/Renal chemoreceptors
6. Central chemoreceptor pathways

Symposium III: Mechanoreceptor mechanisms in cardiorespiratory control

Chairman: A. Paintal (India)
Co-Chairman: B. Nail (Aust)

1. Arterial baroreceptors: transducer behaviour
2. Arterial baroreceptors: pathways
3. Arterial baroreceptors: reflex responses; interactions; gain, set point
4. Cardiac receptors: reflex responses
5. Intrapulmonary receptors: respiratory, and circulatory influences

Symposium IV: Effector mechanisms and interactions in cardiovascular and respiratory responses

Chairman: J. Sinclair (N.Z.)
Co-Chairman: C. Bell (Aust)

1. Patterns of respiratory activity: tidal volume, frequency; panting
2. Thorax as pump

3. Bronchial muscle interactions
4. Patterns of autonomic activity + mechanisms (e.g. effects through different receptors etc.)
5. Parasympathetic + sympathetic interactions and the heart
6. Diaphragm v other muscles and respiratory patterns

Symposium V: Behavioural aspects

Chairman: A. Zanchetti (Italy)
Co-Chairman: C. Sullivan (Aust)

1. Exercise: chemical and metabolic problems of cardio-respiratory matching
2. Exercise: neural problems of cardiorespiratory matching
3. Sleep 4. Diving/Hypoxia
5. Defence - rage/sexual activity 6. Central 'command'

PROPOSALS FOR SINGLE SYMPOSIA

CARDIAC ARRHYTHMIA (1)

Chairman: E. Coraboeuf (France)
Co-Chairman: A. Tomkin (Aust)

1. Depolarization-induced automaticity
2. Anoxia and acidosis:
   a) Intracellular pH
   b) Ionic mechanisms of after-excitation
3. Low and high potassium:
   a) K^+ current - K dependence
   b) K^+ on tension and calcium current
4. Cardiac glycosides
5. Anti-arrhythmic agents - physiological mechanisms - calcium current blockade
6. cAMP - relation to possible mechanisms of arrhythmia

PAIN (24)

Chairman: W.D. Willis (U.S.A.)
Co-Chairman: A. Duggan (Australia)

1. The physiology of spinal neurones transmitting nociceptive information to the brain
2. The origin and termination of descending fibres controlling spinal transmission of pain
3. Peptides and pain 4. Role of substantia gelatinosa
5. The spinothalamic tracts and pain
6. Primary afferent neurones and nociceptive information
7. Pain and the trigeminal system

CARDIAC MECHANICS (3)

Chairman: G. Elzinga (Netherlands)
Co-Chairman: Hunter (N.Z.)

1. Isolated cardiac muscle
2. Stress and deformation in intact heart

PATHOPHYSIOLOGY OF LARGE ARTERIES (4)

Chairman: R. Ross (U.S.A.)
Co-Chairman: J. Campbell (Aust)

1. Overview
2. Reactivity of arterial wall
3. Blood constituents/wall mechanisms (endothelium)
4. Smooth muscle cell and atherogenesis
5. Receptor mechanisms and spasms of coronary arteries
6. Haemodynamics of wall damage

COMPARATIVE PHYSIOLOGY OF HEARING (5)

Chairman: R. Klinke (G.F.R.)
Co-Chairman: B.M. Johnstone (Aust)

1. Cochlear mechanics
2. Hearing in insects
3. Hearing in reptiles and amphibia
4. Hearing in birds
5. Hearing in bats
6. Mammalian hearing

Other topics: Marsupial audition; species-specific vocalization; mechanics of hearing, gain and directionality of meatus

PLATELET FUNCTIONS (6)

Chairman: B. Firkin (Aust)
Co-Chairman:

1. Membrane receptors
2. Interaction with coagulation proteins
3. Prostaglandins
4. Release reaction
5. Aggregation

COMPARATIVE PHYSIOLOGY OF VERTEBRATE AND INVERTEBRATE VISION (7)

Chairman: R.W. Guillery (U.S.A.)
Co-Chairman: S. Laughlin (Aust)

1. Image formation in invertebrate eyes
2. The visual streak
3. Visual field overlap and binocular vision
4. Evolution of X, Y, W systems
5. Vision in albinos and other abnormalities of vision

AUTONOMIC NERVOUS SYSTEM IN MAN (8)

Chairman: J. Ludbrook (Aust)
Co-Chairman:

1. Sympathetic nerve recording in hypertension
2. Reflex analysis - heart rate, blood pressure (incl. effects of exercise, diet?)
3. Reflex vagal effects
4. Biochemical indices
5. Sleep

MOTIVATIONAL BEHAVIOUR STATE CONTROL (9)

Chairman: P. Karli (France)
Co-Chairman: R. Bandler (Aust)

LEARNING AND MEMORY (10)

Chairman: E.R. Kandel (U.S.A.)
Co-Chairman: R. Mark (Aust)

CONSTRUCTION AND TESTING OF MODELS OF CNS ACTION (11)

Chairman: D.M. MacKay (U.K.)
Co-Chairman: W.R. Levick (Aust)

METABOLIC ASPECTS OF ENDOTHELIAL FUNCTION (12)

Chairman: D. Shepro (U.S.A.)
Co-Chairman: B. McAusland (Aust)

CAPILLARY TRANSPORT (13)

Chairman: C. Crone (Denmark)
Co-Chairman: P. Lingard (Aust)

ONE POSSIBLE ARRANGEMENT OF THEMES AND SYMPOSIA

	MORNINGS					AFTERNOONS				
	MON	TUES	WED	THUR	FRI	MON	TUES	WED	THUR	FRI
1	Execution of voluntary movement (C)					Excitation and contraction (G)				
2	Regulation of body fluids (K) Symposia I-II + IV-VI					Membrane and epithelial transport (11) Symposia I-IV + VI				
3	Neural communication (N)			M.E.T. (11) Symp. V	Vision (7)	A.N.S. (8) in man	R.B.F. (K) Symp.III	Peripheral autonomic nerves (F)		
4	Developmental neurobiology (Q)					Models of (11) CNS action	Channels in excitable membranes (L)			
5	Endocrinology (P)					Reproduction (B)				Platelet (6) functions
6	Hearing (5)	Capillary (13) transport	Endothelial (12) function	Perinatal events (A)		Circadian pacemakers (O)			Learning (10) & memory	Motivational (9) behaviour state control
7	Pathophysiol (4) of large arteries	Cardiac (1) arrhythmia	Cardiac (3) mechanics	Blood flow & function (E)		Physiological basis of perception (M)				
8	Respiratory gas transport/Respiration (I)					Cardiorespiratory control (R)				
9	Adaptation/environment (D)					Pain (24)	Metabolism/nutrition (J)			

OTHER MEETINGS

INTERNATIONAL SYMPOSIUM: CENTRAL NEURAL PRODUCTION OF PERIODIC RESPIRATORY MOVEMENTS

An International Symposium of Central Neural Production of Periodic Respiratory Movements will be held on April 14-18, 1982, in Chicago, IL. The primary objective of this four-day intensive workshop is to define and focus on the important questions concerning the mechanisms underlying normal and pathological respiratory pattern generation in mammals. Internationally recognized authorities on neural generation of respiratory pattern are scheduled to participate. Attendance will be limited to 80 scientists.

For further information contact Jack L. Feldman, Physiology, Northwestern University, 303 East Chicago Ave., Chicago, IL 60611. Phone: (312) 649-8216.

INTERNATIONAL PRIMATOLOGICAL SOCIETY IXth CONGRESS

The IXth Congress of the International Primatological Society will be held August 8-13 at the Colony Square Hotel in Atlanta, GA. This Congress is the first joint meeting of the International Primatological Society, the American Society of Primatologists, and the International Society for Human Ethology. The scientific program includes invited lectures, symposia and workshops, oral/slide presentations, poster sessions, and film and videotape presentations.

Registration and *information*: Dr. Frederick King, Congress Chairman, Yerkes Regional Primate Research Center, Emory University, Atlanta, GA 30322. Telephone: (404)329-7707.

XXIX CONGRESS OF INTERNATIONAL UNION of PHYSIOLOGICAL SCIENCES

SYDNEY, AUSTRALIA, AUGUST 28–SEPTEMBER 3, 1983

PRELIMINARY REPLY SLIP

I am likely to attend the Congress. Please send me the second circular ☐

I expect to be accompanied by the following number of persons ☐

I expect to submit **one** free communication and the most appropriate Theme (select one of "A" to "R") **or** the most appropriate Symposium (select one of "1" to "13") for this communication is ☐

The Themes, Symposia and Satellite Symposia which appeal to me most are (please list up to 5 of each):

Themes ☐☐☐☐☐ Symposia ☐☐☐☐☐ Satellite Symposia ☐☐☐☐☐

I am interested in the following accommodation for the period of the Congress:

MOTEL/HOTEL Deluxe ☐ Single ☐

Medium ☐ Shared ☐

Budget ☐

COLLEGE/STUDENT Single ☐

(BLOCK CAPITALS PLEASE) TITLE: .....

FAMILY NAME: .....

OTHER NAMES: .....

ADDRESS: .....

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COUNTRY: .....

DATE: ..... SIGNATURE: .....

The information on this form is for planning only. Travel and accommodation bookings will not be made on the basis of this form.

Please photocopy if additional Reply Slips are required.

Please note that the second circular will be sent only to persons returning the preliminary registration slip before June 30, 1982.

SOCIETY NEWS

AMERICAN PHYSIOLOGICAL SOCIETY
126th Business Meeting

Time: 4:30 P.M., Thursday, October 15, 1981
Place: Cincinnati Convention Center, Room 2

I. Call to Order

The President, F.J. Haddy, called the meeting to order and welcomed the members to the 126th Business Meeting of APS. The agenda, the ballot for proposed Amendment to the Bylaws, and the ballot for Election of New Members were distributed to the membership in attendance.

II. Report on Membership

The President-Elect, W.C. Randall, reported on the current status of membership and deaths since the Spring Meeting.

A. Summary of Membership Status

As of September 1, 1981, the membership reached 5,927, distributed as Regular 4,399, Honorary 8, Corresponding 79, Emeritus 525, Associate 683, and Student 233. In addition to those members, attention was called to the steady increase in the number of Sustaining Associate members, who were identified (p. 44). Considerable effort has been made by the Financial Development Committee to increase this category of membership.

B. Deaths Reported Since the Last Meeting

The names of the members whose deaths have been reported since the Spring Meeting were read, and the membership observed a standing moment of silence in tribute to them (p. 44).

III. Election of New Members

A. Appointment of Tellers

R. F. Bond, J. Di Salvo, J. P. Filkins, and R. P. Steffan were appointed by the President as Tellers and asked to collect the ballots for the Election of New Members.

Of the 153 new members candidates, four have been nominated for Honorary membership. As designated in the Bylaws, "Distinguished scientists of any country who have contributed to the advancement of physiology shall be eligible for proposal as Honorary members of the Society." It has been a decade since a scientist has been elected to Honorary membership. With the endorsement of Council, the Honorary Membership Committee, consisting of three past presidents, proposed these candidates.

B. Election of Officers

It was announced by the Executive Secretary-Treasurer, O. E. Reynolds, that all candidates on the ballot were elected to membership (p. 44).

