International Society for Neuroethology

Newsletter
July 2007

International Society for Neuroethology
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This Issue Includes

The ISN President's Column

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Last report as President: In writing my last column as President of our Society, I find it important to ask what has and what hasn't been accomplished during my tenure. Some may feel that "change" isn't why officers of small organizations like ours are elected. Rather the job is to keep the ISN running smoothly, to oversee and to make sure that the finances are spent wisely, to build up the financial base, to maintain and if possible increase the membership base, and to run a wonderful Congress every 3 years. In other words, the job of the officers is "stewardship" and ensuring a future for the organization, while not changing things too much either.

I believe that the present Executive Committee, with whom I have thoroughly enjoyed working (Al Feng, Peter Narins, Ian Meinertzhagen, Martin Heisenberg and as a special advisor from the Council, Sheryl Coombs), has done an excellent "stewardship" job. We are just about to have an outstanding Congress and our financial ship of state is secure. A huge thank you is therefore due this group of colleagues who with the firm hand of Linda Hardwick as our manager from Allen Press, Inc. have ensured a continuing future for the ISN. There were other issues, however, that I felt were important to address to keep our organization moving forward in new directions. I'll discuss some of these here as they may fall into the bailiwick of the new President, Martin Heisenberg, and he too will have to think about these issues.

1. More frequent Congresses: I felt this issue to be an important one when I assumed the presidency, and still feel this to be important for the ISN. Many smaller organizations than ours have annual meetings. I raised this possibility several times over the last 3 years via the ISN Newsletter (which is now even more valuable to the Society because of the terrific job by Ian Meinertzhagen in putting each issue together), inviting comment by the membership. I did not receive much in the way of reply from Society members about this. Those replies that I did receive were well thought out opinions of why we should *not* have Congresses more often than once every 3 years. Hence this issue will stand where we are for the immediate future.

2. Funding for students to attend meetings: This matter was begun during Al Feng's tenure as President and continued by me and, as a result, we now have Heiligenberg Awards in place on an annual basis that offer funding for 6 graduate students to attend neuroethology-related Congresses if the students are scheduled to present a talk or poster. Mark Konishi and his committee select the awardees, which became a difficult task this year with the large number of applicants to attend the Congress.

3. Bullock Awards for faculty travel: Although still somewhat ill-defined (this will have to be clarified during Martin Heisenberg's tenure) we have set aside ISN funding for awards for faculty to fund visits to meetings or to academic institutions to talk about their research. We will have a symposium at the upcoming ISN Congress supported via this funding.

4. Chapters of the ISN: This too was not greeted with much enthusiasm by the membership. The EC did receive a comprehensive report on the possibility of having local Chapters of the ISN, which was dawn up by Hans Hofmann and Barry Trimmer, but no action was actually taken on the matter of Chapters. This too will have to be picked up by Martin Heisenberg if he senses enthusiasm on the part of the membership for going this route.

5. New members and keeping the membership intact during the between Congress years: This matter too is continuing discussions begun during Al Feng's tenure as President. Student membership dues were eliminated in order to encourage the formation of a next generation of neuroethologists. This required that the mentor sponsoring the student had to be up to date on his/her dues payments. We imposed penalties on letting membership lapse and have worked hard to keep dues for regular members as low as possible. Still we have suffered membership losses during non-Congress years. My only additional comment about this is to encourage present members to remember that this is *our Society*, not one that belongs to the EC or the Council. Its success depends on every one of you getting as involved as possible in ensuring its future. That means: keep paying dues and encourage others to join the ISN (in the case of financial hardship, dues are waived for members); get involved with the Society by offering to run for ISN office if you can; when called upon, serve on ISN Committees like the Congress Committee, the Heiligenberg Awards Committee, etc.; respond to issues raised in the Newsletter; and finally, by all means read the Newsletter and let the editor know whether he or she is doing a good job, and volunteer to write feature articles for the Newsletter as well.

6. The Congress: Last, and possibly most important, we will have a superb Congress again this year. For that, we must thank the Congress organizers, who have worked incredibly hard during the last 2 years in selecting speakers and symposia, applying for and receiving funding from grants, organizing the Congress in a beautiful location and adding ancillary events like the fireworks cruise that will greatly enhance our enjoyment of the event. On top of all that they had to deal with incredibly complex financial issues in an efficient and effective manner. Barb Beltz chaired the Congress Committee and Cathy Rankin was the local Chair. I vividly remember their initial presentations to the EC, which were beautifully done with an attention to detail that left the members of the EC in awe of their accomplishments. Ron Harris-Warrick and Sten Grillner were co-vice Chairs, and with a hard working Congress Committee they put the Program together. Barb and Ron applied for and received NSF and NIH support for the Congress (an amazing feat in this terrible funding climate). We had a number of committees dealing with awards and special presentations at the Congress: Martin Giurfa chaired the Young Investigator Awards Committee, Claire Rind chaired a special committee for Congress Awards for students and post-doctoral fellows, and Mark Konishi chaired the Heiligenberg Awards committee. Of course Linda Hardwick was always there as our manager. In fact, when one looks at the numbers of members involved in all of these efforts, I feel greatly assured that we really do have many members who are super strong supporters of the ISN, and that makes me feel great confidence in our future.

It has been an honor to serve all of you as President of the ISN, and I am certain we are in good hands with Martin Heisenberg as our incoming President. *Ed Kravitz.*

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Editor's Note: July issue of the ISN Newsletter

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This issue of the Newsletter falls just before the International Congress that many of us will attend in Vancouver. The Congress will I'm quite sure generate a large volume of news and features for the next issue of the Newsletter. So, please prepare and send any features and documentation from the ICN that you would like to share with members, for the next Newsletter, in November. In particular, I would greatly appreciate images, compromising or otherwise, of themselves, friends, colleagues and events from the Congress.

Former ISN President John Hildebrand Elected to US National Academy

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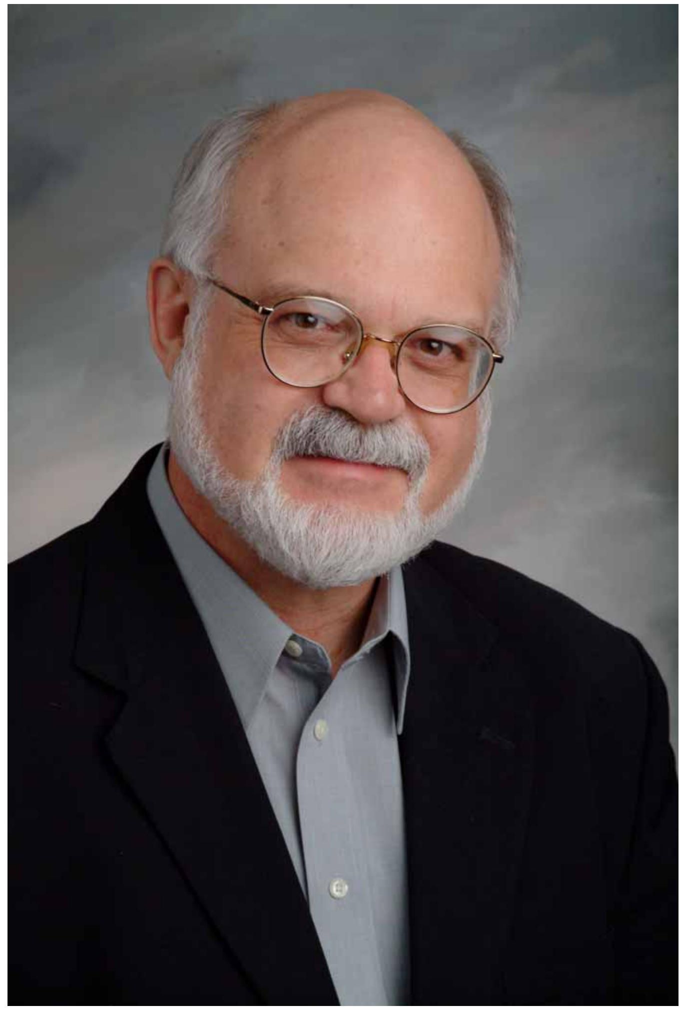
It is with great pleasure that the Society acknowledges that one of its former Presidents, John G. Hildebrand, was elected to the US National Academy of Sciences.

