

INTERNATIONAL SOCIETY FOR NEUROETHOLOGY Newsletter November, 2000

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EXECUTIVE COMMITTEE MEETING

The Executive Committee of ISN met on September 25, 2000 at Loyola Univ. of Chicago. This was a follow-up to the meeting last year, and part of our recommendation that the EC meet on an annual basis to discuss ISN business. As last year, the meeting proved to be very effective. The following outlines the major outcomes of the meeting.

There was considerable discussion about the 2001 Congress. President Malcolm Burrows visited with Professor Horst Bleckmann and his colleagues in Bonn several months ago and was most impressed with the meeting venue (in downtown Bonn). He was particularly pleased with the proximity of hotels, and excellent meeting rooms that are all pretty much contiguous with one another. All meeting rooms will have full AV, including facilities for PowerPoint presentations. We discussed the registration fees which will be kept as low as possible for students. Indeed, even those proposed for regular members will be lower than other meetings (such as the Society for Neuroscience). It now appears that the meeting will operate "in the black" due to the excellent support generated from the Univ. of Bonn by Professor Bleckmann and his group, and if this trend continues the EC decided that some excess funds may be used either to further reduce registration or perhaps increase the number of travel awards made to young members.

We set up committees to do the Young Investigator and Travel awards, and further information is to be found in this newsletter and on the Congress web site. Note that the deadlines for these awards is December 15, 2000.

We discussed the year 2004 Congress and again are looking for people or groups who would like to host and chair the Congress (as per the last Newsletter).

Since the President, Treasurer, and Secretary need to be replaced this year, we have started to formulate a committee to solicit nominations for various offices.

Treasurer Sheryl Coombs reported that the ISN treasury is in excellent shape due to prudent investments and the health of the stock market. We agreed that we need to consider how we might use some of these funds to enhance the society. Some suggestions were made as discussed below.

We have been discussing the possible affiliation with a journal and have been in discussion with several publishers about a variety of options. Since this is still in the early stages of discussion and exploration we will wait until the March newsletter to provide additional information.

Last year we decided to have several committees look at issues of ISN with relationship to Science and Education, Outreach, and Long Range Plans. We were provided with three fine reports, and it was interesting how much they overlapped in their recommendations for things that ISN should/could be doing to enhance its services to members and the stature of neuroethology within the neurosciences. After much discussion, we concluded that development of a neuroethology web site with information for education and science would serve many purposes ranging from teaching of neuroethology in colleges to outreach to high +school students. We are going to explore this further with the appointment of a small committee. The other suggestion that surfaced was support of seed money to small meetings and workshops in years when the Congress does not take place, and again, we will be exploring this concept.

We are looking into greatly expanding our current ISN web site that handles business issues and are exploring dues paying on-line, a greatly expanded and more useful membership directory, and other related services.

Finally, we agreed to continue having these EC meetings in years other than those of the Congress since we all felt that they greatly serve the membership of ISN.

PROPOSED CHANGES TO BY-LAWS

Your Officers and Councillors, after careful consideration and approval, would like to propose the following change in ISN's By-laws. Essentially the changes are minor and are to help the Treasurer conform with the reporting requirements of the Inland Revenue Service (IRS) in the USA where our Society is registered, and to ensure smooth transitions between office holders. Our By-Laws require me to announce these changes to you and then to hold a ballot as stated in paragraph 11 of the By-Laws.

"On recommendation by a majority of the Council or by a written proposal signed by not fewer than fifty regular members, these Bylaws may be adopted or, thereafter, amended by a simple majority of votes cast in a mail ballot of voting members. Written notice of the text of proposed amendments must be sent to all members not fewer than sixty days prior to the mailing of the ballot. Changes in the By-laws shall go into effect upon closing and counting of the ballots."

The complete By-Laws are posted on our web site. We propose to include the ballot in the next new sletter. *Malcolm Burrows, President*

I. Item 6, Executive Committee and Officers of the Society

Current By-law: Elections to these offices shall take

place by postal ballot *within six months* after the International Congress.

Proposed Change: Elections to these office shall take place by postal ballot by the end of the calendar year of the International Congress.

Current By-law: The terms of office of the Secretary, Treasurer, and new President-Elect shall commence *immediately after an election*.

Proposed Change: The terms of office of the Secretary, Treasurer, and new President-elect shall commence at the end of the calendar year of the ISN Congress. However, the outgoing Treasurer shall work closely with the incoming Treasurer through May 15th of the following year and assume the primary responsibility for filing tax reports to the United States Internal Revenue Service for the year of the Congress.

Reason for Change: The current six-month latitude during which elected office can begin is unnecessary and causes difficulties for elected officers, especially the Treasurer.

Because the International Congress ordinarily takes place during late summer, the new term of office can theoretically begin before or after the end of the calendar year. IRS reporting requirements and the amount of work involved with Congress finances make it much more reasonable to tie the terms of office to the end of the calendar year.

II. Item 8, Congress Committees

Current By-law: Each International Congress shall be organized by an International Congress Committee. This Committee shall be responsible for planning and implementing the scientific and social programs of the next International Congress, as well as for fund-raising in support of that Congress. A Local Organizing Subcommittee of the International congress committee shall be responsible for all local arrangements for the congress. The chairpersons and membership of the Committee and its Subcommittee of the Society in consultation with the Council.

Proposed Change: The International Congress shall be organized by the Congress Program Committee and the Local Organizing Subcommittee according to ISN's policies for Congress management. The Program Committee shall be responsible for ..., whereas the Local Organizing subcommittee shall be responsible for..

Reason for Change: The difficulty of organizing and providing a stable financial base for the International Congress, the burden that this places on the Congress Committees, and the need for stricter accounting procedures for IRS reporting purposes have all necessitated that a formal set of guidelines for Congress management be drafted by the Executive Committee. In accordance with these guidelines and how the duties of the two Congress committees have evolved, we are also proposing that the names of the committees be changed to reflect their charge more accurately.

MEMBER SURVEY

We would be most grateful if *all members* would respond to the following questions. Send your answers to Arthur Popper by E-mail, fax, or snail mail (addresses with officers list). You may either cut out this form or send an E-mail with question numbers and yes or no. Please be SURE and include your institution and country.

Institution:

Country: _____

- 1. Do you have reasonably regular and reliable access to E-mail (at least on a weekly basis) - yes / no
- Do you have reasonably regular and reliable access to the WWW (at least on a weekly basis)
 yes / no
- 3. Are you able to access some of the major journals in our field (below) on the WWW either from your business or home computer (or via your library computers?
 - a. Journal of Comparative Physiology A -- yes / no
 - b. Brain, Behavior, and Evolution yes / no
 - c. Journal of Experimental Biology yes / no
- 4. Please feel free to add additional comments.