IV. Amendment to the Bylaws

In referring to the ballot on the proposed amendment to the Bylaws dealing with the Election of Officers, the President announced that it had appeared in the June/July 1981 issue of *The Physiologist*. The proposal is to reduce the number of candidates for the office of President-Elect from ten to four and Councillors from ten to eight candidates.

By a written ballot vote, Article IV, Section 4, Election of Officers, of the Bylaws, was amended with 54 members voting in the affirmative and six voting in the negative.

V. Actions of Council

"Council is very concerned about the animal care issue," stated President Haddy. "If we are not vigilant, the pound dog may be a thing of the past and as much as 30% of the NIH budget may be used in a search for alternative methods. As you know, the Animal Care and Experimentation Committee organized a workshop in conjunction with the Association of Chairmen of Departments of Physiology, and it was held here Monday. Those of you who were at that workshop now know that the opposition consists of professionals. The Committee Chairman, Helene Cecil, has returned to Washington to attend the current congressional subcommittee hearings on alternatives to the use of animals in research. Also, the Society will be represented at these hearings by E. Knobil, who, by good fortune, happens to be a constituent of Congressman Walgren, Chairman of the Subcommittee. These hearings constitute an example of the need for action on the part of the Society and its members.

"A few weeks ago, the headquarters office sent out an appeal to all members who are chairmen of academic departments, whether of physiology or some other field, urgently appealing to them to write to the Subcommittee expressing themselves on the issue of diverting funds from research to alternatives for experimentation. We do not have any way of knowing to what extent members were responsive to this appeal, but only two copies of such letters have been received at the headquarters office indicating action.

"Since it is our understanding that the Subcommittee will be influenced by the 'weight' of mail received pro and con on the issue of animal experimentation, it is to be devoutly hoped that the response from the research community was greater than is indicated by the copies of letters we have received. The animal issue impacted upon our budget.

"The Finance Committee report (p. 37) and a budget for 1982 was received by Council. As submitted, the budget was in balance. However, two new items which have influenced the 1982 budget were acted upon by Council. A minor item was the need to increase the funds available for program development in order to provide more stability to the Sections in the financing of symposia for the Spring Meetings.

"The major item was the animal issue, i.e., the threat to animal experimentation that is occurring both at the national level in congressional hearings and in many local communities by groups wishing to repeal laws which make pound animals available for research. Council decided to allocate some funds for expert assistance in dealing with these legislative issue at the Federal, State, and local levels. We are obviously facing experts, and we must respond with experts.

"The combination of these requirements, even after reducing some budgeted items, such as the publication costs of *The Physiologist,* will require a dues increase of $5 in 1982. It is important to note that whereas we are allocating funds to bring in professional help in our attack on these forces adverse to animal experimentation, it will be to no avail unless members respond to the threat personally. Within the next year, you can expect to be called upon to be active in this campaign, and your responsiveness is crucial to effective action on the part of the Society.

"The Program Executive and Advisory Committees held meetings here and reported to Council (p. 39). Planning is well under way for the 1982 Spring Meeting of the Society in New Orleans with FASEB and for the 1982 Fall Meeting in San Diego, which is jointly sponsored with the Association of Latin American Physiologists and the Division of Comparative Physiology and Biochemistry of ASZ. Planning is in the beginning stages for the 1983 meeting in Honolulu, scheduled to precede the IUPS Congress in Sydney, Australia, by a few days.

"On the basis of questionnaires circulated concerning meetings of the Society and specifically concerning the desire for the continuation of the Fall Meeting, Council has decided to continue the Fall Meetings but to return for a trial period to campus meetings. Proposals for meetings to be held at the University of Kentucky, Lexington, KY, in 1984 and the State University of New York at Buffalo in 1985 have been tenatively approved.

"In this connection, it should be said that most of the Fall Meetings in recent years have operated at a small loss of revenue, but the highly successful meeting with the Canadian Physiological Society in Toronto produced enough net income to recover the previous years' losses. The Fall Meetings as a whole are, therefore, now operating in the black. Information on the Cincinnati meeting indicates that it will also operate in the black.

"The Council spent a great deal of time discussing plans for the Society's Centennial Celebration, which will occur in 1987. Our original plan was to hold the 1987 Centennial Meeting in Bethesda, MD, at the Uniformed Services University of the Health Sciences: However, it is now possible that it will be held in the spring with FASEB in Washington, DC. This will be decided in November. Other activities of the Committee are a 25-year history of APS by J. R. Brobeck and O. E. Reynolds; a History of American Physiology; a Biographical Directory of APS Members, living and deceased; and historical lecture series beginning with the Spring 1982 Meeting. Other publications are also being developed; e.g., H. W. Davenport has prepared a historical study which will appear as a supplement to *The Physiologist.*

"On recommendation of the Financial Development Committee, Council has agreed to establish a Liaison Committee with Industry to consider possible ways in which our relationship with our Sustaining Associates and other industrial companies can be improved. One proposed mechanism for such improvement is the establishment of a visiting lecturers program of the Society.

"The Publications Committee's midyear report (p. 38) is posted on the bulletin board in the registration area. The publications of the Society are in a very healthy condition from the standpoint of content and management. However, inflation has required subscription price increases, and I suspect that, despite our efforts to hold these down, increases can be expected to continue as long as the inflationary spiral afflicts our whole economy.

"Because of a suggestion that there should be compulsory subscriptions of members to APS journals, an ad hoc committee, chaired by A. P. Fishman, considered this matter. On the basis of that committee's recommendation, Council decided not to institute the policy of compulsory subscriptions. It appears that 50% of our members now subscribe to the Society's journals on a voluntary basis. Council is considering ways to make voluntary subscriptions more attractive, particularly to the younger members.

"We have succeeded in getting FASEB to modify its budget cycle so that its budget is available for review at our October Council Meeting. This will, in turn, help us prepare our budget more realistically.

"A proposal made at the last Business Meeting that multiple assessment for members of more than one FASEB Society by eliminated was placed before the FASEB Executive Committee by APS but was voted down until such time as central billing for dues from FASEB is adopted.

"A questionnaire on the APS membership evaluation of the Federation services has been analyzed, and the results are posted on the bulletin board in the registration area (p. 40). Approximately one-third of the Society members responded. The respondents indicated a high degree of satisfaction with FASEB services. Eighty percent or more of the respondents indicated these services to be very useful.

"The APS was approved as an accrediting institution by the Liaison Committee for Continuing Medical Education. CME credits are now available to members attending our meetings.

"Council approved a Section on Neural Control and Autonomic Regulation (p. 43) and approved a Task Force to Study the Establishment of a Section on Water and Electrolyte Homeostasis."

VI. New Business

Papers presented for publication in APS journals are referreed to assure there are no violation relating to the treatment of animals, and L. Share expressed concern that a similar procedure is not used for paper and poster presentations at Society meetings. It was announced that the Program Advisory Committee will assume the responsibility of reviewing abstracts from this standpoint when making program assignments. In addition, a statement certifying adherence to APS guidelines will be included in the call for papers.

Another member expressed concern about voting on amendments to the Bylaws with so few members in attendance (less than 100) and proposed that the Bylaws be amended to allow for a mail vote. If it is the desire of this group, O. E. Reynolds said a proposal could be made at this Business Meeting, as required in the Bylaws, and an amendment drafted for submission to the members at the Spring Business Meeting.

It was moved and seconded that amendments to the Bylaws be voted on by mail ballot and that a proposed amendment be drafted for presentation to the membership at the Spring 1982 Business Meeting. By a show of hands, the motion was carried with 35 voting in the affirmative and 21 in the negative.

N. C. Staub asked if consideration has been given to abandoning the APS Fall Meeting since so few sections wanted to meet at that time. It was pointed out that the Respiratory, Cardiovascular, Comparative Physiology and Biochemistry, and Environmental, Thermal, and Exercise Physiology Sections wished to hold sessions in the fall. As long as these groups wish to meet, F. J. Haddy said that Council believes the Fall Meeting should be continued. Also, there is sentiment for this meeting, since it is a place for graduate students to "cut their teeth." Although it may not serve the purposes of the entire Society, it serves an important segment.

If it is understood the Fall Meeting will not appeal to everyone, N. C. Staub did not think any serious business should be conducted by the membership at this meeting. There was a suggestion of reevaluating the structure of the Business Meeting with the possibility of it being scheduled earlier in the week to allow for wider participation by the membership. It was further recommended that the Fall Meeting be organized with graduate students (students and Associate members) in mind.

One member expressed strong feelings about not meeting with FASEB but rather with the pharmacologists every few years. In response F. J. Haddy mentioned the results of the survey conducted by the APS Task Force on Future Meetings were overwhelmingly in favor of meeting with FASEB in the Spring. The results of this survey appeared in Vol. 24 (No. 3) of *The Physiologist*.

Another suggestion related to meetings was that nonmembers, particularly students, presenting papers at the Fall Meeting be allowed to register at the member rate. It was pointed out, in a comment from the floor, that students receive a preferential rate, and that members contribute financially in other ways to the support of the meeting.

Attention was again drawn to the issue on legislation on alternatives to animal experimentation and the need to keep the membership apprised. Therefore, a request was made to notify the members directly on important issues such as animal care.

The Workshop on Legislative Issues Concerning Animal Experimentation was very illuminating, and the participants were very impressive. There was an expression of interest from the audience in conducting a similar workshop at the Spring Meeting in New Orleans. It was announced that the American Veterinary Medical Association and APS will cosponsor a Symposium on Pain Perception in Animals which will be of vital interest to the membership. However, if there is enthusiasm for another workshop, members are urged to contact H. C. Cecil, Chairman of the Animal Care and Experimentation Committee.

With no other business, the Business Meeting was adjourned at 5:25 P.M., October 15, 1981.

Walter C. Randall, President-Elect

FINANCE COMMITTEE

The Finance Committee meeting was held at the Netherlands Hilton Hotel, Cincinnati, October 10, 1981, with the following in attendance: A. C. Guyton, Chairman; R. Forster, member; H. E. Morgan, O. E. Reynolds, W. A. Sonnenberg, ex officio members; and S. R. Geiger.

GENERAL CONSIDERATION

As a prelude to our further discussions, the committee first reviewed the history of the Publications Contingency Reserve Fund, which is the major investment fund of the Society. In the early 1970s, this fund had reached a value of approximately $1.4 million. Then with the slump of the stock market in 1973 and 1974, it fell to a value of about $0.9 million. Since that time, it recovered to a value of approximately $1.5 million at the end of 1980, and with the recent slump in the stock market, the value of this fund is again very nearly equal to what it was in the early 1970s. However, during this period the value of money has depreciated to no more than one-half of what it had been. Therefore, in real dollars, the Contingency Reserve Fund has decreased to approximately one-half of its value in early 1973, eight years ago.

In reviewing the disposition of the income from the Publications Contingency Reserve Fund, we find that since 1970 in only one of the eleven years studied, 1970 through 1980, was any of this income reinvested, and that year only about 60% of the income. During the remaining ten years, about 35% of the income was used to help defray excess costs of publications and about 65% of the income was used to defray excess costs of Society operation. These results have pertained despite the fact that it has been the official position of Council throughout these years that the primary use of the income should be for reinvestment and only secondarily for bailing out operations either of publication or of the Society.