In an announcement on May 1, 2007 John, who is a University of Arizona Regents' Professor of neurobiology, was among 72 new members and 18 foreign associates from 12 countries recognized for distinguished and continuing achievements in original research. With their election, the total number of active Academy members comes to 2,025. Election to membership in the academy is considered one of the highest honors a U.S. scientist or engineer can achieve.

John is known for his seminal work on the neurobiology and development of insect olfactory systems and their effects on insect behavior. His work integrates approaches drawn from various different fields: anatomy, physiology, behavior, developmental biology, biochemistry and neurobiology.

John and his many co-workers have pioneered the use of the hawkmoth *Manduca sexta*, the tobacco hornworm moth, as a model organism to study the organization of insect olfaction. With a wingspan of about 10 cm, adult moths have a relatively large brain among other insects, making them easier to study than smaller model insect species. His lab in Tucson is elucidating how a moth's neural circuits analyze the airborne chemical cocktail that the moth uses to determine where to feed, then mate and then lay eggs.



John G. Hildebrand, Elected Member, National Academy of Sciences

John joined the University of Arizona in 1985 to establish and direct the Division of Neurobiology, part of the Arizona Research Laboratories devoted to insect neurobiology and behavior, and also part of the Center for Insect Science he helped found at the University of Arizona. Election to the National Academy comes as the latest in a considerable list of elected memberships in exclusive scientific societies. John is already a fellow of the AAAS (1986); a member of the Deutsche Akademie der Naturforscher Leopoldina (1998); a Foreign Member in the Norwegian Academy of Science and Letters (1999); and a member of the American Academy of Arts and Sciences. He also holds an honorary doctorate from the University of Cagliari, Italy (2000), and has received numerous other awards.

Election to the National Academy signifies not only the great distinction accorded John as an individual scientist, but also the recognition this election brings to the field of neuroethology we all share. John has been closely associated with the Society since its inception, serving as its President in the years 1995-1998. He is currently the chair of the ISN Membership Committee.

Congratulations, John, for a success well deserved!

Neuroethology Across the Tasman

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The University of Auckland hosted the first "Neuroethology Across the Tasman" minisymposium. This event was sponsored by the School of Biological Sciences, the School of Medical Sciences, the Department of Psychology and the Auckland Neuroscience Network and organized by John Montgomery, Mark Hauber and Fabiana Kubke. The objectives of the meeting were to strengthen the interactions between the local (tans-Tasman) neurothology community. Key speakers included Christine Köppl from University of Sydney (auditory processing in birds); Alison Mercer from the University of Otago (honey bee neurobiology); John Montgomery (evolution of cerebellum and cerebellar like structures); Mike Walker (magnetic sense and navigation);

Neuroethologists across the Tasman display the breadth of Neuroethology research in Australia and New Zealand

From left to right, Top: Mike Walker, Fabiana Kubke, Christine Koeppl, Hugo Rios. Bottom: John Montgomery, Martin Wild, Alison Mercer, Russel Gray, Mark Hauber

Russell Gray (tool manufacture in New Caledonian crows); Mark Hauber (song perception and recognition) and Martin Wild (birdsong neurobiology). The event highlighted the breadth and quality of neuroethology research in both Australia and New Zealand and provided a foundation for future growth and development of the discipline in this region.

The lineage of arthropod neuroethologists in Japan

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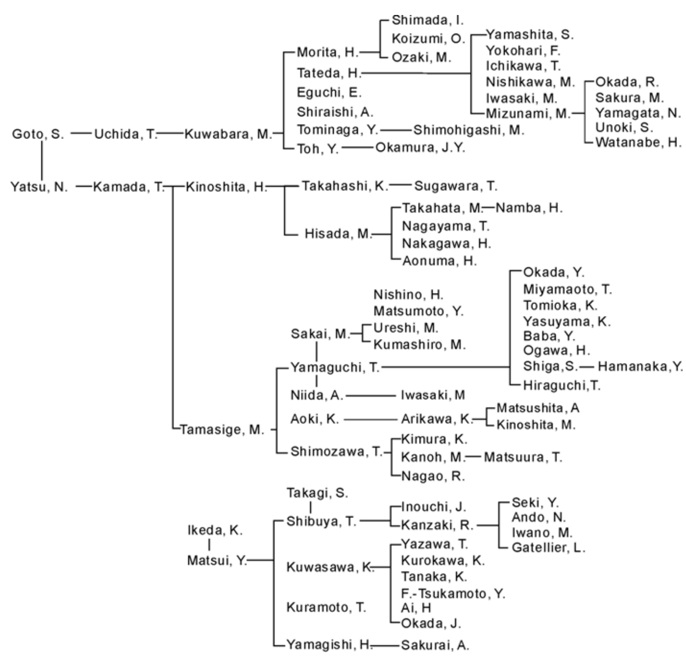
Quite a few Japanese scientists regularly attend the International Congress of Neuroethology. The Editor mentioned to me, however, that many members of the ISN from western labs hear so little news about their colleagues in Japan that it might be interesting for readers of the Society Newsletter to know the intellectual roots of the Society's Japanese members. So, I will briefly introduce how the different labs in Japan succeeded from senior professors and how as a result the tradition of neuroethology in Japan arose from relatively few sources.

In this essay I will focus on people who mainly study arthropod behavior and neurobiology, in areas that also engage my own laboratory, because it was difficult to cover all Japanese members of the ISN. I could summarize the relationships between these different workers in a figure showing the intellectual lineages of Japanese neuroethologists. In order to construct the figure, I collected current neuroethologists working with arthropods



Intellectual lineage of neuroethologists studying arthropods in Japan

from the directory of ISN in the web site and from that of the Japanese Association for Neuroethology, and traced the descent of these people from their mentors and colleagues back to the nineteenth century. I should first offer my excuses if not all arthropod neurobiologists in Japan appear in the figure, and also for expedience that I refer to scientists by name only, without title.