YOUNG INVESTIGATORS AWARD FOR ISN 2001 CONGRESS

As in previous Congresses, the ISN will present Young Investigator Awards to as many as three young neuroethologists. To be eligible for an award, an individual must (a) have completed his/her doctoral dissertation and received a doctoral degree in the period 1997-2000, (b) have published a paper based on the dissertation research (or have had a paper manuscript accepted for publication) by the time of application, and (c) be committed to attending the 2001 Congress in Bonn. Each awardee will receive a waiver of the Congress registration fee, a monetary prize of \$1000, and an invitation to give a short research talk at the Congress. One of the plenary lecture slots at the Congress will be devoted to, and shared by, the awardees.

Each candidate should submit an E-mail application or five printed copies (outlining the candidate's research accomplishments and future aspirations and briefly explaining the significance of the paper submitted for consideration), a published paper or manuscript that has been accepted for publication, and his/her Curriculum vitae. In addition, s/he should arrange for letters of recommendation to be sent directly by two scientists who know him/her well. These materials must be received no later than December 15, 2000, by the President of the ISN: Prof. M. Burrows, Dept. of Zoology, Univ. of Cambridge, Downing St., Cambridge CB2 3EJ, UK. E-mail: mb135@cus.cam.ac.uk

Applications will be evaluated by a selection committee appointed by the President and the Chair of the Congress Committee. The four top rated candidates will be notified as soon as possible, and no later than February 1, 2001.

Travel Awards to 2001 Congress

We invite applications from students, and from scientists in developing countries, for awards to help with travel and conference costs for the Bonn Congress. The society has made \$8,000 available to support this scheme. Please Email your application by December 15, 2000, to the President of the ISN: Prof. M. Burrows. Dept. of Zoology, Univ. of Cambridge, Downing St., Cambridge, CB2 3EJ, UK. E-mail: mb135@cus.cam.ac.uk

Your application should contain the following information: Name, Address, Institution, Country, E-mail, Status (if student then please give supervisor's name), Are you a member of ISN?, Will you be presenting a poster?, What are your estimated travel costs?, Tell us why you need a grant (100 words maximum)

Applications will be evaluated by a selection committee appointed by the President. We will let you know the outcome of your application by February 1, 2001.

HOW FAR CAN SPIKES AND SYNAPTIC PATHWAYS TAKE US?

Theodore H. Bullock tbullock@ucsd.edu

I am a long-shot betting man. Not with simoleons and lotteries, that is. But with neurobiological ideas and my time and good name.

Much of science is betting our time and names on long-shots of the type: "I bet it will turn out this w a y . " L i k e characters from Damon Runyon stories, one is willing to bet one's wad when you think you have a sure thing. One too easily overlooks in science



that the only sure thing is this: today's favorite will not be tomorrow's. And that's the substance of this piece; I expect the prevailing view today will be very different tomorrow. (I have elsewhere catalogued a number of major revolutions in my lifetime.)

I am betting we will look back and say "How naive, that we used to think we would understand the brain in terms only of impulses and synaptic pathways!" We don't have a good idea of the other horses to bet on, so the sure thing is only a generic negative bet. What makes me think that classical pathways are not enough - with all-or-none impulses and synapses that can integrate, facilitate, antifacilitate, excite,

or inhibit, with infinitely complex circuitry?

Several things. (A handful of readers who have gotten this far may have déjà vu all over again.) First, a wide variety of experimental evidence shows that subthreshold electric current can influence neurons, especially if it is slow or lasts for some tens of milliseconds. Some of this evidence shows that such stimulation can be weaker than some biological potentials commonly measured. Some also shows that among neurons and parts of neurons there is a wide range of sensitivity to imposed voltage gradients - spanning many orders of magnitude. The limitation of such evidence is that we don't know how to compare the natural with the artificially imposed field in effective geometry at the site of sensitivity. But we do know that some sub-threshold events or states in one neuron can influence other neurons. So I am betting simply on the difference between minor or rare and widespread or significant in the extent of such non-impulse, intercellular signaling.

Second, substantial converging evidence suggests that transmitters and modulators sometimes influence cells within a radius of several micrometers or even tens of micrometers - as is well known in certain smooth muscles. Again, the great unknown about which we can bet is the extent and distribution of such influences. I find it highly suggestive and potentially relevant that we have a plethora of transmitters and modulators. There must be degrees of privacy and of crosstalk, and most likely graded and nonlinear signals that alter spontaneity and responsivity.

These electrical and chemical field effects make us think of the known anatomy. There must be meaning, I believe, to the wide array of anatomical arrangements at axonal ramifications, dendritic arbors, and intercellular embraces. This nearly infinite span of complexity, with patterns as various and characteristic as the branching patterns of trees but multiplied by the facts of convergence and divergence of hundreds and thousands of interrelated arrays, has so far been given virtually no formulated and differentiated function. Why such a variety if, as in our models, they represent nothing but strength of connectivity? Most of the



events in the thickets of neuropile must be before or after all-or-none impulses and probably spread out in time into the range of "slow" potentials.

Neuroglia belong in such a list even though we cannot specify well just how they participate in signaling or sensing or integrating so as to influence neural output. Every week evidence crops up in journals pointing to more than passive glial roles in neural function, in synapse

formation and operation, and in filtering and setting receptivity and reactivity. The types and subtypes of glia point to the probability of a more rather than a less complex story.

Then there's the semantic argument - or is it just a quibble? The prevailing mental model of the brain, based on all-or-none impulses in synaptic pathways, is generally described in terms of "circuits" and "networks". We enjoyed a period of euphoria in the '70s and '80s when we came to realize the wide distribution of identifiable cells in some invertebrate groups and the possibility of working out the complete circuitry of some behaviors. The great hope was that when we work out the circuit of even just a few behaviors, we will have gone a long way toward understanding how brains work. Circuit and network, however, seem pretty inadequate terms for a system that depends so much on gradations of a long list of dynamic integrative properties. Facilitation of various time constants, enhancement, potentiation, accommodation, and long-term effects, oscillations at widely distinct frequencies, different degrees of synchrony, quadratic phase coupling among frequencies, chemical modulation of electrical coupling, electrotonic invasion of axonal and dendritic terminals, scores of chemical messengers, field effects and effects of milieu - these are just some of the sixty-odd integrative variables, each graded over some range. Terms such as circuit and network may tend to channel our thinking. Subthreshold population processes, slow in a range of milliseconds to minutes may have been undervalued in today's mental and formal models.