COMMENTS ON THE PROPOSED BUDGET FOR 1982

Publications Budget

The Publications General Fund. The Publications General Fund funds the publication of all the journals of the Society. The total proposed budget for 1982 is slightly over $2.6 million. The income is expected to be slightly over $2.5 million. This represents a proposed deficit budget of about $100,000. In the past the budget for the Publications General Fund has been very conservative. For this reason, the Finance Committee is not overly concerned about the proposed deficit.

However, this deficit is expected desite a 20% increase in journal subscription costs beginning in 1982. It is expected that the journal subscription costs will have to be increased again the following year if the Publications General Fund is not to deteriorate into an annual deficit position.

The Finance Committee reached the general agreement that it would be more fiscally prudent to increase the subscription prices for the journals a small amount each year rather than by very large amounts every few years.

The committee also discussed the rising costs for the operation of Section Editors' offices. It is hoped that the Publications Committee can prevail upon the Section Editors to reduce this. In the

period from the mid to late 1970s, the Publications Office was able to decrease the costs of publications considerably by going to new methods of publication and by a search for more competitive bidding. However, these gains seem now to have reached a plateau. Therefore, in general, publication costs are now increasing approximately in proportion to inflation, and in the future a progressive increase in number of pages published will probably also have to be covered by increased expenses rather than increased efficiency.

Publications Special Projects Fund. This fund pays the costs of the Handbooks and the Monograph series. Publications of the Handbooks began in the late 1950s, and as of December 31, 1980, the total cost of the project over and above the income that has been received from the Handbooks was $65,000. But on the same date, APS held an inventory of Handbooks to be sold valued at over $600,000. Therefore publication of the Handbooks has never been a financial burden to the Society, and it is hoped that this situation will continue. However, the cost of publishing the Handbooks is increasing drastically, and the sale are decreasing considerably. Therefore it will be prudent for the Publications Committee to study new formats for publication of the Handbooks in the hope that this operation can remain fiscally sound. We understand that the Publications Committee is making such a study at the present time.

The Monograph series has thus far been completely self-supporting. There have been a few thousand dollars net income over costs thus far, and at the end of 1980 there was a Monograph inventory on hand valued at about $25,000. We see no difficulty in continuation of the Monograph series with reasonable assurance of its fiscal soundness.

Society Operating Fund

The scope of the Society operations is not expected to change significantly between 1981 and 1982. There are small increases in budget in most of the categories of the Society Operating Fund, the increase in each category averaging slightly less than 10%, which is an amount less than or close to expected inflation.

Present projections indicate that the Society Operating Fund will have a net income for 1982 of about $27,000. However, the budget of the Society has made either very little or no provision for two proposals presently before Council: *1)* the proposal for a public affairs representative and *2)* the proposal for a staff person to carry out projects for the Centennial Committee.

Business Office Expenses

Business Office expenses are allocated to all of the operating budgets of the Society. Because the publications operation represents by far the largest proportion of Society activity, slightly over 80% of the Business Office costs are allocated to publications and the remainder to the Society Operating Fund. The Business Office expenses have through the years remained almost exactly equal to 9% of the total costs. This is the same ratio that is proposed for 1982. There are no significant changes predicted for this operation.

Audiovisual Production

Audiovisual production has now come to an end. It is expected that these productions will yield as much as $150,000 or perhaps even more during their lifetime. The net cost of this operation to date has been almost $200,000. Therefore, in the end, the net cost of the operation may not be greater than $20,000 to $50,000. However, there has been loss of interest income on this investment during the period of time.

REVIEW OF INVESTMENT FUNDS

The Committee reviewed the investment funds of the Society: *1)* the Publications Operating Reserve Fund, *2)* the Publications Contingency Reserve Fund, *3)* the International Union of Physiological Sciences Fund, and *4)* the John F. Perkins, Jr., Memorial Fund. All of these funds are performing as expected in relation to market conditions.

RECOMMENDATIONS

1) It is strongly recommended that the income from the Publications Contingency Reserve Fund, and possibly that from the Publications Operating Reserve Fund as well, be reinvested rather than spent on an annual basis. In the past it was the goal of Council to maintain a Publications Contingency Reserve Fund equal to 1 to 1.5 times the annual operating budget for publications. This was achieved during the early 1970s but never since. We are now down to the value of approximately 0.5 times the Publications annual operating budget. It is suggested that a greater degree of long-range planning be effected in relation to pricing of journals so that the journal cost can go up a small amount each year rather than a large amount every three years or more.

2) It is recommended that more long-range planning also be effected for dues so that we do not have large dues increases in one year and no dues increases in other years, despite the fact that inflation continues at a rate of 10% or more each year.

Arthur C. Guyton, Chairman

PUBLICATIONS COMMITTEE (Mid-Year Report)

Changes in the membership of the Publications Committee were announced by Council. The Committee is now composed of H.E. Morgan, Chairman; R.M. Berne, and L.E. Farhi.

E. Page became the Editor of the *American Journal of Physiology: Heart and Circulatory Physiology* on January 1, 1981.

Twenty-six more articles (+4%) were published in the journals in the first half of 1981 compared with the same period last year.

Five hundred and thirteen more pages (+11%) were published in the *American Journals of Physiology* and the *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology* in the first half of 1981 compared with the same period last year. However, the total number of pages published was down by 3% as fewer pages were published in the *Journal of Neurophysiology* and *Physiological Reviews.*

Three books are scheduled for publication in the second half of 1981: *Motor Control* (Vol. II of the *Handbook of Physiology* section on the nervous system); *Disturbances in Neurogenic Control of the Circulation* (the fifth book in the Clinical Physiology Series); and *New Perspectives on Calcium Antagonists* (the sixth book in the Clinical Physiology Series).

Howard E. Morgan, Chairman

PROGRAM EXECUTIVE COMMITTEE

The Program Executive Committee, on advice from the Program Advisory Committee, has approved nine symposia for the APS Fall Meeting to be held in San Diego, CA, October 10-15, 1982. The program will be highlighted by a three-session symposia entitled "Man at High Altitude" cosponsored by the APS Publications Committee. Two symposia, entitled "Ionic Channels in Excitable Membranes" and "Differentiation of Epithelial Cells" are cosponsored by the Latin American Association of Physiological Sciences (ALACF). A symposium entitled "Anaerobic Energy Metabolism of Invertebrates" is cosponsored by the American Society of Zoologists. Additional symposia submitted by the Program Advisory Committee include "The Blood-Brain Barrier," "Compartmentalization and Exchange of Calcium in the Heart," "Is Efferent Control of Arterial Baroreceptors Important?," "Regional Vascular Behavior in the Gastrointestinal Wall," and "Temperature Effects on Fish." Many of these topics receive support from several sections within the Society, and the program should make optimum use of the unique features to be found in the San Diego area. In addition, a broad list of tutorial lectures which cover the full range of interests of the Society was approved. A refresher course will be organized by B. R. Duling and will cover microcirculatory aspects of the circulation.

The Program Advisory and Executive Committees will begin making plans for the 1983 Spring Meeting of the Society to be held with FASEB in Chicago, IL. Suggestions concerning program content and format are encouraged from the general membership and should be forwarded to the member of the Program Advisory Committee (p.) responsible for the content area matching your interests.

Franklyn G. Knox, Chairman

APS (& GUEST SOCIETY) SYMPOSIA 1982 FASEB MEETING

Tuesday, April 20—am

Pain perception in animals: Session I
R. L. Kitchell and H. H. Erickson, American Veterinary Medical Association and APS
Roles of plasmalemmal vesicles in cells—a multidisciplinary review: Session I. Vescicles in the vascular bed
J. Gil

Tuesday, April 20—pm

Pain perception in animals: Session II
New approaches to the study of airway section
J. A. Nadel (SEBM)
Man in the heat
R. F. Goldman

Wednesday, April 21—am

Pain perception in animals: Session III. Alleviation of pain
Roles of plasmalemmal vesicles in cells—a multidisciplinary review: Session II. Vesicles in cell biology
J. Gil
Brain protein synthesis and memory: the use of antibiotic probes
E. M. Eisenstein
Exercise performance at high altitudes
R. F. Grover and J. Mahrer

Wednesday, April 21—pm

Current topics in coronary physiology
E. O. Feigl
Kinetics of capillary exchange
J. A. Jacquez (SMB/APS)
Information processing in cutaneous mechanoreceptors
L. Kruger

Thursday, April 22—am

Kinetic analysis of hepatic function
E. L. Forker
The renal concentrating mechanism: Session I. Basic concepts and data
J. L. Stephenson (SMB/APS)
Central nervous system regulation of sodium excretion
S. L. Bealer and E. G. Schneider
Cardiopulmonary dynamics during exercise in health and disease
K. T. Weber
Regulation of intracellular proteolysis
G. E. Mortimore

Thursday, April 22—pm

Membrane receptors for GI hormones
L. R. Johnson
Experimental approaches to pancreatic cancer research: transformation in acinar cell surface properties (4:30-6:30)
C. Liebow, National Pancreatic Cancer Project
The renal concentrating mechanism: Session II. Models and experiments (mini-symposium)
J. L. Stephenson (SMB/APS)
The brain in slices: new approaches to old problems
G. I. Hatton
President's Symposium
Bioelectric phenomena and quantitative elctro-physiology
R. Plonsey (BMES)
ALZA Lecture
The saltatory nature of propagation in cardiac muscle: changing physiological and biophysical models that include structural complexity (4:00-5:00)
M. S. Spach (BMES)
Fuel utilization during exercise
O. E. Owen

Friday, April 23—am

Contribution of splanchnic circulation to overall cardiovascular and metabolic homeostasis
C.-C. Chou
Development of the autonomic nervous system
P. M. Gootman

Friday, April 23—pm

Central nervous system control of mammalian circadian rhythms
M. S. Kafka

APS Member Interest in FASEB Products and Services

Earlier this year, President Haddy distributed a questionnaire to APS members to determine the value of FASEB products and services that constitute the major part of the FASEB assessment to member societies.

In most years, this assessment is largely compensated by income to the societies from the annual FASEB meeting. However, in 1979 and 1980, the meeting income fell short, and the level of the assessment became a matter of concern to some members because of its impact on Society dues.

As a result, a poll of the membership was initiated to enable Council to deal with the FASEB budget in a manner consistent with membership interests.

SUMMARY OF RESPONSES TO QUESTIONNAIRE

The total number of responses, 1,666, constitutes almost a third of APS membership and is greater than the number of ballots received in election of Society officers. This should therefore constitute a good sample of members' attitudes.

Federation Proceedings

Eighty percent of respondents rated the usefulness of *Federation Proceedings* to be in the upper three of five rankings. Therefore, a majority of our members consider it to be from moderately to very useful. Eighty-two percent would favor a change to optional subscription to FP only if that action resulted in a dues decrease. As things now stand, no dues decrease would result from the subscription becoming optional. About half of the respondents indicated they would subscribe to FP if it were optional and the price was kept at $20 or below.

The majority felt the amount and balace of material in FP is optimal now with the exception of a rather strongly expressed desire for more review articles (71%). Almost half the respondents felt FP should contain more Symposia.