Japanese zoology was originally founded by two American zoologists, Edward Sylvester Morse and Charles Otis Whitman, who started the Department of Zoology of the University of Tokyo at the end of 19th century. Morse gave a wide range of lectures and knowledge on general zoology, and Whitman instructed students in how to do experiments and use lab techniques such as making serial sections. After returning from the USA and various European countries Kakichi Mitsukuri was then appointed professor, the first Japanese professor of zoology in the natural science department the University of Tokyo. He studied animal taxonomy, embryology and ecology. Isao Iijima, who had been a student of Whitman, had started parasitology, in addition to taxonomy and embryology. Iijima classified many terrestrial and aquatic animals as part of his study of the fauna in the Japanese islands, around the time when zoogeography was born in Japan. When Mitsukuri died in 1909, Seitaro Goto and Naohide Yatsu became respectively the professor and assistant professor in the science college of Tokyo Imperial University. Tracing back the common mentors or senior colleagues of most current Japanese ISN members, I always came to these two names, Goto and Yatsu. Except for studies on parasitology with Iijima, Goto had made studies on the taxonomy of Oligochaeta, morphological studies on Hydrozoa, and the developmental study of Asteridea. Goto's taxonomical study was subsequently succeeded by those of Tohru Uchida.

Since 1921, science colleges and zoology departments were built in other Imperial Universities, in Kyoto, Kyushu, Tohoku and so on. Zoologists who were educated in Tokyo moved to these universities to establish zoology in departments there. When the faculty of science was established in 1930 in Hokkaido University, Tohru Uchida, a great systematic zoologist, was appointed professor. Before this appointment, Uchida had a chance to meet sensory physiology through contact with Karl von Frisch during his studies in Europe. Masutaro Kuwabara studied sexuality in Hydrozoa in the Uchida lab. After he graduated from Hokkaido University, however, he encountered a book by von Frisch "Aus dem Leben der Bienen" at a book store. This discovery determined his career and future direction toward sensory physiology. Kuwabara studied honey bees in the Uchida lab and obtained a degree with his thesis entitled "Ueber die Funktion der Antenne der Honigbienen (*Apis mellifica*) in bezug auf der Raumorientierung". Kuwabara moved to Kyushu University as a professor to found the laboratory of animal physiology there. His studies on sensory physiology have since flourished under many successors. Groups founded by Hiromichi Morita and Akio Shiraishi led Japanese studies on insect chemosensory cells. Hideki Tateda's lab investigated photoreceptor neurons, hygroreceptors and so on. His lab was especially productive in studies on the insect ocellus. Eisuke Eguchi, Yoshiya Tominaga and Yoshihiro Toh all developed studies on the fine structure and electrophysiology of visual systems. People who studied in the labs of this generation of leaders are in turn currently active in their own fields, and in many cases have moved their study from the sensory periphery to the central nervous system.

Another line of research was developed under Yatsu who, as his first piece of work, studied the embryological development of the brachiopod *Lingula*, under Mitsukuri. Yatsu later founded experimental morphology and animal physiology in Japan. When he was running the zoology department in Tokyo, experimental morphology rose after a long period of taxonomical studies in Japan. In his essay on this subject, Uchida analyzed this change of the tide as follows, "although it could be due to the trend of zoology we saw in oversea journals, in general the younger generation thought that analytical studies were modern and in a higher rank in science compared with descriptive taxonomy" (Uchida 1954). Yatsu had great interest in animal physiology and put his efforts into developing this field. The physiological studies by Yatsu were in turn succeeded by those of Takeo Kamada. Kamada had studied physiology under A. V. Hill, who was then at Cambridge, and he did a series of important physiological works including those on the contractile vacuoles and ciliary movement of *Paramecium*, the responses of chromatophores in freshwater fish, and so on. Kamada's lab laid the groundwork for later studies on animal physiology. Haruo Kinoshita and Mituo Tamasige from Kamada's lab then produced later crustacean and insect neurobiologists. Mituhiko Hisada from the Kinoshita lab made electrophysiological studies on protozoa in Tokyo and then moved to Hokkaido University, where he started neurobiological investigations on crayfish. Hisada's interests and his lab were introduced in his autobiography in the ISN newsletter issue of March, 1998.

Tamasige was subsequently appointed to Hokkaido to set up a physiology lab. He studied a range of animals, including insects, jellyfish, starfish, crustaceans, and vertebrates. In Tamasige's lab Tsuneo Yamaguchi, later a professor in Okayama University, had started studies on crayfish with the question of "what the crayfish sees". When he visited C.A.G. Wiersma in California Institute of Technology, the two of them succeeded in recording from the optic nerve using needle electrodes *in vivo* and they used these methods to investigate visual integration in the crayfish. In Okayama University research on the crayfish visual system had been developed with Yoshinori Okada. Akiyoshi Niida from the Tamasige lab joined the Yamaguchi lab and did fine-structural and electrophysiological studies on stretch receptors. Masaki Sakai who had previously studied monkey prefrontal cortex in the Primate Research Institute in Kyoto University also came to the Yamaguchi lab and built his group studying cricket neuroethology. Members in the Yamaguchi lab currently study various fields of neurobiology in different universities.

Tateo Shimozawa made neurophysiological and biophysical studies on the auditory and vocalization system in echo-locating bats in Tamasige's lab and later also in Nobuo Suga lab's at Washington.

Another member of the Tamasige lab, Kiyoshi Aoki made electrophysiological studies on the sensory organ and the walking leg of the crayfish. Aoki moved to Sophia University, in the heart of Tokyo, where Kuwabara had also taken a position after retiring from Kyusyu University. Aoki studied the honey bee proboscis-extension reflex and fish polarized-light perception with Kuwabara. Later Aoki led the neuroethology lab in Sophia University where many current researchers have studied a range of animals. The current generation includes Kentaro Arikawa who works on the insect visual system

Kizo Matsui had already started the topic of cardiac physiology around the 1940's, in Tokyo Bunri Daigaku (Tokyo University of Arts and Sciences). Matsui was appointed associate professor in the animal physiology laboratory organized by Shun-ichi Takatsuki, who was famous for work on the digestive enzymes in molluscs, in Tokyo University of Education. In the beginning of the 1950's, when intracellular recording with microelectrodes was introduced into Japan, he promptly applied this method to cardiac ganglion neurons in the lobster as a means of studying oscillatory heart activity, and he assumed the lead in the cardiac physiology of arthropods. In Matsui's lab, studies on cardiac physiology had been carried out in various species. Invertebrate cardiac physiology was in turn continued by Naohiro Ai and Hiroshi Yamagishi who worked on the isopod *Ligia*, by Kiyoaki Kuwasawa who worked on opithobranchs (*Aplysia* and *Dolabella*), and by Taketeru Kuramoto on the lobster, and so on. Tatsuaki Shibuya earned a doctoral degree from work on the mantis shrimp heart, and then moved to Gunma University to study vertebrate olfaction with Sadayuki Takagi. Shibuya went on to make an excellent study on the olfactory epithelium and lower olfactory pathways in the Takagi lab. When Matsui became a professor in Tokyo University of Education, Shibuya returned to the Matsui lab as associate professor and continued his work on olfactory physiology.

During the controversy over university reform in Japan, Tsukuba University was founded in 1973 as a new prototype university, and it succeeded Tokyo University of Education. Thus Shibuya's lab became located in Tsukuba, and from there Jun Inouchi and Ryohei Kanzaki built their own neuroethology labs studying olfactory systems. When Matsui retired, Kuwasawa moved to Tokyo Metropolitan University to build his own lab there, studying invertebrate physiology especially the neural control of the cardiovascular system. Members who received their training from the Kuwasawa lab currently study arthropod neuroethology in different places in Japan. Yamagishi was appointed professor in Tsukuba University to study the isopod heart system.