Granting that models have to simplify by choosing to fix some variables, lest the explosion of permutations makes the game impossible, we cannot forget that the real thing is much more complex and unlike a dictionary circuit.

I am not in bed with complexity. I hope that simplifying by ignoring many of the known complexities will be justified. But every twitchingly enchanted loom in my head warns that such justification is not at hand. It is easy to forget that models that behave like the real thing simply permit an explanation in terms of the assumptions in the model. The more powerful strategy of disproving a model is still all too rare in brain theory. Nevertheless, *I am* optimistic that we will continue to make major progress including more than a few revolutions among the many levels and approaches of neuroscience.

The reason I take advantage of Art Popper's invitation and unload this cry in the wilderness in the informal unrefereed pages of a newsletter among friends is obviously - that the title question exemplifies what I have taught generations of students not to do, namely to formulate a question too broad or difficult to quantify or to disprove. I am voicing a very deep unease, difficult to get into formal journals, about our need to recognize domains of nonclassical neural operations for which we cannot yet estimate the relative importance, and our need for a new vocabulary and metaphor to include the neglected parameters of function, structure, and evolution. Especially evolution, since I bet that the vast span of complexity between jellyfish nervous systems and the octopus brain or between lampreys and the simplest mammals is not mainly due to numbers of neurons but to emergent features of anatomy and physiology, many of which remain to be discovered.

If you have heard the same song before, even from the same source, so much the better. It is always cheering to hear evidence that someone has remembered something you have said! Especially if it is unpopular. No apologies for singing the same song, even after a few Bronx cheers. Even if I'm wrong, as soon as that is shown, I'll gladly say "Progress!".

"FIELD" BEHAVIOR

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"SAME OLD, SAME OLD"

D^{oes this sound familiar?} "While the proposed studies will provide information of interest to specialists, they seem unlikely to stimulate any line of further investigation."

"If the experiments are successful, what would one do next?"



"It is not clear what Dr. K.... expects to learn by this work. The research is to some extent unfocused. It is now known from work on simpler preparations that retinal ganglion cells respond to light over a restricted area. What does Dr. K.... expect to find that would justify this re-investigation of the problem?"

And last, but not least: "A problem for the proposed research is that Dr. K.... apparently has no experience in recording from mammalian retina: nor are any collaborators named who might bring such experience to the study. It is planned that two junior investigators join his laboratory in the future, but these individuals are physicians (from Canada and Sweden) whose research potential is unclear."

No, I'm not the Dr. K.... of this review, although it could have been me. This was from 1952 and the Dr. K.... was Steve Kuffler. The work was Steve's proposed studies aimed at carrying out single-unit recordings from the cat retina (published in *J. Neurophysiol.* 16: 37-68, 1953). These studies, following up on Hartline's elegant experiments in *Limulus*, opened the world of visual physiology in vertebrates by demonstrating the center/surround organization of receptive fields, notions that ultimately led to the Nobel Prize in Physiology or Medicine in 1981 for Dave Hubel and Torsten Wiesel (shared with Roger Sperry for his discoveries concerning the functional specialization of the cerebral hemispheres). And, of course, Dave and Torsten were those lowly physicians whose research potential was unclear.

How, you may well ask, could this happen? How could a panel of peers be so far off the mark? How could there be such an under appreciation of the desire to move in a new direction by an investigator who already had a track record of taking novel and elegant approaches toward solving important scientific questions? Shouldn't Steve's dissected single muscle fibers with attached functional innervation, which yielded so much valuable information about neuromuscular transmission have told a reviewer that here was an unusually talented investigator who might be worth the investment of a relatively small number of federal dollars? Instead, all we see in this review (and in so many others) are those *oh-so-easy-to-use* grant-killer phrases (GKPs) like: "Dr. K.... has no experience ...," "the research is .. unfocused," and "studies [are].. of interest to specialists [only]."

Should we be surprised that there is so much resistance on the part of review panels to creative science and new ideas? I think not. New ideas fly in the face of prevailing opinion, and prevailing opinion is set by dominant personalities, and dominant personalities don't take particularly well to criticism, do they? To challenge authority is risky, even in science. New ideas have ways of appearing, then disappearing, usually done in by the cult of personality and the court of prevailing opinion, only to surface again to an ultimate acceptance, sometimes decades later. Here's a little history about chemical transmission to illustrate.

A simple statement ended the abstract of a paper presented by T. R. Elliott at the Physiological Society on May 21, 1904 (*J. Physiol. 31: 20, 1904*). Elliott, then a

research student at the Physiological Laboratory in Cambridge, U.K. said: "Adrenalin might then be the chemical stimulant liberated on each occasion when the impulse arrives at the periphery." This notion was backed up by detailed comparisons of the actions of the recently characterized adrenalin with the effects of sympathetic nerve stimulation on a variety of peripheral target tissues. At the same time the idea that substances made by one tissue might have actions on another was very much in the That was because Bayliss and Starling had just air. introduced the word hormone to describe a substance released into the blood stream by acid-activated intestinal cells for actions on the pancreas. The suggestion that nerve endings might release "adrenalin," however, was not well received. Not even by (the not yet Sir) Henry Hallett Dale who played such a major role in the identification of acetylcholine as a transmitter compound two decades later. One year after the abstract was published, Elliott's full 66 page article describing these experiments (J. Physiol. 32: 401-467, 1905) made no mention whatsoever of the possible release of adrenalin from nerve endings.

Fourteen years and a World War passed before Otto Loewi carried out his famous "dream experiment." Supposedly Loewi awoke one night having dreamt an important experiment. He wrote the details down on a piece of thin (toilet?) paper, returned to sleep, but couldn't read what he wrote the next morning. The next night, the dream recurred. Now not willing to take chances, Loewi rushed to the laboratory to carry out the experiment. The design was remarkably simple. Two frog hearts were set up, one with functional innervation, one without, and the mixed vagus/sympathetic nerve supply to the innervated heart was stimulated, in this case causing inhibition of the heart beat (stimulation of the vagus inhibits while stimulation of the sympathetic nerve supply excites the heart beat). The fluid filling that heart was transferred to the second heart where a somewhat lessened, but readily apparent, inhibition was seen. Thus in a single experiment, Loewi demonstrated the release by nerve stimulation of the material he called Vagusstoff (later shown to be acetylcholine). Loewi was heavily criticized for his suggestion that chemicals conveyed information between nerve endings and effector organs, mostly because it was too simple minded. When the effect of nerve stimulation was mainly inhibitory, then an inhibitory substance was released (Vagusstoff): when the effect was mainly excitatory, then an excitatory substance was released (Acceleransstoff). What nonsense!