Membership Directory

Eighty-five percent of respondents rated the usefulness of the Directory to be moderately to very useful. More than half of the respondents felt a Directory of APS members only would be less useful, but 48% would not buy a separate directory of FASEB members if they received an APS directory as part of their dues payment.

Public Affairs/Public Information

Eighty-two percent of respondents consider this program to be moderately to very important. In general, most respondents felt the level of effort of activities within the program to be appropriate at presents, but there was some sentiment that more information should be supplied on legislation and/or regulations.

QUESTIONNAIRE

(All numbers are percentages unless otherwise noted)

Federation Proceedings (excluding Abstract issue)

Number Responding

1. I find *Federation Proceedings:*

   a. 25; Very useful — b. 28; c. 27; d. 15 Somewhat useful — e. 6 Not useful — 1,636

2. *Federation Proceedings* would be more useful if it included:

	More	Same	Less	
2.1 Symposia	a. 46	b. 45	c. 9	1,427
2.2 Public Affairs Information	a. 21	b. 57	c. 22	1,286
2.3 Editorial Comment	a. 18	b. 55	c. 27	1,266
2.4 "Science News" articles	a. 39	b. 40	c. 22	1,331
2.5 Review articles	a. 71	b. 21	c. 7	1,343
2.6 Other	65 responses			

3. I would prefer *Federation Proceedings* to be an optional subscription to members of member societies rather than an obligatory publication:

Only if this results in a dues saving	a. 82	1,443
Regardless of effect on dues	b. 14	
Even if it results in a dues increase	c. 5	

4. If subscriptions were optional, I would subscribe to *Federation Proceedings* at membership rate of:

   a. $10, 27; b. $20, 22; c. $30, 7; d. $40, 2; e. $50, 1;
   f. Would not puchase, 42 — 1,566

Membership Directory

5. I find the Directory to be:
   a. 49; Very useful b. 18; c. 18; d. 7; Somewhat useful e. 7; Not useful 1,654

6. If the Directory were limited to APS members, it would be:
   a. 6; More useful b. 9; c. 21; d. 15; Equally useful e. 49 Less useful 1,620

7. If a directory of APS members were provided to members as part of dues payment, I would purchase a consolidated directory of all FASEB members at a cost of:
   a. $5, 31; b. $8, 8; c. $10, 13; d. Would not purchase, 48 1,615

Public Affairs/Public Information

8. I believe the FASEB program in Public Affairs and Public Information to be:
   a. 32; Very important b. 28; c. 22; d. 11; Somewhat important e. 7 Unimportant 1,615

9. The Public Affairs/Public Information function would be improved if it included:

	More	Same	Less	
9.1 Information of legislation and/or regulations	a. 54	b. 43	c. 7	1,337
9.2 Public information program (science news)	a. 36	b. 50	c. 13	1,294
9.3 Congressional Fellowships	a. 17	b. 57	c. 26	1,201
9.4 Other	72 responses			

Total Responses 1,666

Physiological Reviews Coming Attractions

1982 promises to be a bumper year for *Physiological Reviews*. If you are not already a subscriber, become one now, so that you do not miss any of the following articles.

Physiological implications of the presence, distribution, and regulation of calmodulin in eukaryotic cells. A. R. Means, J. S. Task, and J. G. Chafouleas, *Baylor College of Medicine*

Acid-base regulation and phospholipid adaptations to temperature: time courses and physiological significance of modifying the milieu for protein functions. F. N. White and G. Somero, *Scripps Institution of Oceanography*

Topology of the microvillar membrane hydrolases of kidney and intestine. A. J. Kenny and S. Maroux, *University of Leeds, UK, and Centre de Biochimie et de Biologie Moleculaire, Marseille*

Human platelet size, shape, and related functions in health and disease. M. M. Frojmovic and J. G. Milton, *McGill University*

Mediation of ventilatory adaptations. J. A. Dempsey and H. V. Forster, *University of Wisconsin and Medical College of Wisconsin*

Deglutition. A. J. Miller, *University of California, San Francisco*

Information arising from the tracheobronchial tree of mammals. G. Sant'Ambrogio, *University of Texas Medical Branch*

Physiological aspects of primary hypertension. B. Folkow, *University of Göteborg*

Physiological significance of fluid secretion in the testis and blood-testis barrier. G. M. H. Waites and R. T. Gladwell, *University of Reading, UK*

Organization of visual pathways in normal and visually deprived cats. S. M. Sherman and P. D. Spear, *SUNY at Stony Brook and University of Wisconsin*

Vascular impedance in studies of arterial and cardiac function. M. F. O'Rourke, *University of New South Wales*

Nonvesicular release of neurotransmitter. L. Tauc, *Laboratoire de Neurobiologie Cellulaire, Gif-sur-Yvette*

The hearing of modulation in sounds. R. H. Kay, *University of Oxford*

Electrophysiology of the sinoatrial node. H. F. Brown, *University of Oxford*

Actin polymerization and its regulation by proteins from nonmuscle cells. E. K. Korn, *National Heart, Lung, and Blood Institute*

TENTH ANNUAL NORTHEAST PHYSIOLOGISTS MEETING

The 10th Annual Northeast Physiologists Meeting will be held on Saturday, January 9, 1982, at the University of Vermont College of Medicine, Burlington, VT. The theme of the meeting will be Innovative Physiological Models and Measurements. Those interested in attending and in presenting a poster of demonstration should contact Dr. William Halpern, Dept. of Physiology and Biophysics, University of Vermont College of Medicine, Burlington, VT 05405.

APS Sections

COMPARATIVE PHYSIOLOGY SECTION

The Comparative Physiology Section met in Cincinnati, OH, October 12, 1981. Although a quorum was not present, the election results were announced. With approximately 22% of the members voting, the following officers were elected: Councillor; F. N. White (2 years); Councillor; H. T. Hammel (3 years); Secretary R. Fedde (3 years); and Program Committee Representative; D. C. Jackson.

The nominating committee, composed of A. F. Bennett, L. B. Kirschner, and B. Reeves, submitted an outstanding set of nominees. The Section is greatly in their debt and is indebted to those members who kindly agreed to stand for election.

It was announced that K. Schmidt-Nielsen was successful in having topics in comparative physiology included in the program of the IUPS Congress to be held in Sydney, Australia.

B. Umminger also made a few remarks concerning the status of federal funding for the National Science Foundation.

Roger McNabb, Retiring Secretary

GASTROINTESTINAL SECTION

The Statement of Organization and Procedures for the Gastrointestional Section was adopted by Council in April 1976. It was the first Section so recognized.

According to the Society's Operational Guide, APS Sections are granted recognition for five years, after which they are required to provide Council with a written report of their activities and accomplishments. Council extends recognition of a Section for an additional five years upon approval of this report.

At the 1982 Fall Meeting in Cincinnati, Council was pleased to extend its recognition of the Gastrointestional Section for another five years.

FIVE-YEAR REPORT

The Gastrointestinal Section of the American Physiological Society has expanded considerably in the last five years. The attendance at the various functions and the number of symposia sponsored by the Section have increased. I will review here the structure of the Section and some of its major activities during the past five years.

Structure of the Gastrointestinal Section

The purpose of the Section is to advise APS on matters of interest to gastrointestinal physiologists and to organize and present scientific sessions, symposia, and other programs of interest to gastrointestinal physiologists. These activities include sponsoring an annual dinner and organizing annual symposia. Since 1979 the Steering Committee has consisted of three councillors, a secretary-treasurer, a program officer, and a chairman selected from the councillors during his/her third year of office.

The following officers have served during the past five years.

1977: P.D. Webster (Chairman), L.R. Johnson, H.J. Binder, J.F. Long*

1978: L.R. Johnson (Chairman), H.J. Binder, G. Sachs, A. Robert*

1979: H.J. Binder (Chairman), G. Sachs, S.A. Adibi, M.J. Jackson,† A. Robert*

1980: G. Sachs (Chairman), S.A. Adibi, E.L. Forker, M.J. Jackson,† A. Robert*

1981: S.A. Adibi (Chairman), E.E. Forker, S.J. Hersey, M.J. Jackson,† A. Robert*

*Secretary-Treasurer; †Program Officer

Major Activities During the Past Five Years

Annual Dinner-Lecture and Hoffman-LaRoche Prize. This prize was first awarded in 1977 and is the highest honor bestowed by the Section for outstanding contributions in gastrointestinal physiology. The award is given at the dinner meeting held during the Federation Meeting. The awardees were

Warren Rehm, University of Alabama (1977)
Stanley G. Schultz, University of Pittsburg (1978)
Leonard R. Johnson, University of Texas (1979)
Michael Field, University of Chicago (1980)
Jerry Gardner, National Institutes of Health (1981)

Symposia. The following symposia were held at either the Spring or the Fall Meeting of APS (the organizer is listed in parentheses).

1977: Mechanism and Regulation of Gastrointestinal Secretion and Absorption (G. Sachs, S.G. Schultz, L.R. Johnson)
Models for Gastrointestinal Transport (G. Sachs)

1978: Gastric Motility and Gastric Emptying (J.H. Szurszewski)

1979: Pancreatic Secretion (M.J. Jackson)

1980: Cellular Models of Epithelial Function (G. Sachs)
Physiology of Mamalian Peripheral Ganglia; A New Look (J.H. Szurszewski)

1981: Prostaglandins and tne Digestive System (A. Robert)
Physiology of the Mamalian Gastric Mucosa (L.L. Shanbour)

New Journal. In 1977 the *American Journal of Physiology* was divided into several journals, one of them devoted to our specialty, called "Endocrinology, Gastrointestinal and Liver Physiology." In 1980 it became "Gastrointestinal and Liver Physiology," with Leonard R. Johnson as editor. This development underscores the enormous increase in research in Gastrointestinal Physiology. An average of 12 papers are published in each monthly issue.

André Robert, Secretary-Treasurer

NEURAL CONTROL AND AUTONOMIC REGULATION SECTION

Statement of Organization and Proceedings

ARTICLE I. Name

The name of this organization is the Neural Control and Autonomic Regulation (NCAR) Section of the American Physiological Society.

ARTICLE II. Purpose

The purpose of this organization is *1)* to advise the American Physiological Society, its Standing Committees, the Publication Committee, and the Editors of the Society's journals on matters of interest to physiologists working in the areas of autonomic regulation and integration as well as those of neural control of circulation and other organ systems; *2)* to assist the American Physiological Society in organizing and presenting scientific sessions, symposia, and other programs of interest to physiologists in these areas; *3)* to interact with the other Sections of the Program Advisory Committee in assessing and in coordinating the demands for programs on topics of integrated physiology; and *4)* to foster active membership in the Society among physiologists interested in regulatory systems.

ARTICLE III. Membership

Membership is open to all members of the American Physiological Society. Intersociety membership is open and encouraged to those with interest in neural control and autonomic regulation. Membership will be automatic to those individuals who attend any annual gathering sponsored by the NCAR Section. The Secretary-Treasurer of the Steering Committee shall maintain a roster of active members.