In this article, as I briefly traced the history of our senior professors, I was deeply impressed by their intense desire to observe or investigate natural phenomena even when times in the outside world were very hard. Thus, in order to continue research during World War II, Takeo Kamada traveled around Japan to seek places to which his lab could be evacuated. Or, even when, in the 1960's, radical students fought the university to protest against a treaty with the United States, Tsuneo Yamaguchi showed a cine film to crayfish and recorded activities from its optic nerve, to satisfy his curiosity about crayfish visual world.

I thank Dr. Hiroshi Yamagishi at Tsukuba University, Dr. Kiyoaki Kuwasawa at Okayama University of Science and Dr. Tsuneo Yamaguchi at Kawasaki College of Allied Health Professions for giving me appropriate references and information to construct the scientific lineages documented in this essay. I also thank the Editor for giving me an opportunity to make an enjoyable journey back to our roots and for minor editing of this article.

Uchida T. (1954) Doubutsugaku zasshi 63: 294-297. (in Japanese)

The place of non-human primates in neuroethology

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Monkeys always steal a glance. Whether we perceive them as beautiful animals, furry children, or imperfect, somewhat embarrassing versions of ourselves, monkeys are too close for us to be indifferent. As we take in their scrutinizing eyes, their facial expressions and skillful hands, we seem to be looking in a mirror – some of us glance into it with awe and admiration, some with contempt, but we all stop for a look.

I asked my students the other day why it was important to study the neural bases of primate behavior when these studies are technically difficult, time-consuming, expensive, emotionally taxing, and often yield less elegant results than neurobehavioral studies in other animals? Without exception they all mentioned the hope that our work will lead to a better understanding of ourselves. To my delight, one of the voices argued that the similarity between the cognitive and socio-emotional faculties of humans and monkeys should work both ways (anthropomorphism notwithstanding) and that we are, therefore, the best suited species to understand monkeys.

Anybody who has spent a few minutes in a quiet room with a monkey has experienced the feeling of being examined and evaluated by a perceptive mind. I always have a sense that somewhere behind the ever-exploring eyes of a monkey, an opinion is formed; my posture, the confidence of my gestures, my emotions and intentions, are accurately estimated. It is an interview without words. Like many of my colleagues, I became captivated by these animals and arrived at the question that comes with the territory: what are the relevant structures and functions that account for the similarities and differences between us? We know that small changes in the genome led to huge changes in brain size and functional complexity, but aside from a few types of neurons that have been added to humans and chimpanzees but not to monkeys (Nimchinsky et al., 1999), and to monkeys but not to other mammals (Pitkänen and Kemppainen, 2002), the general wiring of the micro- and macrocircuits of the brain is remarkably preserved. Where and how then should we look for the critical differences?

Behavioral paradigms used so successfully by comparative cognitive psychologists have been enriched in the past decade by multi-channel, non-invasive electrophysiology, transcranial optical imaging, and neuroimaging techniques that can be applied to both humans and non-human primates. Structural neuroimaging coupled with sophisticated algorithms allows warping or morphing entire brains onto each other to compare the size and diversity of specialized areas. Diffusion tensor imaging visualizes the large-scale connectivity of the brain and can be used to compare broad circuits that support the same function. Although functional neuroimaging (e.g., functional MRI) does not measure neural activity directly, it highlights the areas activated by specific stimuli or cognitive tasks, thereby providing a transition from neuroanatomy to neurophysiology. The territory covered by these new techniques can be further expanded by pairing the same behavioral tasks performed by humans and monkeys with verbal report in humans and invasive neurophysiological recordings in monkeys.

A combination of new and traditional techniques recently revealed the precursors of several cognitive functions previously considered uniquely human. A fundamental function of the human social brain is to join the experience of the self with the experience of others. This function is instantiated by the “mirror neuron system” discovered in the frontal areas of the monkey brain (Rizzolatti and Craighero, 2004). Mirror neurons are active when the monkey performs a gesture or an action but also when the monkey witnesses the same gesture or action being performed by others. Such complex mappings are thought to be required not only for empathy but also for language. With respect to language, the circuit that processes social vocalization in monkeys is identical with the circuit of speech perception in humans, indicating that the neural substrate for the evolution of human speech and language is already present in our ancestors with monkeys (Ghazanfar and Miller, 2006). Also, the representation of numerosity in the prefrontal cortex of the monkey (Nieder and Miller, 2003) and in a (yet) unknown area of the chimpanzee brain (Matsuzawa, 1985) is considered today the core of a primitive arithmetic. Although tool making, cooperation, and altruism are not unique to primates, it appears that elements required for these functions, such as learning by observation, encoding rewards and errors, and inhibitory control, engage homologous structures and similar neurotransmitter systems in both human and non-human primates.

The readers of this article will legitimately reply that the brains of many animals contain modules that carry out spectacular computations that clearly qualify as high-level cognitive functions. Dozens of species solve complex problems faster and better than primates and the neural mechanisms involved are more accessible for study and yield clearer results. Yet I believe that monkeys offer a unique contribution to neuroethology. The majority of primates are face experts and they use this skill to navigate *flexibly* the intricacies of their social environment. There is no doubt that the social organization, specific for each species, shaped this expertise. Due probably to similar social pressures, humans and certain species of non-human primates achieved comparable sophistication in detecting and interpreting the slightest changes in the configuration of facial features induced by emotion. Rhesus monkeys (*Macaca mulatta*) are the ideal species for looking at the neural substrate of emotional communication with facial expressions. Few other species, that are also suitable for neurophysiological studies, live in more complex social environment or display a richer array of facial emotions.

The monkey brain contains face cells, neurons that respond selectively to faces, discovered and characterized in visual areas of the temporal lobe by Gross and his colleagues (1972) more than three decades ago. However, we still do not know where and how the social and emotional evaluation of face stimuli takes place. The team in my laboratory works on experiments that address the role of the monkey amygdala in recognizing and interpreting facial expressions. The amygdala, a cluster of deep nuclei in the temporal lobe, is involved in emotion in many species but in primates it also plays an important role in processing facial expressions.

Facial expressions in monkeys communicate emotion but serve also as social currency for transactions within the dominance hierarchy of the group. Successful integration into the despotic, hierarchical social group of the rhesus monkeys requires behavioral flexibility, memory for prior interactions, inhibitory control of impulses, and a good understanding of the social rules and of the advantages offered by the context in which each encounter occurs. These complex mental processes and their neural underpinnings are hard to characterize even with the most advanced techniques, but simpler component processes, such as the recognition of individual faces