The 1930s saw a magnificent series of experiments carried out mostly by Dale and his colleagues (H. W. Dudley, W. Feldberg, G. L. Brown, and M. Vogt). These demonstrated conclusively that acetylcholine was in fact the chemical transmitter substance released from preganglionic nerve endings in the sympathetic and parasympathetic branches of the autonomic nervous system, and more surprisingly at the time, at vertebrate neuromuscular junctions as well. Finally there was an acknowledgment of the magnitude of these accomplishments, with the awarding of the Nobel Prize in Physiology or Medicine in 1936 to Dale and Loewi for their discoveries relating to chemical transmission of nerve impulses. But not so fast! While scientists in England and all of the European continent accepted the "fact" of chemical transmission, relatively few believers were found among physiologists and biochemists in the United States.

Insert another World War, and move on to 1946, a full decade after the Nobel Prize for Dale and Loewi, and a meeting of mostly American scientists in 1946 at the New York Academy of Sciences. A key organizer of that meeting was David N achman sohn, a distinguished professor of Biochemistry at Columbia Univ. Nachmanson did not believe that chemicals like acetylcholine mediated information transfer between neurons. Instead he believed that the cyclical synthesis and destruction of acetylcholine was the mechanism of conduction of nerve impulses while electrical currents transferred information between neurons. The final summary of the meeting by Ralph Gerard, who at the time did not like either the notion that acetylcholine was a transmitter compound or that it played a role in nervous conduction, was that it was time for "those who work with the ACh [acetylcholine] system to emerge from the chrysalis which they have outgrown and to seek fresher and greater fields of intellectual nourishment". The lengths to which investigators went to explain what seemed then, and still seems now to be a simple idea, were remarkable. Two famous quotes somehow seem relevant here. Cajal said "certain minds with a propensity to mysticism are troubled by simple and obvious truths": Dale, commenting on the transmitter role of acetylcholine in autonomic ganglia said "it was unreasonable to suppose that nature would provide for the liberation in the ganglion of AcCh, the most powerful stimulant of ganglionic cells, for the sole purpose of fooling physiologists."

Still the American resistance persisted. A leading theoretician of the opposition was Steve Kuffler's good friend Jack Eccles (later Sir John Eccles winner of the 1962 Nobel Prize). Steve once introduced Eccles at a seminar by saying "I've never known a person who has been wrong more times than Jack Eccles, but [with a twinkle in his eve] he's always wrong on important issues." It was not pleasant to disagree with Eccles, and more than once I observed him cutting into people who held opinions different than his own. It's worthwhile to read Eccles papers from that era to see the lengths to which imaginative, energetic investigators went to avoid accepting a too simple idea. Eccles finally conceded that chemical transmission existed, but Nachmansohn never did. As late as 1989, in the Biographical Memoirs of the National Academy of Sciences, Severo Ochoa (another Nobel prize winner) talks about how Nachmanson's supposedly now established ideas never were accepted by neurophysiologists.

Science and its history are full of such stories. My concern here though, is how to ensure that creative science is not suppressed before it gets started by dominant personalities, by prevailing opinion, and by overzealous members of review panels who hypercritically search for what is bad rather than what is good in the applications that lie before them. I know about the latter point---as a or three members of your panel who have primary responsibility for an application. That way you can serve as

youth, I was one of those overzealous reviewers.

Of course the GKPs are an important part of the problem. They are what push o t h e r w i s e a c c e p t a b l e applications down to the unfundable, 260, 270 and 280 priority score levels. Some of these are illustrated



above, but my favorite is not. It's the "not enough preliminary results" one. Here's the catch. You need lots of preliminary results to get a grant application past a study section. In fact you need to have a substantial part of the work you're proposing to do already done but not yet published. Of course, you need money to get preliminary results and if you've got preliminary results without the money you're requesting, why do you need money? Yossarian said it all, "That's some catch, that Catch 22." Not too much, not too little preliminary results, mind you, just the right amount. Who determines the right amount? Two reviewers of course, usually the only study section members who actually have read your grant application. Sometimes after you read reviews, you wonder whether anyone actually has read your application.

How can we improve this situation? How can we ensure that creative, imaginative grant applications are encouraged, applauded and rewarded with funding rather than being shot down? How can we guarantee that responsible challenges to prevailing opinion actually make it through review panels? Here, are a few suggestions:

1. To reviewers: Avoid like the plague the use of GKPs. They are too easy! They are too qualitative! They hardly ever deal with the substance of a grant, which should be the primary concern of a reviewer. The only reason for including them is to reduce priority scores, which unfortunately, they do very successfully. Search for the good, the exciting, the novel in grant applications, and do not take as your goal to criticize the details of every experiment. That can be done by anyone with any grant application: like the GKPs, that's too easy. Investigators take a month of their lives to write a grant application. Have the patience and the courtesy to take a day or two of your life to properly read and critique that application.

2. To others on the review panel: Challenge the use of GKPs. What do you mean there is too little preliminary data? What do you mean there is no evidence that the PI can carry out these experiments? Try to read at least the summaries of all applications. Better yet, try to fully read all applications. That way you are not beholden to the two

be involved in the review process, and true peers will become part of peer review. This is something that has happened in a very hit-and-miss way in the past. Such service should not be on higher level Councils, or Boards of Scientific Counselors, but on the Study Sections and Panels that carry out the primary review of applications. Busy investigators should be allowed to say no twice but be required to serve when asked a third time. Of course, a worry is how to avoid dominant personalities who only tolerate prevailing (their) opinions, but that's easily dealt with. Most workers in a field can identify colleagues who are supportive of innovation and new ideas, and those who aren't. Seek out the Steve Kufflers of the nation and ask them to serve.

If some of these things actually happen, I suspect that it will be difficult for the person writing an essay on this topic in the future to find a fifty year old review that sounds the same as reviews of his or her present day. Maybe instead, that essayist will be full of praise for a peer review process that really works.

AUTOBIOGRAPHICAL SKETCH

MAKING MY WAY THROUGH LIFE

Thelma L. Williams Physiology Dept. St George's Hospital Medical School Univ. of London t.williams@sghms.ac.uk

I was born in a small Indiana town called Gas City (named for a pocket of natural gas discovered late in the nineteenth century but used up long before I was born). In my day it was a glass-making factory town, in corn-growing country. Now, many decades later, I live in London where I teach medical students and do research on an guilliform locomotion. How did I travel so far?

I graduated from high school in 1958. I sometimes wonder who and where I might be now, if I hadn't been awarded a Certificate of Merit as a finalist in the National

an advocate for an investigator who might be being treated unfairly.