ARTICLE IV. Officers

Section 1. Steering Committee. The responsibility for management and supervision of the affairs of the Neural Control and Autonomic Regulation Section shall be vested in the Steering Committee. The members of the Steering Committee shall be five Councillors, each elected for a three-year term. Terms shall be staggered such that only one Councillor will be elected each year by membership at the Annual Spring Meeting.

A quorum for conducting official business of the NCAR Section shall be three of the five members of the Steering Committee.

Section 2. The Steering Committee shall elect a chairperson to serve a term of one year, a Secretary-Treasurer and a Program Committee Representative to serve a term of three years.

ARTICLE V. Committees

The Chairperson may appoint committees that are necessary for the proper conduct of the affairs of the section.

ARTICLE VI. APS Relationship

Nothing in this Statement of Organizational Procedures shall be construed as contradictory to the Constitution and Bylaws or Operational Guidelines of the American Physiological Society.

HARWOOD S. BELDING AWARD IN ENVIRONMENTAL PHYSIOLOGY

The Environmental, Thermal and Exercise Physiology Section of APS will again present the annual Belding Award for outstanding research in environmental physiology by a graduate student at the Temperature Regulation Dinner during FASEB week. The Award includes a prise of $200.00. To be eligible for the Award, the graduate student must have present or will present the paper at the 1981 Fall or 1982 Spring Meeting and must be the first author on the published abstract. Either a typewritten copy of the presentation or a manuscript related to the research should be submitted by March 15 to Dr. E. R. Nadel, John B. Pierce Foundation Laboratory, 290 Congress Ave., New Haven, CT 06519. The Award committee will notify all applicants of its decision by April 5.

Previous Belding Award Winners:

1975: Berry Pinshow, Duke University
1976: Michael Maron, University of California, Santa Barbara
1977: Linda K. Vaughn, University of Michigan
1978: Daniel E. Lemons, Portland State University
1979: Joseph M. Steffan, University of New Mexico
1980: Martha O'Donnell, University of California, Davis
1981: Richard Moalli, Brown University

CORRECTION

Robin A. Felder of Georgetown University was one of the two recipients of the 1980 Renal Section Award. His name and affiliation were incorrectly printed in *The Physiologist* 24 (5): 23, 1981 (Oct/Nov). We regret that this error occurred.

IUPS WORLD DIRECTORY—ERRATA

The publication by the International Union of Physiological Sciences (IUPS) of the second edition of the *World Directory of Physiologists* was announced in *IBRO News* 9:2. A systematic error in the coding of degrees has occurred in 16 of the 51 lists of members of Supporting Societies. Individuals listed for the first time in the 1980 Directory have correct degree codes, but those previously listed in the 1977 Directory do not. In many cases holders of Ph.D.'s are credited with veterinary degrees and vice versa. The Societies concerned are *Belgium:* Société Belge de Physiologie et de Pharmacologie; *Bolivia:* Instituto Boliviano de Biologia de Altura; *Brazil:* Sociedade de Fisiologia, *Chile:* Society of Biology, Physiology Section; *China:* Physiological Society, Taipei; *Finland:* Societal Physiologica Finlandiae R. Y.; *FRG:* Deutsche Physiologische Gesellschaft E. V.; *India:* Association of Physiologists and Pharmacologists of India; *Japan:* Physiological Society of Japan (Nihon Seiri Gakkai); *The Netherlands:* Nederlandse Vereniging voor Fysiologie; *Nigeria:* Physiological Society of Nigeria; *Norway:* Norwegian Physiological Society; *Sri Lanka:* Ceylon Association for the Advancement of Science—Section A; *Sweden:* Physiological Societies of Sweden & the Swedish Society for Clinical Neurophysiology; *UK:* The Physiological Society; *USA:* Division of Comparative Physiology and Biochemistry of the American Society of Zoologists.

MEMBERSHIP STATUS

REGULAR	4,399
EMERITUS	525
HONORARY	8
CORRESPONDING	79
ASSOCIATE	683
STUDENT	233
TOTAL	5,927

DEATHS REPORTED SINCE THE 1981 SPRING MEETING

ARMSTRONG, PHILIP B.
Syracuse, NY
12/80

CALVIN, D. BAILEY
Galveston, TX
4/21/81

CAMPBELL, CONSTANCE
Evanston, IL
1/81

COLLINS, WILLIAM D.
Washington, DC
3/23/81

CRANDALL, LATHAN A., JR.
Panama City, FL
12/23/80

DORMAN, HOMER L.
Dallas, TX
6/6/81

FISCHER, ERNST
Richmond, VA
2/7/81

GOLDRING, WILLIAM
New York, NY
2/81

HALL, VICTOR E.
Los Angeles, CA
7/23/81

HAVLICEK, VIKTOR
Winnipeg, Manitoba
8/6/81

HINSEY, JOSEPH
Scarsdale, NY
3/25/81

KRAMAR, JENO L.
Ellensburg, WA
2/10/81

LILLEHEI, RICHARD C.
Minneapolis,MN
4/1/81

McLAIN, PAUL L.
Pittsburgh, PA
1/24/81

MOULTON, DAVID G.
Philadelphia, PA
1/25/81

NICOLL, PAUL A.
Indianapolis, IN
1980

RANNEY, ROBERT E.
Chicago, IL
4/11/81

REINECKE, ROGER M.
Hato Rey, PR
2/28/81

SCHAPIRO, HERBERT
Norfolk, VA
4/13/81

SUTHERLAND, GEORGE F.
Vancouver, British Columbia
1/7/81

THOMSON, JOHN D.
Iowa City, IA
5/8/81

ZWEMER, RAYMUND L.
Silver Spring, MD
10/5/81

NEWLY ELECTED MEMBERS

The following, nominated by Council, were elected to membership in the Society at the Fall Meeting, 1981.

REGULAR MEMBERS

ALBISSER, ANTHONY M.
DIV. OF BIOMEDICAL RESEARCH
HOSPITAL FOR SICK CHILDREN
555 UNIVERSITY AVENUE
TORONTO, ONT. M5G 1X8 CANADA

ALLEN, JULIUS C.
DEPT. OF MEDICINE
SEC. OF CARDIOVASC. SCIENCES
BAYLOR COLLEGE OF MEDICINE
HOUSTON, TX 77030

ALTURA, BELLA T.
DEPT. OF PHYSIOLOGY
DOWNSTATE MEDICAL CENTER
450 CLARKSON AVENUE
BROOKLYN, NY 11203

ARBEENY, CYNTHIA M.
DEPT. MED., ULLMANN RM. 511
ALBERT EINSTEIN COL. OF MED.
1300 MORRIS PARK AVENUE
BRONX, NY 10461

BALINSKY, JOHN B.
DEPT. OF ZOOLOGY
339 SCIENCE 11
IOWA STATE UNIVERSITY
AMES, IA 50011

BANZETT, ROBERT B.
HARVARD SCH. OF PUBLIC HLTH.
DEPARTMENT OF PHYSIOLOGY
665 HUNTINGTON AVENUE
BOSTON, MA 02115

BATT, ELLEN R.
DEPT. PHYSIOLOGY
COLUMBIA UNIVERSITY
630 WEST 168 STREET
NEW YORK, NY 10032

BENOS, DALE J.
DEPT. PHYSIOL & BIOPHYSICS
LHRRB, HARVARD MEDICAL SCHOOL
45 SHATTUCK STREET
BOSTON, MA 02115

BLACKSTONE, EUGENE H.
DEPT. OF SURGERY
U OF ALABAMA IN BIRMINGHAM
UNIVERSITY STATION
BIRMINGHAM, AL 35294

BLANK, MICHAEL S.
2008 LA VISTA ROAD N.E.
ATLANTA, GA 30329

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2106 SALISBURY ROAD
SILVER SPRING, MD 20910

BRITTON, STEVEN L.
DEPARTMENT OF PHYSIOLOGY
MEDICAL COLLEGE OF OHIO
C.S. 10008
TOLEDO, OH 43699

BURTON, KAREN P.
DEPT. OF PATHOLOGY
U TEXAS HLTH. SCI. CENTER
5323 HARRY HINES BLVD.
DALLAS, TX 75235

CAPEN, RONALD L.
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Diameter Versus Number in Diameter of Vessel Resistance

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Difficulty is often encountered in the teaching of circulatory physiology by using Poiseuille's equation for a single circular cylinder (*Eq. 1*) to describe differences in resistance (*Eq. 2*) occurring in different segments of the circulation.

$$F = \frac{\Delta p}{R} = \frac{\pi r^4 \Delta p}{8 \eta l} \quad (1)$$

and

$$R = \frac{8 \eta l}{\pi r^4} \quad (2)$$

where F is the flow rate, r the vessel radius, Δp the driving pressure, η viscosity, l the vessel length, and R resistance. One utilizes this equation to state that "resistance (R) increases through the circulation because of the great dependence of R on vessel size."

We have encountered at least two problems by thus simplistically using Poiseuille's law. *1)* In attempting to reconcile the concept of continuity with Poiseuille's law, many students, visualizing one cylinder, say "but if radius goes down as it does in the circulation, why doesn't flow velocity increase?" The answer is of course that cross-sectional area increases, area increasing because vessel number increases. We believe that by tacitly omitting consideration of vessel number in presenting Poiseuille's law we have permitted confusion in understanding continuity. *2)* Furthermore, when students enter respiratory physiology, they are told that airway resistance decreases as one passes into the lung. Thus resistance decreases as vessel radius decreases, an apparent contradiction of Poiseuille's law. Unless vessel number has been considered in presenting Poiseuille's law, this useful teaching device is unusable, and consistency in presentation of an important physiological principle suffers.

We believe that the above problems can be circumvented by simply incorporating vessel number explicitly into Poiseuille's law. If flow through one vessel is represented by *Eq. 1,* flow through N parallel vessels is given by

$$F = \frac{N \pi r^4 \Delta p}{8 \eta l} \quad (3)$$

and

$$R = \frac{8 \eta l}{N \pi r^4} \quad (4)$$

Equation 4 explicity describes the balance that occurs between decreasing r and increasing N in determining total resistance of parallel vessels (assuming identical vessels). The relationship is entirely consistent with, and perhaps a worthwhile simplification of, the more general concept that the reciprocal of the total resistance in parallel vessels equals the sum of the reciprocals of the individual resistances.

None of the foregoing is new. What we are encouraging, and what we feel textbooks rarely present, is the explicit combination of Poiseuille's law and consideration of vessel number. To further emphasize this concept and to present a mnemonic device for students, we believe a graphic illustration of the balance between r and N in determining resistance may be useful. This illustration may be made by comparing two systems where in one, the circulatory system, r dominates, and in the other, the pulmonary airways, N dominates.