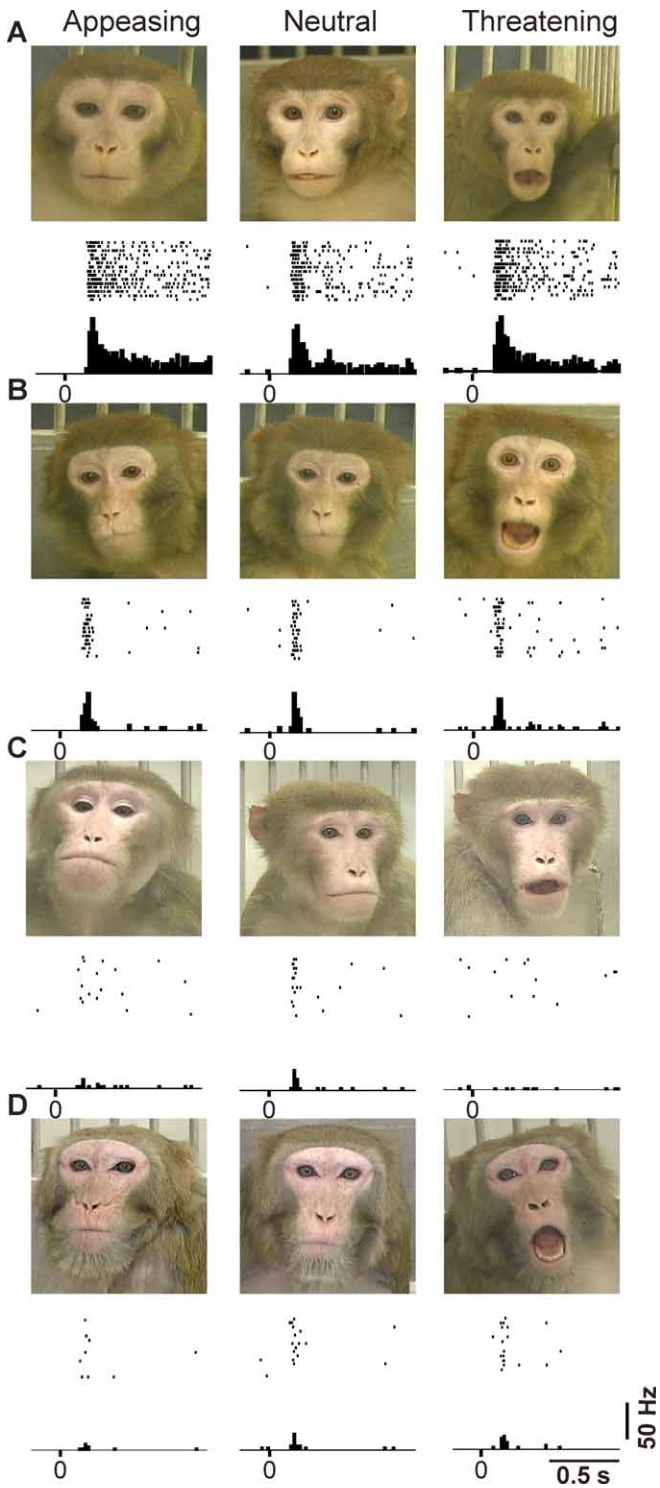

Figure 1. Example of an identity-selective neuron recorded from the monkey amygdala. Each row of images (A, B, C, and D) contains three facial expressions displayed by the same monkey. Below each image are the peri-stimulus time histograms (in 20 ms bins) and single-trial spike rasters of a neuron that responded with a tenfold increase in firing rate to the faces of the two monkeys in the top two rows. 0 indicates the time of stimulus display. Note the strong phasic and tonic neural response to all facial expressions of the monkey in the top row. A short phasic increase in firing rate encodes the faces of the monkey in the second row. Although time-locked to the stimulus, the neural responses to the faces of the monkeys in the bottom two rows are negligible. (From Gothard et al., 2007.)

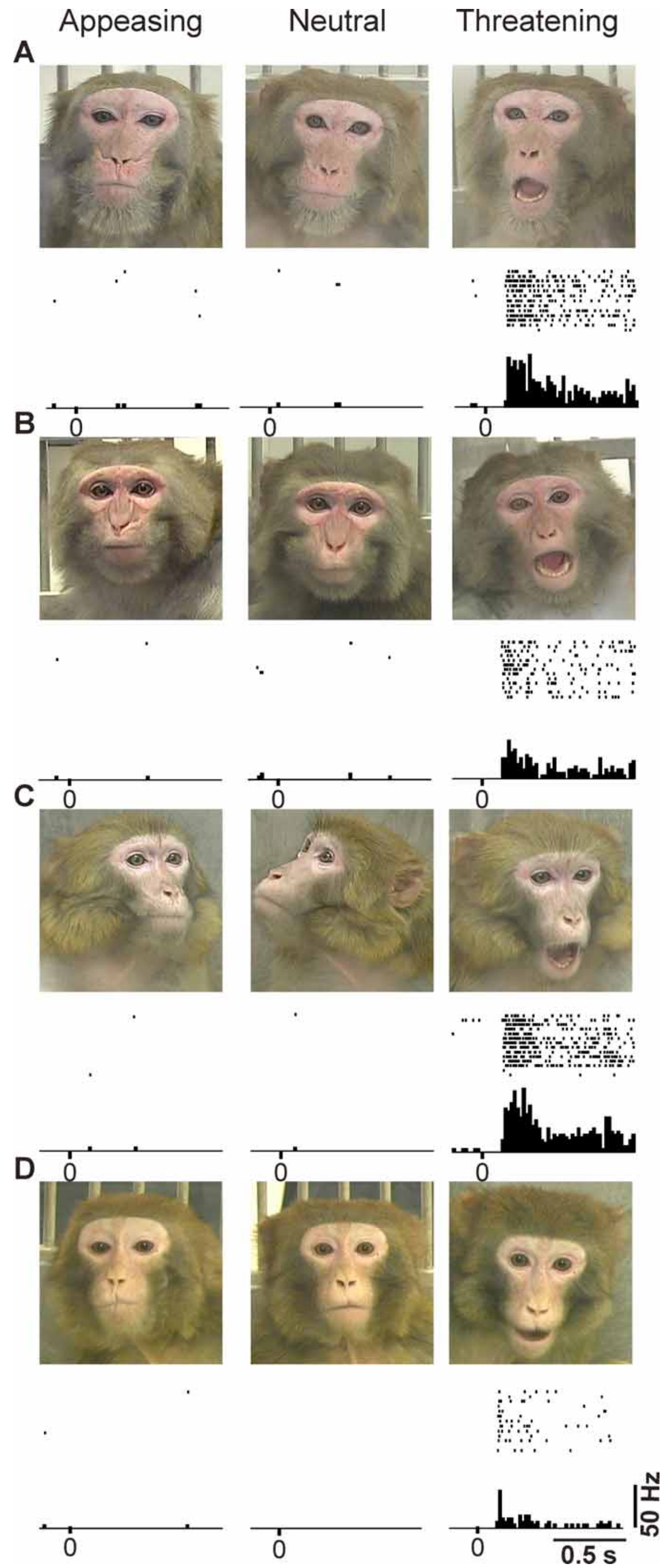

Figure 2. Example of an expression-selective neuron recorded from the monkey amygdala. Each row of images (A, B, C, and D) contains three facial expressions displayed by the same monkey. Below each image are the peri-stimulus time histograms (in 20 ms bins) and single-trial spike rasters of a neuron that fired almost exclusively when threatening faces were presented. 0 indicates the time of stimulus display. Although the firing rate was significantly higher for threats, large variations of response magnitude were observed depending on monkey identity. (From Gothard et al., 2007.)