3. Finally, to the powers that be at NIH and NSF: All investigators who receive federal support for research should be required to serve on review panels, if asked. In that way, the best scientists in the nation actually will Merit Scholarship examination. The names and addresses of awardees were sent to colleges and universities, and many wrote to me, urging me to apply. But one letter was unique – from Wilmington College, a small progressive college in Ohio affiliated with the Society of Friends. Wilmington didn't ask me to apply, they simply told me they had a place for me and a full tuition scholarship, and would I please come. They also had a work-study program that would allow me to earn my room and board. That summer I was very uncertain about where to go and what to do, so I took the easiest course – I just said "yes."

My best and favorite subject throughout my school years had been mathematics, but my high school math teacher told me, with sadness in her eyes, that there were very few jobs available for women in mathematics. She advised me to major in something else. (Imagine my pleasure 30 years later when my daughter got a Ph.D. in mathematics from Warwick Univ., and a job in the Mathematics Dept. of the Univ. of Nottingham!)

My first two years of college were as a premed, thanks to my chemistry teacher. I went through an intense religious phase in my last two years of high school, and I wanted to be a foreign missionary. Rather than try to talk me out of it, this wise man gave me an article on Albert Schweitzer's life and work. So I followed his suggestion and enrolled as a premedical student. I must confess, however, that I spent much more time and energy in my first two years discussing the meaning of life and reading novels than I spent on my courses. Wilmington had the Quaker commitment to a world without war and encouraged overseas students to apply. It was an exciting place to be. I learned a lot about myself and the world in my two years at Wilmington.

But in the late autumn of my second year, I was in a horseback riding accident and fractured two cervical vertebrae. After six weeks in traction I was able to go back to classes and to work, wearing a plaster cast from chin to pubis, but in the following months I began to be haunted by my mortality. When summer came I set off with a friend to see the world. We were hoping to travel steerage to Europe – we got as far as Boston, where we both got jobs for the summer. Diti tested diodes on a factory assembly line; I got a job as a technician in the Physiology Dept. at Tufts Medical School. By the end of the summer, we had lost our dream of going to Europe; Diti went back to Wilmington and I stayed on at Tufts. A year later, I moved as a technician with Norman Briggs, a colleague of my boss, to the Univ. of Pittsburgh.

In Pittsburgh, I decided to go back to college, starting as a part-time student and eventually leaving work to go full time. (Norman offered me an interest-free loan to pay off my debt to Wilmington College so they would send me a transcript – it was only in later years that I came to appreciate the great generosity of this act.) I knew by then that I did not want to study medicine, but I still wasn't sure what I wanted to do with my life. The first course I enrolled for at Pitt was Physics, which I fell in love with: I was entranced by Newtonian mechanics, by looking at the world around me through the differential calculus. So I took physics as my major. But a summer job designing a Faraday cup to focus a ray of electrons convinced me that I did not want a career in physics. I had loved the research I had been involved in as a physiology technician: the logic of experimental design, the analysis and interpretation of data, but it was only now that I realized how much of its fascination for me was in the subject matter. Since childhood I had been entranced by living things – my mother often pleaded with me to stop playing with spiders – but my early contact with academic biology had not caught my imagination. I enjoyed the Zoology labs - I loved making careful, highly detailed pencil drawings of fresh or pickled specimens from all phyla - but the course was primarily descriptive, and I had no contact with analytical biology or animal behavior.

By the time I graduated from Pitt in 1965, I had acquired not only a degree in physics but also a husband and a baby daughter. In the year after graduation, I went back to my old job in the Physiology Dept. Once again, my boss Norman Briggs played a major role in the direction my life took. He convinced me that I would never be happy working as a technician and reading novels - that I ought to do my own research, that I should go to graduate school. My husband had just accepted a post-doc in physics at Western Reserve Univ. (as it was then) and Norman urged me to apply for a graduate student position in the Physiology Dept. I did. On the day of my interview, my babysitter was unwell. I arrived in the head of Dept.'s office an hour late, with a 2-year-old in tow. It was not a good beginning, but George Sayers was so impressed with my academic record that he offered me a place.

I opted to do my thesis work on the cardiovascular system, which charmed me as an intricately interactive mechanical system. I worked on the vagal control of heart rate with Matthew Levy, not only a clear thinker and great fun to work with but also one of the kindest men I have ever known. My thesis work was on an interesting phenomenon whereby stimulating the efferent vagus could entrain the heart beat 1:1, so that increasing the rate of stimulation gave rise to a paradoxical increase in heart rate.

By the time I had finished a post-doc with Matt, I knew that I did not want to continue working on whole body mammalian preparations. For my second post-doc I went to work with Otto Hutter, in Glasgow, learning the techniques of electrophysiology. By this time I was divorced, and I took my long-suffering 8-year-old daughter with me across the big water. In Otto's lab I looked at some aspects of potassium conductance in skeletal and cardiac muscle. This didn't satisfy me either – it was too much like focusing electrons.

But I loved Britain. Somehow I felt less an outsider here than I had back home. Also, the US was deeply into the war in Vietnam, and I felt happier ideologically in Britain (Labour was in power - this was before the Thatcher years). I married an Englishman, and got a job as a tenure-track Lecturer in London. I was paid to teach physiology to medical students, but encouraged to do research as well. I was given *carte blanche;* what did I want to do? There was no start-up money, but I was given access to stores of old teaching and research equipment. I decided I wanted to work on some aspect of motor control, in a less complicated creature than a mammal. Martin Rosenberg, also a lecturer at Bart's, was studying sensory systems in tortoises. In my search through the literature for ideas, I came upon Sten Grillner's 1975 review of vertebrate locomotion. I was hooked. Why not study locomotion in the tortoise? So I borrowed tortoises from Martin and using an old 16 mm film camera with variable filming speed, I studied the effects on speed and gait of body temperature, body size, and roughness of the surface. Convincing a tortoise to walk often took a lot of patience, but it paid off: I managed to fit the data to a single linear model giving speed and gait pattern as a function of the three independent variables. In addition, I showed that in the tortoise, trotting and walking are a continuum.