In Fig. 1, we have illustrated how resistance changes from the aorta to the capillaries (middle curve). Resistances were calculated using *Eq. 4* and a compilation of morphological data from Milnor (Ref. 3, p. 953, Table 35-1) and Burton (Ref. 1, p. 53, Table 6-1) [both modified from Mall (2)]. To emphasize the importance of each of the factors, N and r, in determining resistance, we have compared the actual resistance curve to curves obtained by assuming that *1)* N does not change, i.e., r totally dominates the resistance calculation (top curve) and *2)* r

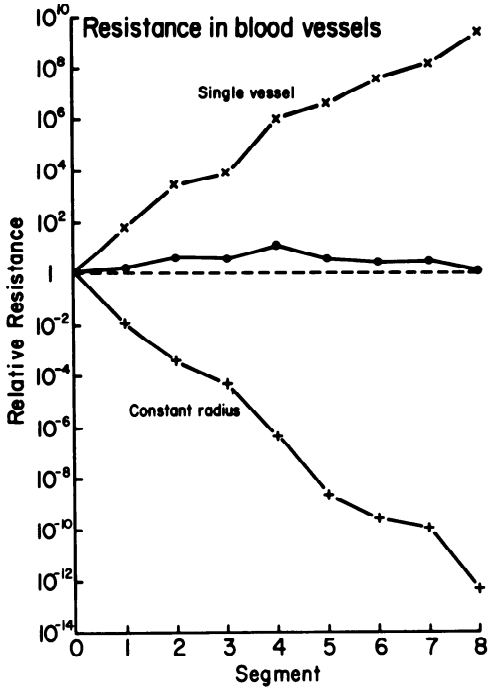

Fig. 1. Variation in relative resistance ($R_{segment}/R_{aorta}$) through various segments of the circulation (•) compared with resistance of a single vessel with a decreasing diameter (×) and to resistance of an increasing number of parallel vessels with constant radius (+). See text for calculations. *Segment 0* is the aorta, *segments 1-3* represent large arteries and their branches, *segments 4-7* are the small arteries through arterioles, and *segment 8* is the capillary segment.

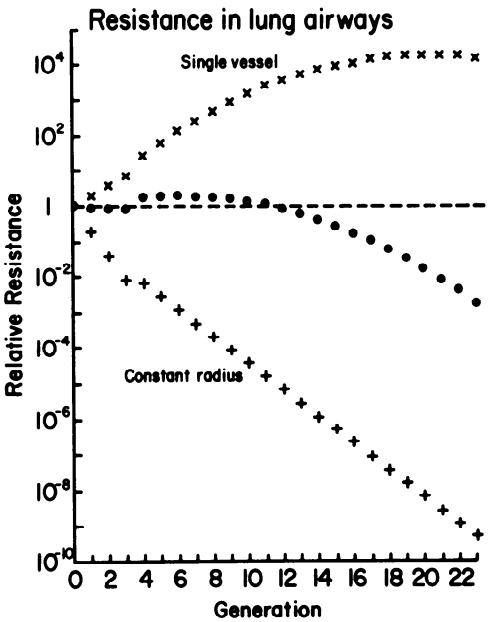

Fig. 2. Variation in relative resistance ($R_{generation}/R_{trachea}$) through successive generations of pulmonary airways (•) compared with resistance of a single vessel with a decreasing diameter (×) and to resistance of an increasing number of parallel vessels with constant radius (+).

does not change, i.e., N totally dominates the resistance calculation (bottom curve). The top curve illustrates the drastic effect decreasing radius has on circulatory resistance in the absence of bifurcation, a picture we believe many students remember if Poiseuille's law for a single vessel is used to represent resistance. Equally drastic is the effect of bifurcation without radius change (bottom curve). The obvious upward deflection of the actual (middle) curve toward the single vessel curve illustrates the known dominance of r in determining circulatory resistance, but its attenuation relative to the top curve illustrates the modifying effect of vessel bifurcation.

In Fig. 2, we have illustrated how resistance changes through each generation of the pulmonary airways (middle curve). For this case we have used the data of Weibel (Ref. 4, p. 139, Table XI.2). Again we have compared the calculated curve to the curve for a single vessel and to that for a constant radius to emphasize the importance of *both* N and r in determination of resistance in bifurcating vessels. Note in this case the downward deflection of the actual curve toward the curve where N changes (constant r), implying the relative dominance of N in determining pulmonary airway resistance.

In conclusion, we believe the foregoing discussion has indicated the need to consider vessel number when discussing resistance in parallel vessels. While Poiseuille's law for a single cylinder may be adequate in describing the trend of resistance changes in the circulation, it is not conceptually complete. Vessel number is even more important in discussing pulmonary airway resistance, since vessel number so greatly influences airway resistance especially at high generation numbers.

Notes. 1) In calculating resistances for Figs. 1 and 2 we have assumed η to be constant. The changes that might occur (e.g., due to plasma skimming or reduction in tube diameter) were assumed to be small relative to changes in N and r. *2*) In calculating the hypothetical curves for a single vessel and for multiple tubes of constant radius we have allowed vessel length, l, to change as it does in the circulation or the airways. *3*) The calculated curve for resistance in the circulatory system does not precisely concur with the present concept that the largest resistance to flow occurs in the arterioles. A possible explanation may be that the data of Mall was taken in dead tissue, probably maximally vasodilated. The data of Wiedeman (5), taken in living tissue, tends to agree with the idea that arteriolar resistance is highest (i.e., $R_{arteriole} = 1.5\ R_{small\ artery}$), but her data were less complete than Mall's and thus not used.

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Short-Term Autonomic Control in the Cardiovascular System

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The autonomic nervous system (ANS) is intricately involved in the maintenance of many physiological homeostatic processes. The heart and circulatory system are two vital areas regulated by the ANS. Acute changes in blood pressure bring about changes in sympathetic and parasympathetic activity to homeostatically adjust heart rate and blood flow and thereby regulate blood pressure (2,3,6,).

Increased sympathetic activity results in the release of norepinephrine. The norepinephrine (via β-receptors) promotes an elevated heart rate while generating constriction (via α-receptors) of resistance and capacitance vessels. The net outcome of these activities is an elevated blood pressure. It is important to understand that both the heart and blood vessels receive constant sympathetic activity, referred to as tone. If sympathetic tone is decreased, heart rate and contractile strength are diminished: resistance and capacitance vessels will also tend to dilate. These effects reduce the blood pressure in the major arteries. Therefore, adjustments in sympathetic tone, either an increase or decrease, promote a concomitant increase or decrease in blood pressure, respectively. The adrenal medulla, which is under sympathetic control, releases epinephrine and smaller quantities of norepinephrine which also promote sympathetic responses.

With specific regard to the heart, sympathetic nerves are distributed to the sinoatrial (SA) and atrioventricular (AV) nodes (intrinsic pacemaker tissues) of the right atrium and to the musculature of the atria and ventricles. Elevated sympathetic activity increases the rate of node depolarization resulting in an increased heart rate (HR). Sympathetic stimulation also increases the strength of ventricular contraction (positive inotropic response) and thus promotes an increased stroke volume (SV). Because cardiac output is the product of heart rate and stroke volume (CO = HR $\times$ SV), an increase in either heart rate or stroke volume or both will increase cardiac output and tend to elevate blood pressure.

Parasympathetic fibers of the vagus nerves also innervate the SA and AV nodes and the musculature of the atria and ventricles. Acetylcholine released by these nerves acts on muscarinic receptors to slow the rate of nodal depolarization and result in a decreased heart rate. Acetylcholine also decreases the contraction strength of the atrial myocardium; however, there is little effect on the ventricular muscle. The end result of parasympathetic stimulation is a decrease in cardiac output and thus a decrease in blood pressure. The parasympathetic nervous system does not directly affect blood vessel diameter.

Although many factors influence autonomic control of blood pressure, the baroreceptors of the carotid sinus and aortic arch have probably been most extensively studied (1). These are stretch receptors, which monitor changes in blood pressure via the degree of distension within the walls of the carotid sinuses and aortic arch. The threshold for stimulation of the carotid receptors is approximately 60 mmHg pressure, with peak activity being achieved at 175-200 mmHg. Aortic receptors have a slightly higher threshold. These receptors are thus moderately active at "normal" blood pressure. An increase in blood pressure results in an elevated firing frequency, and a lowering of blood pressure decreases baroreceptor firing frequency. The baroreceptor impulses pass by way of cranial nerves IX and X to areas in the medulla. These medullary areas relay information to other areas of the central nervous system (CNS) for the overall integration of blood pressure regulation. Autonomic output to the cardiovascular system may be influenced by many CNS areas, including the cerebral cortex, the hypothalamus, bulbar reticular areas, and the upper spinal cord. Historically the primary regulators of the cardiovascular system were thought to reside in the bulbar reticular formation. Separate centers (cardioacceleratory, cardioinhibitory, and vasomotor) were designated within this area based on responses to electrical stimulation. It is now believed that these are diffuse areas which work in concert with many other CNS areas to regulate autonomic output (4). Autonomic output is tonic. The tonic activity of the vasomotor areas promotes vasoconstriction. Constriction of the small muscular arteries tends to elevate central blood pressure by restricitng the flow of blood from the larger arteries. The tonic activity of the cardioinhibitory areas tends to reduce heart rate, whereas activity in the cardioacceleratory areas tends to increase heart rate. The baroreceptors influence the activity of these areas to regulate blood pressure (see Fig. 1).

If blood pressure increases, the baroreceptors inhibit vasomotor and cardioaccelerator tone, producing vasodilation and a lowering of heart rate, respectively. At the same time, the baroreceptors elevate the activity of the cardioinhibitory areas, inducing a decrease in heart rate. The total effect is a lowering of blood pressure toward normal. If on the other hand blood pressure falls below normal, the reverse of the above sequence occurs to elevate blood pressure. The baroreceptors thus function to buffer acute changes in blood pressure. This laboratory exercise was designed to acquaint the student with the multifaceted control of the cardiovascular system by the ANS.

OBJECTIVES

1. Demonstrate the primary parasympathetic pathway to the heart.
2. Demonstrate the effects of acetylcholine, norepinephrine, and epinephrine on the cardiovascular system.
3. Introduce the concept of autonomic tone.
4. Introduce the concept of specific autonomic tissue receptors.

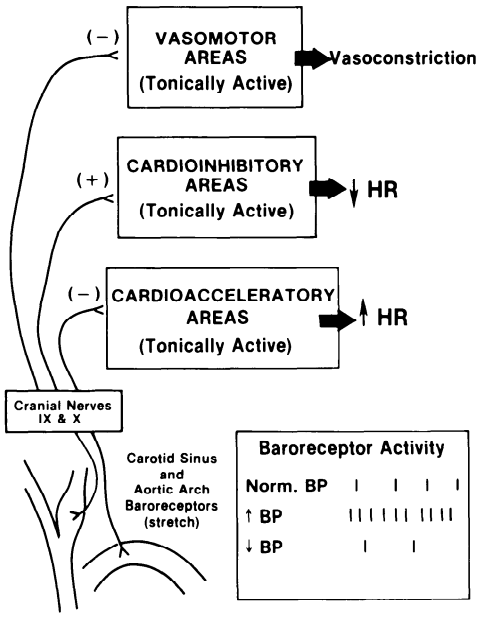

Fig. 1. Diagram depicting output of baroreceptors on cardiac and vasomotor areas. See text for description.

5. Demonstrate the buffer effect of baroreceptors on blood pressure.
6. Demonstrate the effects of altered autonomic tone by administration of specific autonomic receptor blocking agents.