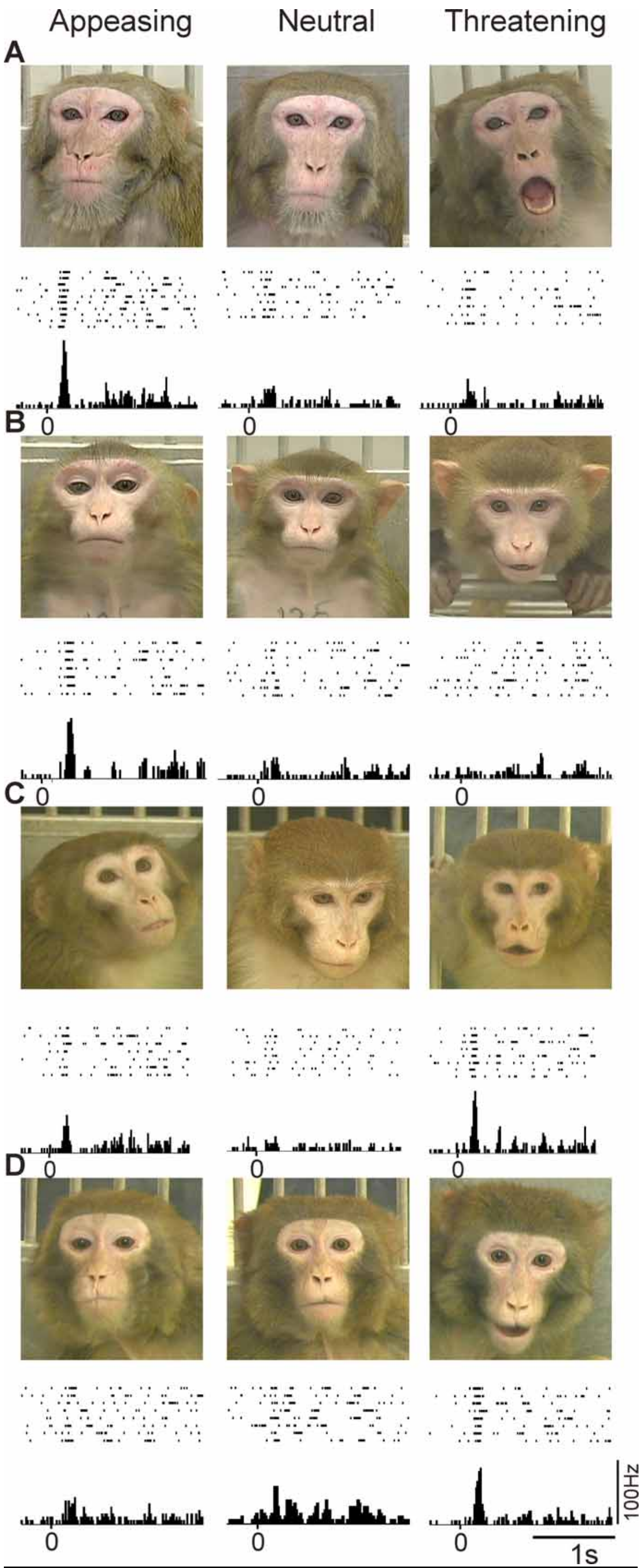

Figure 3. Example of an amygdala neuron selective for specific combinations of identity and facial expression. The organization of the stimuli and of the data are the same as for Figs. 1 and 2. The neuron in this figure showed elevated firing rates in response to mutually exclusive combinations of identity and expression (df=18, F=5.203, *p* <0.001), namely the appeasing expressions of the top two monkeys and the threatening expression of the bottom two monkeys. (From Gothard et al., 2007.)

and facial expressions, are within our reach. We set out to determine whether face identity and facial expression are encoded independently or jointly in the firing properties of the face-responsive neurons in the amygdala. This study required independent assessment of the contribution of face identity and facial expression. We used the faces of dozens of monkeys each displaying multiple facial expressions ranging from the most appeasing lipsmack, through neutral, to the most aggressive open-mouth threat. We found that neurons in the amygdala respond selectively to face identity (Fig. 1), but also to specific facial expressions (Fig. 2), and to select combinations of face identity and facial expression (Fig. 3). The presence of identity- and expression-selective neurons indicate that the outputs of the temporal visual areas fraction of neurons encoded identity regardless of expression, or expression regardless of identity. The that extract these dimensions of face stimuli are recapitulated in the amygdala. Interestingly, only a small majority of neurons in the amygdala responded conjunctively to more than one dimension of face stimuli (identity AND expression). The ethological relevance of these findings rests with the fluid dominance hierarchy of macaque troupes, within which facial expressions gain or lose emotional significance as the displaying monkey ascends or descends in social rank. In many social situations, the identity of the displaying individual might carry as much emotional significance as the expression itself, e.g., the threatening face of a high-ranking adult is more dangerous than the threatening face of a juvenile (Gothard et al, 2007). We have strong indication from other studies that several other dimensions of face stimuli, such as direction of gaze also contribute to amygdala activation (Hoffman et al. 2007).

Most neuroscientists think of the amygdala as the "automatic fear machine" of the mammalian brain, due, in part, to the great success of deciphering the role of the amygdala in fear learning in rodents (Le Doux, 2003). Indeed, the amygdala of lower mammals, especially of prey animals, does its best as a protective device and sets the organism on a flight or fight course. This function is highly conserved across species; rats, monkeys, and humans learn via the same pathways of the amygdala to fear an aversive stimulus (Phelps and LeDoux, 2005). With the great expansion and arealization of the primate brain, however, the amygdala became connected to higher level sensory and cognitive areas and acquired a key role in social cognition. This newly acquired role of the primate amygdala is just one example that sets primates aside from other mammals and provides an exciting and promising new world for neuroethological exploration.

Literature

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Gastropod Neuroscience Highlights Strength of Neuroethological Approach:

Friday Harbor Laboratories Centennial Symposium June 5-9, 2007

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http://depts.washington.edu/fhl/centsymp/2007gastropods.html

Organizer Paul Katz opened the meeting with some somber remarks on the decline of gastropod neuroscience productivity. The meeting was called to gauge interest in a community effort to arrest and maybe reverse this trend. To this end, the meeting covered a large spectrum of topics and a host of different gastropod model systems. As with most invertebrate neurosciences (and perhaps with neuroethology in general), gastropod research faces funding and public image problems that hamper its development. How to overcome these problems was a recurrent theme not only in the discussion sessions, but also in private discussions at the lunch and dinner tables. In the course of the meeting, the somber, maybe even somewhat depressed or fatalistic mood of the opening evening gave way to a more enthusiastic and an uplifting, can-do spirit when we all departed. We resolved to form an online gastropod/mollusk community bringing together all researchers, not only to support each other scientifically and psychologically, but also to demonstrate community interest and organization to funding agencies and the general public. The reason for the mood swing was the strong scientific record the community has to show for itself. The neuroethological aspects of gastropod neuroscience appear especially strong as candidates for successful future research.

Gastropodologists too numerous to mention, Friday Harbor Labs

Neural control of behavior

Friday Harbor Labs resident scientist Dennis Willows kicked the meeting off with a talk about the nudibranch *Tritonia*. These animals orient themselves with respect to the earth's magnetic field towards the shoreline. While there have been central neurons identified which react to changes in the magnetic field, they appear to be postsynaptic to yet unknown magneto-sensory neurons. The central neurons control the beating frequency of cilia in the foot that might be involved in turning behavior.