Some years later, I went to Sten Grillner's lab on a sixmonth sabbatical, to work with him and Peter Wallén on the lamprey spinal cord preparation. There I met Karen Sigvardt, the beginning of a good friendship and a very fruitful collaboration. In the following years, I worked at various times and in various combinations with Karen, Nancy Kopell, Bard Ermentrout, and Avis Cohen, studying pattern generation and intersegmental coordination in lamprey locomotion - exciting work and very rewarding. But I had not really left my interest in mechanical systems forever. I became quite interested in the relative timing between muscle activation and body curvature - which is pretty tightly controlled in the lamprey by mechanical feedback - and realized that I couldn't understand its significance without a model of the whole system - body, water and all. So I found a computational fluid dynamicist, John Carling, and a mathematician good at physics, Graham Bowtell, who both thought modeling an anguilliform swimmer would be fun. With Nancy Curtin we have looked at the physiology of swimming musculature, and now we are bringing some real eel kinematics into the picture thanks to George Lauder and Gary Gillis. It has been almost 10 years since I set myself the goal of understanding, through mathematical modeling, the major physical interactions giving rise to anguilliform swimming. We are still learning.

I have done a lot of meandering in my life and work, trying first one thing and then another. Looking back from here, I feel privileged to have been able to do this. If I had started my adult life in these more demanding and competitive days it would surely not have been possible.

NEUROETHOLOGY LISTSERV

Reminder: The ISN maintains a Listserv. Any member may join the Listserv and use it to broadcast announcements, requests for information or materials needed for research, etc. Members who have joined the Listserv receive all notices posted to it, including meeting announcements, advertisements of job openings and postdoc positions, fellowships, etc. To join the Listserv or update your E-mail address for its messages, please send an E-mail to John Hildebrand at <jgh@neurobio.arizona.edu>.

INTERNATIONAL SOCIETY FOR INVERTEBRATE NEUROBIOLOGY Tihany, Hungary

The International Society for Invertebrate Neurobiology is a non-profit society founded in 1989 in Tihany, Hungary. Its main purpose is to provide a forum for all neuroscientists who are interested in understanding the nervous systems of invertebrates. The enormous progress of the neurosciences at the millennium change would have been impossible without studies of the functional mechanisms of the nervous systems of Invertebrate animals. Regardless of whether researchers use a molecular, genetic, cellular, pharmacological, or behavioral approach for analysis of the nervous system, the society will provide grounds for discussion at meetings, and encourage interdisciplinary work among members.

One of the most remarkable features of this society, originally founded in Hungary at a time when scientific societies spanning East and West were rather unusual, is that many of its members come from former East bloc countries. Thus, the society has the unique opportunity of serving as a truly international society bringing together researchers and students from countries all over the world. In order to enable researchers from poorer countries to become members, the annual fee is set at the unu sually low rate of US \$10,-- but of course, members from richer countries are kindly asked to make voluntary contributions. In particular, the society plans to set up a travel fund to enable promising young scientists to attend meetings sponsored or supported by the society.

Currently this society has the following executive board: H.-J. Pflüger, Berlin (president); Karoly Elekes, Tihany (executive secretary), and the following council members: P. Balaban, Moscow; L. P. Croll, Dalhousie; J. Messenger, Sheffield; L.L. Moroz, Houston; D. Nässel, Stockholm; M. Sakai, Okayama; D. Sonetti, Modena; N. Terenina, Moscow.

Please direct all inquiries to: ISIN Secretary, Prof. Dr. K. Elekes, Balaton Limnological Research Institute, Hungarian Academy of Sciences, TIHANY, PO Box 35, H-8237, Hungary. phone: +36-87348 244, fax: +36-87348 006, e-mail: elekes@tres.blki.hu

This society, together with the Polish Neuroscience Society, announces the following satellite meeting to the 6th International Congress of Neuroethology, 28 July to 3 August 2001, Bonn, Germany, European Conference of Neurobiology, 11 to 15 August 2001, Krakow, Poland.

This conference will provide a broad perspective into neurobiological mechanisms of both vertebrates and invertebrates, and will emphasize a comparative view onto systems undergoing similar development and serving similar functions The organizers are keen to provide a forum and meeting place for young scientists, Ph.D. students or postdocs, and would like to encourage young scientists from all countries, in particular from Eastern countries, to attend and present and discuss their own work. For this reason, we plan to keep costs as low as possible, and to include general oral and poster sessions not devoted to one particular topic.

Preliminary Program, Plenary lectures: Corey Goodman (USA, on mechanisms of development of nervous systems), T. Bliss (USA) on hippocampus, D. Zitnan (Slovakia, on peptide cascades in ecdysis behavior of insects), P. Meyrand (France, on development of rhythm ic behavior in crustacean stomatog astric ganglion), J. Hildebrand (USA, on olfactory coding), R. Levine (USA, on motorneuron development) Symposia on: Brain development, Activity-dependence of neural development, Monoamines in molluscan reproduction and development, Neural and genetic basis of circadian clocks, Mechanisms of learning and memory, Neuromodulation, and other topics. Posters: Open to all topics of vertebrate and invertebrate neurobiology.

Further information can be obtained from: Dr. E. Pyza (pyza@zuk.iz.uj.edu.pl), Institute of Zoology, Jagiellonian Univ., Ingardena 6, 30-060 Krakow, Poland (tel. +48(12)6336377 ext. 2416, fax: +48(12)6342716), and see ISIN s web-page http://tres.blki.hu/ISIN/index.html

NEUROBIOLOGY OF ELECTROSENSORY ORGANISMS

July 27 - 29, 2001, Bonn, Germany Satellite meeting Call for Posters

We would like to invite neuroethologists interested in electrosensory systems to participate in this satellite meeting that will immediately precede the 6th International Congress of Neuroethology. The preliminary program for this meeting can be accessed through the satellite homepage now under construction at the following address: www.electrosat.huckepack.com. It also can be accessed through the main congress website. Poster abstracts on all topics related to electrosensory organisms can be submitted via Internet, together with your registration (Poster deadline: March 15th, 2001; early registration deadline: May 1st, 2001). Posters displayed at the satellite meeting can be later transferred to the main congress. contact: electrosat@huckepack.com

The ANIMAL BEHAVIOR SOCIETY's 38th annual meeting will be held 14-18 July 2001 at Oregon State Univ., in Corvallis, Oregon. Plenary speakers include Eliot Brenowitz, Harry Greene and Ellen Ketterson. Symposia include 'Aggression and group organization in animal societies', 'Behavioral genetics for the next decade,' 'Detecting and measuring mating preferences' and 'Song Learning.' For further information see http://www.animalbehavior.org/ABS/Program, or contact the local hosts Andy Blaustein (blaustea@bcc.orst.edu) or Lynne Houck (houckl@bcc.orst.edu).

BOOKS PUBLISHED BY ISN MEMBERS

A month or two ago, ISN member Tom Finger asked if we could publish an announcement of his new book in the newsletter. We brought the idea of publishing such material to the Executive Committee and it was unanimously agreed that it would be a useful addition to the newsletter, especially in our quest to make this forum a place that members would find material they can find no where else. Thus, we have adopted the following policy for the newsletter.