MATERIALS AND METHODS

Each group of students should have an anesthetized dog (approx 15 kg), polygraph recorder, electrocardiogram (ECG) leads, pressure transducer, endotracheal tube, 1- and 10-ml syringes, PE-320 or PE-260 tubing, string, dissecting instruments, Ringer solution, thermistor, heparinized Ringer solution, stimulator and leads, acetylcholine (1 mg/ml), epinephrine (10 μg/ml, norepinephrine (10 μg/ml), atropine (6 mg/ml), and phentolamine (40 mg/ml).

The quantities of drugs to be utilized in this exercise are based on the use for a 15-kg dog. Alteration of these amounts is recommended if the dog weight is significantly different. Anesthetize the dog with pentobarbital sodium.

1. Insert an endotracheal tube and place a thermistor in the end to record the respiratory rate and depth.
2. Isolate the vagus nerves and carotid arteries. Place loops of thread around each structure for handling but do not tie.
3. Cannulate the femoral artery for direct blood pressure determinations.
4. Drugs may be injected directly into the cephalic vein of the forelimb or an exposed femoral vein opposite the femoral arterial cannula.
5. Arrange to record the ECG (lead II) for heart rate determination.

EXERCISE PROCEDURES

Prior to any autonomic drug injections obtain and record a control value for blood pressures (systolic, diastolic, and mean), heart rate, and respiratory rate (note depth). Examine the control ECG waves (lead II). Utilize a timing marker throughout so that heart and respiratory rates may be calculated.

1. Acetylcholine

Inject 0.5 mg of acetylcholine intravenously and observe the changes in heart rate, blood pressure, and respiratory rate.

Q 1a. Describe the response of heart rate and blood pressure to acetylcholine administration.

Q 1b. After the initial heart rate change how was heart rate affected? Explain the recovery process.

2. Right Vagus Nerve Stimulation

Stimulate the right vagus **without** touching the surrounding tissue for 5-10 s. Stimulator setting: 5 V; 5 ms duration; 4 pulses/s (pps). Note the effect.

Q 2a. What was the response of heart rate and blood pressure to right vagal stimulation?

Q 2b. What region(s) of the heart must be stimulated to produce the observe effect(s)?

Stimulate the right vagus a second time at the following stimulator settings: 5 V; 5 ms; gradually increase the frequency from 2 to 15 pps over 10 s; then stop stimulation and allow recovery.

Q 2c. Once vagal stimulation was terminated what happened to heart rate and blood pressure?

Stimulate the right vagus a third time at the following stimulator settings: 5 V; 5 ms; 25 pps. Maintain the stimulation only until the heart begins to escape from the influence of vagal stimulation (vagal escape).

Q 2d. Describe the effect of strong vagal stimulation and explain the basis of vagal escape.

3. Norepinephrine

Once the blood pressure has stabilized, rapidly inject 2 μg norepinephrine into the femoral vein and note the effects.

Q 3a. Explain the mechanism(s) involved in the initial effect (i.e., within 6 s) of norepinephrine on heart rate and blood pressure (especially note diastolic pressure).

Q 3b. Name the adrenergic receptors involved.

Q 3c. After the initial heart rate response a secondary response occurs (starting 10-12 s after norepinephrine). Describe this response and explain the mechanisms involved.

If the injection did not produce significant changes repeat the procedure with 4 μg norepinephrine.

4. Epinephrine

Allow the animal's blood pressure to stabilize; then inject 5 μg epinephrine into the femoral vein.

Q 4a. Describe the initial effects of epinephrine on heart rate and systolic and diastolic blood pressure changes.

Q 4b. Compare these changes to those induced by norepinephrine.

If the recorded changes were not significant repeat the procedure injecting 10 μg epinephrine.

5. Block of Vagal Afferents from Aortic Arch

Allow the blood pressure and heart rate to stazilize. Then record a value for each along with the respiratory rate. Gently lift up the ligatures about both vagus nerves. Clamp a hemostat on both nerves simultaneously and note the effects on respiration, heart rate, and blood pressure. The hemostats create a pressure block in the nerves. (Tightly tied ligatures may be utilized in place of hemostats.) Once the recordings have stabilized stimulate the right vagus on the heart side of the block: 10 V; 5 ms; 5-20 pps. Stop or drastically slow the heart for 5 s. Record the changes in heart rate and blood pressure for 10 s after stimulation is terminated.

Q 5a. Contrast the systolic and diastolic blood pressures and heart rate during the first 5 s after electrical stimulation of the right vagus was terminated to the same period in *step 2*. Explain why they differ.

6. Norepinephrine with Vagal Block

Record the blood pressures (systolic, diastolic, and mean) and heart rate. Then rapidly inject 4 μg norepinephrine intravenously. Contrast the recorded parameters to those observed in *step 4* with norepinephrine injection and intact vagus nerves.

Q 6a. Describe and explain the role of the vagus nerves in modifying the body's response to acute episodes of hypertension.

7. Atropine

Once the blood pressures and heart rate are stabilized, record a value for each. Then inject 6 mg of atropine (a muscarinic receptor blocker) intravenously and wait 30 min for it to be effective. Once again record blood pressures and heart rate.

Q 7a. Explain any differences in blood pressure and heart rate in relation to normal parasympathetic tone.

Inject 0.5 mg acetylcholine intravenously and compare the cardiovascular changes with those observed in *step 1*. Stimulate the right vagus nerve on the heart side of the compression block: 5 V, 5 ms; 2 pps increasing to 25 pps over a 10-s period.

Q 7b. Describe and contrast the results of acetylcholine injection and vagal stimulation after muscarinic receptor blockage to those observed in *steps 1* and *2*. Explain.

Inject 3 mg acetylcholine (a very large dose) intravenously and carefully observe heart rate and blood pressure.

Q 7c. Understanding that not all acetylcholine receptors are equally blocked by atropine, explain why blood pressure and heart rate may increase following a large dose of acetylcholine in an atropinized dog.

8. Phentolamine

Record the blood pressures and heart rate. Then inject 40 mg of phentolamine (an α-adrenergic receptor blocker). Wait 20 min and again record blood pressures. Inject 4 μg norepinephrine intravenously and note the effects.

Q 8a. Describe and briefly explain the effects of phentolamine on blood pressure.

Q 8b. Contrast the effects of norepinephrine on blood pressure and heart rate before (*step 7*) and after phentolamine. Explain these effects in relation to the adrenergic receptors involved and normal sympathetic tone to the cardiovascular system.

RESULTS AND DISCUSSION

Typical results can be found in the discussion of neural control of the cardiovascular system in the *Handbook of Physiology* (5) or Guyton's *Textbook of Medical Physiology* (3). Additional sample tracings of all of the recordings may be obtained from the authors. Students are asked to hand in their tracings and answers to all questions. This exercise has been very successful in our laboratory either with small groups of students performing the experiment or as a demonstration done by the instructor.

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Book Reviews

We are pleased to report that we have made arrangements with Professor A.D. Smith of Oxford, UK, one of the chief editors of *Neuroscience,* to exchange book reviews. This issue of *The Physiology Teacher* bears the first fruit. All reviews are attributed. *Neuroscience* is an international journal under the editorial direction of IBRO (International Brain Research Organization).

M.C. Shelesnyak

Neural Growth and Differentiation. IBRO Monograph Series, vol. 5. E. Meisami and M.A.B. Brazier, Eds. New York: Raven, 1979. $65.28. (Review reprinted with permission from *Neuroscience* 6: 100, 1981.)

This fifth volume in the IBRO monograph series contains the proceedings of a symposium held at the University of Tehran in 1978. Although editors recognize the need for a multidisciplinary approach to the subject the selection of participants is strongly biased towards the biochemical and more anatomical aspects of growth and differentiation of the brain, with only a handful of papers addressing the functional aspects of maturation. The most successful papers are those in which the authors have reviewed their own work in the context of other current work in the field rather than just contributing a journal-type paper.

The volume has been fairly arbitrarily divided into 4 sections. The first section deals mainly with various biochemical analyses of development and includes papers on the regulation of cAMP in neonates, the role of thyronine receptors in brain growth and changes in cholinergic and dopamine receptors during neurogenesis. Brain slice of fractions of whole brain such as sunaptomes were used in these studies. As a means of furthering the degree of detail of this sort of analysis Balazs and his coworkers have studied protein synthesis and GABA and amino acid transport in particular cell types isolated from the developing cerebellum. The problem with this sort of approach is the difficulty in identifying particular neuron types on morphological criteria after they have been separated by sedimentation. Various antisera were used to validate the morphological identification, but it is not made clear whether such antisera are applicable throughout development since presumably the properties of the cell surface may change through development. (Incidentally, for those readers who do not regularly read the acknowledgements at the end of papers, GFAP stands for glial fibrillary acidic protein.)

James Hinds concludes the first section with an interesting review of his work on the differentiation of neurons studies using serial reconstructions of electron microscopic sections. He suggests that both amacrine cells in the retina, which do not have axons, and the Golgi type II cell in the cerebral cortex which has a short axon, both differentiate late in development from an existing cell type (such as retinal ganglion cells) which loses its long axon.

Section two deals with systems which have been presented as models for examing particular facets of brain development. Ezio Giacobini, for example, examines the cholinergic synapse in the context of the autonomic ganglia and iris of the chick. Papers by members of the Iranian group suggest that the olfactory system has been undervalued as a model for development and discuss their experiments on the hormonal neural and environmental influences on olfactory bulb development. The olfactory system receives further attention in the third section of the book (which covers specificity, plasticity and regeneration in the nervous system) where Barber and Raisman, and Graziadei and Graziadei examine the ability of the olfactory system to regeneration or form new connections after lesions.

Section three of the book also includes a paper by Gaze on one of the best known model systems, the retinotectal system of lower vertebrates. Although the retinotectal system has been studied for over 40 years it continues to provide new and interesting phenomena, but as Gaze indicates, there is still great uncertainty as to the mechanisms underlying the formation of ordered nerve connections. The development of topographic connections is also the subject of a short and lucid discussion by Van der Loos on the influence of the periphery in directing the organization on the sensory cortical areas dealing with the rat's whiskers. His studies have shown a precise correlation between supernumary elements in the whisker pad and their representation in the cortex, but the question as to whether this is achieved through genetic as opposed to epigenetic control remains an open one, through Van der Loos favours the latter mechanism.

The concluding section of the book contains papers dealing with human neural development. The Barcelona group of Sabater and co-workers catalogue their analyses of the lipid, nucleic acid, protein and enzyme analyses of perinatal human brain. While one must agree that such data are scarce on human material one might also question whether such analyses of large areas of brain provide the best return in terms of meaningful data since they give no indication of the variations in development between different regions of the brain and even less of the differences between the growth and differentiation of different cell types within any single region of the brain.

It is an unfortunate, but perhaps inevitable consequence of the profusion of symposia on neural development, that a number of authors represented here have already published very similar reviews of their work elsewhere. This fact, coupled with the bias in selection of the participants for this symposium, means that this volume has little general appeal and will probably only be of interest to those neurobiologists concerned with biochemical changes during brain development.

K. Martin

Development and Chemical Specificity of Neurons. Progress in Brain Research, vol. 51. M. Cuénod, G. W. Kreutzberg, and F.E. Bloom, Eds. Amsterdam: Elsevier/North-Holland, 1979. $97.50. (Review reprinted with permission from *Neuroscience* 6: 99, 1981.)