Richard Satterlie presented a talk on the neurobiological control of swimming speed in *Clione*. These animals have wings and use them to propel themselves (reminiscent of squid) with an undulating movement. The wings can be made more or less stiff to change swimming speed. The swim interneurons controlling swimming speed are well characterized, as are the muscles and motor neurons. Transitions between the different swimming states (fast, intermediate and slow swimming) of the nervous system are modulated by serotonin. Richard's lab is also reconstructing 3-D movement data on the computer using video cameras and software to relate the exact swimming motions to the neural commands generating them. Thus, from behavior to muscles and neurons, the entire spectrum of the behavior can be studied very elegantly in this model.

Klaude Weiss' lab work is on circuit-busting of the feeding behavior of *Aplysia*. In this system, a tongue-like organ, the radula, moves in and out of the buccal cavity. Depending on when the radula is closed, it moves either food into the esophagus (ingestion) or inedible objects out of it (rejection). The interneurons responsible for generating the neural patterns (buccal motor programs, BMPs) interact to generate a continuum of programs to handle any feeding situation the animal might encounter. The properties of the buccal network are history-dependent, such that repeated stimulations trigger different responses depending on the previous stimulation history. We learned that the network has basically two different states (ingestion and rejection) and repeated stimulations (via cerebral-buccal interneuron 2) lead to transitions between these two states. Thus, depending on what state the network is in, the same stimulus will lead to different behavioral responses. Transition between these states appears to be modulated by neuropeptides (e.g. small cardioactive peptide).

Rhanor Gillette showed us how different motivational states lead to animals doing completely opposite things to the same stimuli. The model system here was *Pleurobranchea*. The networks for the different behaviors (swimming, feeding, etc.) are very well worked out and one can show how the different networks interact when, for example, escape swimming inhibits feeding, or when satiation suppresses feeding, or when escape swimming suppresses turning, etc.

Björn Brembs spoke on the use of *Aplysia* to address some rather general questions about the biological basis of spontaneous behavior. He contended that some behavior is not elicited as a simple response to environmental stimuli, and he asked how neural circuits can generate spontaneous behavior. In other words, is an *Aplysia* an "agent" that "decides" to perform a behavior in the absence of determining sensory cues? He outlined some research methods that might help identify how such questions could be addressed in gastropod systems.

Thomas Abrams uses behavioral habituation and homosynaptic depression in *Aplysia* as a model for attention research. There are several molecular mechanisms involved in synaptic depression, e.g. depletion of the readily releasable vesicle pool (presynaptic) and receptor de-sensitization (postsynaptic). Homosynaptic depression is initiated by calcium but is independent of transmitter release. It involves suppression of vesicle fusion for periods up to 90 minutes. This homosynaptic depression is attenuated if the events triggering the synaptic transmission are not single spikes but bursts of spikes (burst protection). Probably the function of burst protection is to prevent habituation to important stimuli. Now, is this non-associative learning or some primitive form of attention? The current studies unravel the molecular pathways involved in burst protection.

These six talks all exemplified the circuits-approach, which is exactly why gastropods are one of the best model systems to study the neural control of behavior. The relative ease with which the neuronal circuits can be deciphered electrophysiologically in this class of animals is unsurpassed by any other taxon. The behaviors in question are readily observed and can be easily quantified, providing researchers with a one-to-one relationship between behavior and the neural structures controlling it. This relationship is less unambiguous in animals with either a more amorphous nervous system. or a behavioral stream which makes single units of behavior much more difficult to define.

Evolution of behavior

Ronald Chase talked about two major problems of evolutionary biology for which gastropods are excellent models. One is sperm competition, which happens if multiple matings occur, and the other is the evolution of simultaneous hermaphroditism. The second is related to the evolution of cooperation, because anisogamy usually favors withholding eggs and only providing sperm (i.e. cheating) instead of providing both (i.e. cooperating). Most gastropods mate multiple times and are simultaneous hermaphrodites, and therefore are great model systems for both problems. In the land snail *Helix*, each animal fertilizes the other, and several matings with different partners can occur sequentially. In this system, the two problems boil down to a single question: How can each animal make sure its sperm is actually used by the other animal? Successful strategies both prevent cheating (blocking sperm from fertilizing) and provide advantages in sperm competition. Land snails have developed a system of calcified darts, which transmits an unknown substance in the coating mucus (pheromones?). The substance promotes sperm competition such that the animal hit by a dart during mating preferentially sires its offspring with sperm from the animal that fires the dart.

Organizer Paul Katz talked about the slugs *Tritonia* and *Melibe*. This pair of snail species is remarkable in being able to swim. *Tritonia* swims by flexing dorso-ventrally and *Melibe* flexes laterally. These behaviors are controlled by homologous swim neurons in the snail CNS. Do these homologous swim interneurons perform the same functions in animals that swim by flexing the body so differently? It turns out that the CPG organization is fundamentally different, in that electrical coupling and synaptic inhibition are exactly turned by 90° between both species, meaning that dorsoventral swimmers synchronize their lateral sides, whereas lateral swimmers synchronize their dorsoventral sides, by means of electrical coupling. Serotonergic modulation of the CPGs is also different in both species. From the phylogeny of the snails, it appears that the different swimming modes have arisen several times independently in evolution.

As the outside phylogeny expert, Annette Klussmann-Kolb presented the modern systematics of gastropods. After demonstrating how unreliable morphology is for phylogeny, compared with molecular genetic data, she told us that all the model systems studied by the people in this meeting belong exclusively to the Euthyneura taxon. This group of Euthyneura is yet not very well characterized phylogenetically. To the great surprise of those at the meeting, she disclosed that Opisthobranchs are not a monophyletic group. After the dust had settled, Annette went on to show us how such phylogenetic data can be used to reconstruct ancestral character states, using the example characters of terrestrial vs. aquatic life, rhinophores, cephalic shields and Hancock's organ.

This section provided fantastic examples of how the gastropod clade can serve as a great model system to study how different species have evolved separate solutions to the same paramount evolutionary problems. The evolution of strategies has been a hot topic in biology ever since Darwin announced the evolution of cooperation to be the most critical issue for his theory of natural selection. Still today, it remains largely unclear how nervous systems could evolve to subserve the various behavioral life-history strategies. The diverse species studied in Gastropod Neuroscience may be the best model systems to pursue this immensely far-reaching research.