"Members of the ISN are invited to submit short announcements of new books for inclusion in future newsletters. The announcement should include full bibliographic information (price may be included as well as the web site of the publisher) and a 40-50 word description of the book. Only books that are authored or edited (but not books that include chapters contributed) by members of the ISN will qualify to be announced in the newsletter. Books must have a year 2000 or 2001 copyright to be included in the newsletter."

We thank Tom for this suggestion, and his is the very first book announcement.

NEW BOOKS BY ISN MEMBERS

The Neurobiology of Taste & Smell, 2^{nd} edition, T. E. Finger, W.L. Silver & D. Restrepo (eds.) 2000, Wiley Press (ISBN 0-471-25721-4; Hardcover, US\$99.95 list price). This completely revised edition provides a substantive overview of the chemical senses. The significant strides made in chemosensory research are reflected in this edition's emphasis on transduction and molecular aspects. The book is designed as an introduction to the field for upper level students as well as for researchers in other disciplines.

MATERIAL FOR FUTURE NEWSLETTERS

We welcome material for future newsletters for a variety of different sections each issue. Advertisements for positions (faculty or student) are limited to 150 words. Announcements of new books (copyright 2000 or 2001) *written or edited by ISN members* should include the full citation information (including ISBN) *plus* a 40-50 word description of the book. (Note, if an ISN member only contributed a chapter this is not ap propriate for inclusion). These should be submitted no earlier than one month before the next issue (March, 2001)

We also welcome announcements of future meetings, discussion material about research areas or topics of interest to neuroethologists, and similar types of material. Please contact Arthur Popper before submission to determine length. All material must be submitted electronically, and preferably as an attached file to an E-mail. Send all material to Arthur Popper.

NEWSLETTER CARTOONIST

Following in the tradition of other major publications that present diverse material, the ISN Newsletter is delighted that we now have our own cartoonist, Ms. Daphne Soares. You may have noticed Daphne's cartoons in the previous issue of the Newsletter, and we plan to continue with her work at least until she graduates. Daphne is in the Neuroscience and Cognitive Science (NACS) program at the Univ. of Maryland where she is doing her doctorate with Dr. Catherine Carr. Coming from a scientific family, Daphne rebelled as art major before succumbing to genetic pressure. She is interested in brain evolution and "cool" animals. E-M ail: daph@wam.umd.edu.

FACULTY POSITIONS

CELLULAR PHYSIOLOGY. The Dept. of Biology at the U of College Maryland, Park (http://www.life.umd.edu/biology/index.html), seeks cellular and systems neurophysiologists using modern functional approaches to study the nervous system to become a part of a Departmental thrust in Neurobiology and Biophysics, as well as participate in a new program initiative in Neuroscience (http://www.life.umd.edu/nacs). Individuals, research teams, or couples with the potential to develop vigorous externally funded research programs are encouraged to apply. Send a CV, a summary of research interests and plans, reprints of three major publications, and the names and addresses (including E-mail addresses) of four persons who can be contacted for letters of reference to: Cellular Physiology Position, Dr. William R. Jeffery, Professor and Chair, Dept. of Biology, Univ. of Maryland, College Park, MD 20742-4415. For best consideration, however, applications should be received by November 15, 2000. Applications are especially encouraged from women and minorities. UM is an EEO/Affirmative Action employer.

NEUROETHOLOGIST OR SYSTEM S NEUROSC IENTIST

Asst./Assoc. Professor (grant funded, leading to tenure-track). The City College, City Univ. of New York, Dept. of Biology, seeks a neuroscientist, preferably working at the systems level, with a strong independent research program and postdoctoral experience. Successful applicants should have research interests that complement those of our neurobiology faculty (visual cortical neurophysiology, neuroanatomy, visual system development, molecular genetics, oculomotor system), and will be expected to participate in teaching do ctoral and undergraduate courses. Startup funds, core facilities, and abundant space are available. Application review begins December 1, 2000. Additional details at www.ccny.cuny.edu/positions or www.rfcuny.org/hr/pvn/. To apply, send curriculum vitae, statement of research interests, and the names of three references to: Dr. Josh Wallman, Chair, Neuroscience Search Committee, Biology Dept., City College, CUNY, Convent Ave at 138th Street, New York, NY 10031; wallman@sci.ccny.cuny.edu. An AA/EO/ADA Employer.

ASSISTANT PROFESSOR OF NEUROBIOLOGY The Dept. of Biological Sciences at the Univ. of Illinois at Chicago invites applications for a tenure-track position at the ASSISTANT PROFESSOR level. The Neurobiology Group currently consists of nine faculty with research interests primarily in synaptic and developmental neurobiology and in sensorimotor integration (neuroethology). All of the faculty and graduate students also are affiliated with the Neuroscience unit of the College of Liberal Arts and Sciences - the Laboratory of Integrative Neuroscience (www.uic.edu/las/LIN). We seek applications from individuals whose research program emphasizes neurodevelopment but will consider other areas as well. Successful candidates will pursue a vigorous independent research program and contribute to graduate and under graduate teaching. For fullest consideration, send a CV, a brief summary of research plans, and three letters of recommendation by December 1, 2000, to: Search Committee for Neurobiologist, c/o Mary Wais, Laboratory of Integrative Neuroscience, 4291 SEL MC 067, 840 West Taylor Street, Chicago, IL 60607.

The **Dept. of Organismal Biology and Anatomy at the Univ. of Chicago** is engaged in a major expansion that will approximately double the size of its faculty over the next five years. The focus in the Dept. is on neuroethology and computational neurobiology. We anticipate making two or more appointments in these and related areas of systems, integrative, and cognitive neuroscience, without prejudice as to techniques, model system, or level of appointment. The successful candidates will be expected to engage in undergraduate and graduate teaching. Applicants should send a curriculum vitae, statement of research and teaching interests, up to four reprints, and names and addresses of three referees to: Neurobiology Search Committee, Dept. of Organismal Biology and Anatomy, Univ. of Chicago, 1027 E. 57th Street, Chicago, IL 60637; Fax 773-702-0037, http://pondside.uchicago.edu/oba/. AA/EOE.