After the disappointment of a recent volume in this series on the maturation of the nervous system, this present volume by contrast contains many high quality papers which will be of interest in develomental neurobiologists. The organizing committee selected two main area for discussion at the Symosium which was held in September 1978 at Schatzalp, Switzerland. The first area concerns the analysis of the cellular properties of neurons and covers areas such as the nature of the cell surface, the cytoskeleton and the influence of the environment of the differentiation of the neurons and the development of their neurotransmitter functions. One technique, now in its infancy which is certain to become an extremely powerful tool for studying the interactions of neural cells, is the use of cell-type specific surface antigens as specific cell type markers. Martin Raff and coworkers described the 'end of the beginning' of the search for such markers. A complementary paper by Schachner and Willinger described the use of antisera raised against these cell surface an-

tigens for isolating pure cultures of different cell types from cerebellar tissue.

Other markers of particular cell lines are also currently in use and Le Dourain and her co-workers have used the nuclear marker occurring in quail cells to great effect in tracing the fates of neural crest cells in the chick. Depending on their eventual location the same population of cells can differentiate into either cholinergic or adrenergic neurons. In a lucid account of related studies using cell cultures of neurons from the autonomic nervous system Patterson discusses his experiments which show that these cells are pluripotent and that their differentiation into cholinergic neurons is mediated by a diffusible factor. Nerve growth factor (NGF) also appears to play some role in enhancing this differentiation and the role of NGF in neurogenesis is examined in a paper by Schwab, Thoenen and their co-workers.

The greater part of the volume is devoted to the second area chosen for discussion which covers four different 'systems,' these being the hippocampus, the basal ganglia, cerebellum and the visual system. The studies on the hippocampus are concerned mainly with a discussion of the neurotransmitters present in the hippocampal-septal system. A number of papers present evidence for the claim that glutamic acid is the major neuroexcitatory amino-acid for the system but other amino-acids such as adenosine and aspartate may also be involved. In an interesting paper, Cotman reviews the reorganization of hippocampal connections which takes place after kainic acid lesions which selectively remove populations of pyramidal neurons.

In the portion devoted to the basal ganglia there are only 2 papers. One of these, by Graybiel and Ragsdale, is an extensive and well constructed review of the fiber connections of the ganglia. Their review shows how the use of tracers such as autoradiographic and enzymatic tracing methods has revealed hitherto unsuspected anatomical subdivisions of the ganglia, which will inevitably cast new light on the functional significance of these structures. The other paper by McGeer, McGeer and Hatori discusses the very complex biochemical interactions found in the ganglia.

Amongst the papers presented on the cerebellum as a model system is one by Chan Palay describing the localization of receptors for the inhibitory transmitter gamma-aminobutyric acid (GABA). These experiments, which use tritiated muscimol, reveal the GABA receptors are widely distributed through the cerebellum among the different cerebellar cell types and that the major portion (90%) are found at axodendritic as opposed to axosomatic synaptic junctions. In the same section Llinas and Sugimori give a concise account of their investigations into calcium conductance in Purkinje cell dendrites and its possible role in neural function. Two further papers by Private *et al.* on the *in vitro* growth of cerebellar explants and by Balazs on cerebellar development and biochemistry conclude this section.

The remainder of the book is devoted to the visual system. Beginning at the retinal level, Wassle, Peichl and Boycott describe the two types of horizontal cell found in the cat retina and present a quantitative analysis of their receptor contacts and their distribution across the retina. Moving more centrally, Guillery has provided a stimulating 'speculative essay' in which he considers the development of laminae in the lateral geniculate nucleus (LGN) and their functional role. This is a complex problem as Guillery shows, and is further complicated by the fact that correlations between the anatomy and physiology seen in one species are not always seen in other. In monkeys, for example, there is evidence that the lamination is related to a segregation of the different functional types of retinal ganglion cell input, but this is less obviously the case in lower mammals such as the shrew and cat. The degree to which afferent input to the LGN influences the lamination is also difficult to analyse since little is known about the development of non-retinal inputs such as the projection from the visual cortex.

Work originally begun on cats on the effect of monocular deprivation on the LGN and the visual cortex has now been extended to the monkey. Garey, Blakemore and Vital-Durand describe their experiments showing that even if the deprivation begins 1 year after birth, the effects can be seen in the physiology of cortical cells which lie outside the main termination layers. However, changes in the cell sizes of LGN are only seen if the deprivation begins before about 2 months of age. The possible mechanisms responsible for experience dependent changes in the neural circuitry and their adaptive significance are discussed further in a paper by Singer.

Although this volume covers a wide area of brain research the topics chosen have general relevance and most of the papers will be readily assimilated by the non-specialist reader. The rapid rate of progress indicated by this volume, particularly in the area of neurochemistry, suggests that many of the questions raised here will have been answered by the time the next volume on these topics appears in this series.

K. Martin

Complex Carbohydrates of Nervous Tissue. R.V. Margolis and R.K. Margolis, Eds. New York: Plenum, 1979. 401 pp., $39.50. (Review reprinted with permission from *Neuroscience* 6: 101-102, 1981.)

Complex Carbohydrates of Nervous Tissue illustrates perfectly the real strength of an edited collection of review articles by specialists. No single person could be expected to cover the entire field with the ease and authority with which the scientists actively at work on its many facets can cover their own areas of specialization. By commissioning review articles rather than relying on the usually disappointing proceedings of a conference, the editors have managed to cover almost every aspect of the field, without the treatment becoming superficial.

There is one unfortunate omission from the book, the cerebrosides and sulphatides associated with myelin and oligodendrocytes. Compared to the titillation obtained from anaylsing the details of N- and O- acetylation and glycolylation in gangliosides, structural chemists may find the cerebroside-ganglioside GM_4 family fairly boring. But the features of myelin cerebrosides, sulphatides, ganglioside GM_4 and sphingomyelins – galactose, long chain and hydroxylated fatty acids and 18 carbon sphingosine – point to a specific pool of oligodendrocyte ceramide derivatives when compared to the glucose, short chain fatty acids and 18 and 20 carbon sphingoid bases of synaptic/neuronal gangliosides and sphingomyelins. The characteristics of astrocyte sphingolipids are unclear, but the possible compartmentation of neural sphingolipid metabolism is an area worthy of more discussion than it received.

I was also disappointed with the chapter by Pfenninger and Maylié-Pfenninger on surface glycoconjugates in the diferentiating neuron, doubly so because I find this one of the most interesting aspects of the field. My disappointment was due not to the quality of the work discussed, but to the fact that in 7 pages of text (including references) the reader is referred to 3 other reviews for discussion of cell surface carbohydrates in 'neuronal growth and recognition,' 'synaptogenesis' and 'in the framework of neuronal membrane organization in general.' I appreciate the authors' scruples in not wanting to rehash their material, but the brevity of their chapter does detract from the generally comprehensive character of the book. Moreover, as a scientist working a long way from European and North American research centres, I found it frustrating to be referred, not to original papers, in widely-circulating journals, but to 3 reviews in books, one of which is not available in the Australian National University Library. How much more difficult must it be for scientists working in more inadequately funded institutions, in less wealthy countries than Australia?

For more scientific reasons, I also found the editors' chapter on perspectives somewhat disappointing. The editors put forward the idea that subcellular distribution studies on brain

glycosyltransferases suggest that these enzymes may be found in synaptic plasma membranes in embryonic brains, but that they may be found in more conventional locations in more mature brains. None of the studies cited rules out the possibility which is, in my opinion more likely, namely that synaptic fractions prepared from young brains are grossly contaminated with Golgi apparatus. It is difficult to prove this one way or another, for the claim is in fact that the enzymes normally associated with the Golgi apparatus are found in the synaptic plasma membrane of embryonic brains and so no demonstration in synaptic fractions of an enzyme activity which is normally found in the Golgi apparatus need disrupt the hypothesis. However, if it is indeed true that the ceramide-galactose family of glycolipids is found overwhelmingly within oligodendrocytes, then the association of UDP-galactose: ceramide galactosyltransferase with synaptic fractions surely points to general contamination with Golgi apparatus. For while redistribution of enzymes normally associated with the neuronal Golgi apparatus to the synaptic plasma membrane during development is not inconceivable, such a shift in localization of enzymes normally associated with the oligodendrocyte Golgi apparatus is much harder to envisage. Roseman's hypothesis on the importance of cell surface glycoconjugates and glycosyltransferases during development needs to stand on firmer ground than this, and fortunately it increasingly appears to do so.

But these are minor problems only. *Complex Carbohydrates of Nervous Tissue* is by far the best and most comprehensive survey of a field whose importance to our understanding of brain development is only beginning to be analysed experimentally. For this the authors and the editors should be congratulated. Despite my quibbles it is an essential item for any library with a serious neuroscience collection and a stimulating tool for those neuroscientists actively interested in, and working in, the area.

I. G. Morgan

Current Practice of Clinical Electroencephalography. D.W. Klass and D.D. Daly. New York: Raven, 1979. 544 pp., $61.20. (Review reprinted with permission from *Neuroscience* 6: 100-101, 1981.)

This is an important addition to the E.E.G. teaching and reference literature. It represents a comprehensive overview of clinical E.E.G. practice by North American specialists involved in courses sponsored by the American E.E.G. Society. It is oriented towards practical laboratory work and interpretaion, and is intended to complement in-service training; but it also provides abundant selected references for back-up reading. It is attractively produced in mini-Atlas (Gibbsian) format, with very good illustrations (about 300) which will be invaluable for teaching and carrying detailed explanatory legends (thus encouraging one to dip in and browse). The text tends to be crisp, practical and stimulating, if over-dogmatic at times; but it also highlights what is known and what is not, and there is much of interest for all levels of expertise.

The Editors have achieved a broad scan of E.E.G. work; this covers practical recording plus technical details and normal findings (including neonates), and goes on through assorted disease groupings and activation procedures, etc. to more theoretical concepts, data processing and evoked responses. Despite multiple authorship the spread is fairly even though some aspects are sketchy at times (e.g. technical details) and some areas might attract more mention in subsequent editions (e.g. cerebrovascular disease, dementias, post-traumatic epilepsy, sleep). However, it cannot be expected to cover everyone's pet topic—and for instance, on the recording side (and reflecting a personal interest), it seems a pity that little attention is directed towards the advantages of accelerometer monitoring of movement (and polygraph recording, including respirator pump). A welcome effort has been made to display pathological and X-ray finding (including C.T. scan). Evoked response data appear occasionally in important settings but such studies seem to have some way to go before they can be expected to appear routinely along with usual disorders of E.E.G. rhythms. Finally, there is an interesting discussion section which sets off the text and provides valuable and stimulating insight into the problems and controversies at all levels in this uncertain art.

This book is certainly to be recommended for laboratory and personal use (including clinicians with only an occasional interest—expense apart). Of course some modifications might be considered—the illustrations would be simplified if montage diagram schema were added to the 10/20 symbols listed (which irritatingly cannot be taken in at a glance). Other blemishes include the minimal time constant and H.F. response data, occasional omissions of time scale, and the parochial inclusion of Grass gain switch settings. An additional overall list of references along with the subject index might help to make the most of this valuable collection.

E.W. Poole