The Dept. of Biology at Case Western Reserve Univ. (CWRU) invites applications for a neurophy siologist or neuro ethologist with an interest in neurome chanics. Successful candidates will be expected to lead an extramurally funded research program, and to develop and teach undergraduate and graduate courses. The level of the appointment will depend on the applicant. The Dept. recently received a training award from the NSF in neuromechanical systems (see http://neuromechanics.cwru.edu). Applicants should send a current curriculum vitae, and a letter describing their research and teaching interests, and have three letters of recommendation sent directly to the Dept. of Biology. Applications should be received by November 15, 2000 but the search will remain op en until the position is filled. Applications, nominations, and inquiries should be directed to: Joseph F. Koonce, Chair, Dept. of Biology, Case Western Reserve Univ., Cleveland, OH 44106 - 7080, Phone: 216-368-3557, FAX: 216-368-4672, E-mail: jfk7@po.cwru.edu. More information about the Dept .: http://www.cwru.edu/artsci/biol/biol.htm. In employment, as in education, CWRU is committed to affirmative action and equal opportunity. Applications from minorities and women are especially welcome.

GRADUATE AND POSTGRADUATE POSITIONS

Postdoctoral training opportunities in Comparative and Evolutionary Biology of Hearing at the Univ. of Maryland, College Park. Our research group includes 11 faculty and over 50 students, postdocs, and visiting scientists. Research emphasizes basic auditory mechanisms using a wide range of experimental approaches. Research models include insects, fish, amphibians, reptiles, birds, and mammals (including humans). We have strong interests in comparative and evolutionary issues. Investigators include: Drs. Catherine Carr, Robert Dooling, Sandra Gordon-Salant, William Hall, Cynthia Moss, David Poeppel, Arthur Popper, Joelle Presson, Shihab Shamma, Jonathan Simon, and David Yager. The program strongly emphasizes inter-laboratory collaborations and training. Postdoctoral positions are supported by a training grant from NIH (limited, by law, to US Citizens and permanent residents) or individual research grants. For details of our research and training program see www.Life.umd.edu/cebh or contact Dr. Popper at AP17@umail.umd.edu. UM is an Affirmative Action Equal Opportunity Employer.

POSTDOCTORAL POSITION available immediately to construct and analyze neural network models of chemotaxis in *C. elegans*. Realistic models, constrained by anatomical and electrophysiological data, will be optimized by neural network training algorithms to reproduce chemotaxis behavior of real worms and testing by neuronal ablations in the biological network. Previous training in electrophysiology, computer science, or physics helpful. Send CV and names of references to: Dr. S.R. Lockery, Institute of Neuroscience, 1254 Univ. of Oregon, Eugene, OR 97403. The Univ. of Oregon is an AA/EO institution committed to cultural diversity and compliance with ADA"

Doctoral Program: Polarization Vision in Fishes - I am seeking a student for a Doctoral Program in the Dept. of Biology, Univ. of Victoria. Victoria is a remarkably beautiful coastalcity located on Vancouver Island. This research program will center on neuronal processing in polarization vision of fishes (see my WEB site at http://web.uvic.ca/biology/people/hawryshy.html for additional details of research program). Applicants should have some background in cellular, computational, and behavioral Relevant experience in extracellular and neurobiology. intracellular recording techniques would be an asset and thus applicants with a M.Sc. degree would be preferred although not necessary. Starting date Sept. 1, 2001. The student will receive a stipend of \$16,500 annually. Applicants should submit a CV, three letters of reference (academic) and academic transcripts to: Prof. Craig W. Hawryshyn, Dept. of Biology, Univ. of Victoria, PO Box 3020, STN CSC, Victoria, British Columbia, V8W 3N5, CANADA E-mail: chawrysh@uvic.ca

A position is available for a postdoc or graduate student to participate in studies of **visual encoding of motion**, **texture and figure-ground segregation**. Approaches include: single-unit electrophysiology, optical imaging, and psychophysics. The starting date is flexible, and applications will be considered until the position is filled. International applications are welcome. Previous experience with one or more of the following would be desirable: single unit neurophysiology, optical imaging, quantitative skills, modeling, computer programming (Matlab, C). The laboratory is one of a close-knit group of vision labs having a community of trainees and faculty who interact and collaborate on a variety of interdisciplinary vision research projects. The lab group is located in Montreal, a cosmopolitan as well as very livable city. Laboratory: http://ego.psych.mcgill.ca/labs/mvr/Curtis/cbaker_home.html McGill vision group: http://ego.psych.mcgill.ca/labs/mvr/ Applicants should contact: Curtis Baker, Mc Gill Vision Research Unit, McGill Univ., 687 Pine Ave W, H4-14, Montreal, Canada H3A 1A1, (514) 842-1231 x4819, curtis@vision.mcgill.ca

A renewable three year postdoctoral position is available for a highly motivated individual to conduct research on auditory communication in bats. This neuroethologically inspired research is geared towards understanding cortical processing for cognition of complex sounds, including speech in humans. Experience with in vivo electrophysiology and computer usage is essential. Additional skills in neuroanatomy, imaging, quantitative techniques, computer programming and/or engineering can be used to tailor the project to suit the interests of the individual. State-of-the-art facilities are available for learning new approaches, such as multielectrode microarrays, fMRI, and optical recording techniques, and combining them with conventional electrophysiology. The metropolitan Washington, D.C., area offers a stimulating environment and excellent opportunities for continued neuroscience research. Interested candidates should send their curriculum vitae and names of two references to Jag Kanwal; E-mail: kanwalj@giccs.georgetown.edu, fax: 202-687-6757. For additional information visit web site at http://www.giccs.georgetown.edu/labs/kanwal/index.htmlSalary is based on experience per NIH guidelines. EOE.

NSF-Sponsored training in NEUROMECHANICAL SYSTEMS. Predoctoral fellowships are available in a multidisciplinary graduate program in Neuro-Mechanical Systems at Case Western Reserve Univ. Neuro-mechanical systems include natural, man made, or hybrid systems combining neural controllers and mechanical peripheries. Examples include natural organisms, biologically inspired robots, and neuroprostheses for restoring motor function in the disable d. This program involves eight faculty from four Departments, Biology, Biomedical Engineering, Electrical Engineering and Computer Science, and Mechanical Engineering. We are seeking outstanding students with backgrounds in biology, neuroscience, biomedical engineering, computer engineering and science, electrical engineering, or mechanical engineering. We are particularly interested in recruiting under-represented minorities. Students must be U.S. Citizens or Permanent Residents of the United States. Details of the program can be found at http://neuromechanics.cwru.edu.For further information, please contact Dr. Roy Ritzmann, Dept. of Biology, Case Western Reserve Univ., Cleveland, OH 44106 - 7080, (216) 368 - 3554, or igert@po.cwru.edu.

International Society for Neuroethology c/o Panacea Associates 744 Duparc Circle Tallahassee FL 32312 USA