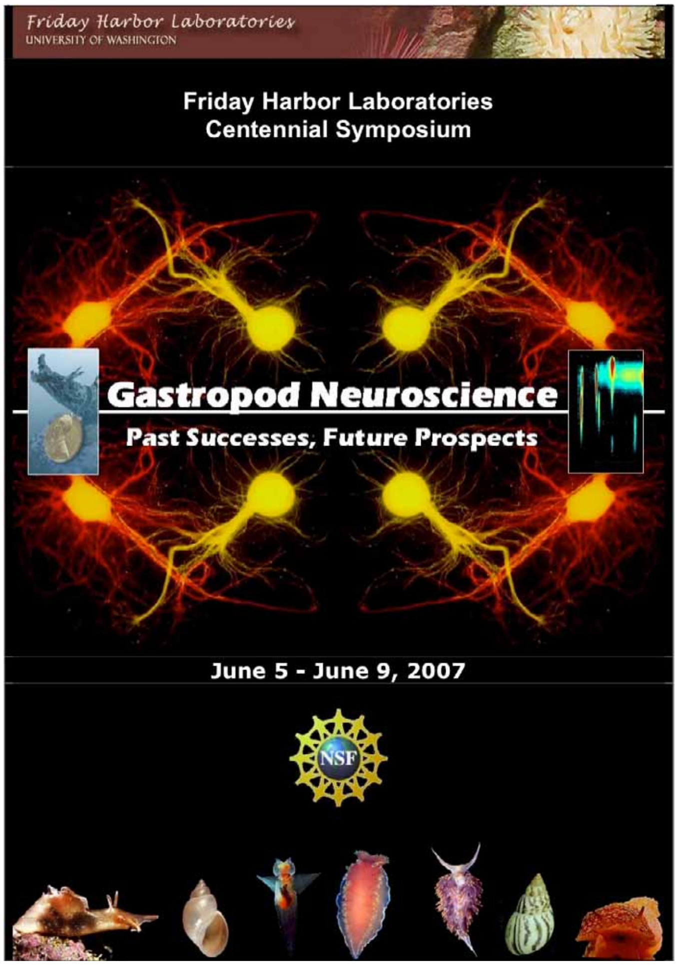
Learning and Memory

The relatively simple identification of one-to-one relationships between behavior and neural activity is also the main advantage of studying learning and memory in gastropods. Other model systems often have difficulties relating the genetic or molecular results to cellular modifications and if they can establish such relationships, the mechanistic consequences for the network and the behavior it controls remain elusive. In contrast especially to vertebrate learning and memory preparations, gastropods provide a one-stop shopping place to progress in one single sweep from molecules to behavior without leaving intervening gaps.

Avrama Blackwell talked about classical conditioning in *Hermissenda*. In this very interesting preparation, the snail is stimulated with light just prior to turbulence or shaking, which induces a shortening of the foot of the animal. If light and turbulence are paired sufficiently often, the animal will shorten the foot to the light alone. The photoreceptors are the first convergence point of light and turbulence, and her talk was all about the subcellular processes mediating learning. The strength of this system clearly lies in the great combination and interaction of biological experiments and computational models. In this preparation the different currents in the photoreceptor neurons which are modified by learning are very well known, as are the molecular cascades leading to the modification of these currents. The modified currents lead to the photoreceptors being more sensitive to light, which eventually leads to the shortening of the foot.

The presentation by Paul Benjamin was all about long-term memory of classical conditioning in the pond snail *Lymnaea stagnalis*. This lab conditions the snail's feeding behavior. Sucrose serves as the unconditioned stimulus (US) and either a tactile stimulus or amyl acetate serve as conditioned stimulus (CS). Depending on the number and spacing of CS-US pairings (trials) the formed memory can last up to 20 days. But even single-trial conditioning can lead to long-term memory. Apparently, much of the learning takes place in a set of modulatory interneurons in the cerebral ganglion which are located between the sensory input and the feeding central pattern generator. One of the changes after training is a depolarization of the CGC (cerebral giant cell) neuron. This modification is important since artificial manipulation of the membrane potential can mimic training. The increase in CGC potential leads to increased synaptic output apparently mediated by calcium. It seems as if this change in the CBC may potentiate the CS pathway.

While there are several good model systems for classical conditioning in other taxa, operant conditioning, the other form of associative conditioning, is less well characterized and only few model systems exist. Especially in this more complex form of learning, gastropod neuroscience has a decided advantage over most other models. Operant conditioning of *Aplysia* feeding behavior is the model of choice in the lab of John Byrne in Houston, Texas. A central neuron in the buccal feeding CPG is the "decision-making neuron" B51. It fires a plateau potential late in the feeding cycle and only during ingestive behaviors. Depolarizing B51 increases ingestive programs and hyperpolarizing it reduces ingestion. Operant conditioning is performed by stimulating the esophageal nerve with electrical activity, mimicking food delivery. Every time the animal bites, the nerve is stimulated (contingent reinforcement). This leads to long-term memory after only a few minutes of training. Analyzing the biophysical properties of B51 after training reveals an increased input resistance and decreased burst threshold in contingently reinforced animals, compared to yoked control animals. These results conform to results from B51 after *in vitro* conditioning of isolated buccal ganglia. Even experimentally induced changes in B51 alone lead to an increase in ingestive motor patterns. The B51 changes can also be observed if the neuron is taken in isolated cell culture and trained by depolarization and contingent dopamine application, indicating that the transmitter mediating reward is dopamine. What happens inside B51 at the molecular scale to produce these significant changes? It turns out that cAMP is involved as well as PKC. It appears that the main intracellular convergence site of operant behavior and reward is therefore an adenylyl cyclase.



One of the main functions of this meeting was to create a stronger sense of community. The organizers created a Molluscan Neuroscience Gateway website and a gastropod neuroscience list server to facilitate more interactions across laboratories. The organizers also created a web database of neuron types (NeuronBank) that includes several gastropod identified neurons, and they invited submissions of more neural types to facilitate more comparative work in neuromics. The participants agreed that the meeting was helpful in providing a broader perspective on their research, and they planned to meet again in 2-3 years.

Positions Available

Assistant Professor, Department of Psychology, Muhlenberg College, Allentown, PA, USA

The Department of Psychology at Muhlenberg College Invites applications for a tenure-track Assistant Professor position beginning in the Fall of 2008. Teaching responsibilities include courses to support both the psychology and neuroscience programs. The successful candidate will be expected to teach a mid-level behavioral neuroscience class with lab, other courses in his or her areas of interest or expertise, and Introductory Psychology. We are particularly interested in candidates with strengths in learning and memory, cognition, or language. Teaching load is three courses a semester. We are seeking candidates who are strongly committed to teaching and research in a small liberal arts college environment. Qualifications include: a Ph.D., a record of excellent teaching, and research interests which involve (or can involve) students. Muhlenberg is a highly selective liberal arts college located in the Lehigh Valley, 60 miles from Philadelphia and 90 minutes from New York City. Review of applications will begin October 1 and continue until the position is filled. Applicants should submit a letter of application, curriculum vitae, statement of teaching and research interests, evidence of teaching excellence, sample publications, and three letters of reference to: Dr. Laura Edelman, Department Chair, Department of Psychology, Muhlenberg College, 2400 Chew St., Allentown, PA 18104-5586, USA, or e-mail at ledelman@muhlenberg.edu.

Information about the department can be found at: http://www.muhlenberg.edu/depts/psychology.

Women and minorities are encouraged to apply. An Equal Opportunity Employer.

Postdoctoral position in Developmental/Sensory Neuroscience, Georgia State University, Atlanta, GA, USA

A funded position is available for a talented and motivated Ph.D. with interests in developmental or sensory neuroscience. The goal of our research is to understand the role of sensory experience in the development of central nervous system circuitry. One project concerns the role of activity-dependent processes in the construction of receptive field properties and topography in the rodent retinotectal projection. Another project concerns the role of afferent modality on the development of sensory cortical circuitry (cross-modal plasticity). Experience with mammalian surgery, visual or auditory stimulation, and/or *in vivo* or *in vitro* electrophysiology techniques is desirable. We also use anatomical and molecular approaches to these questions in the laboratory.

The successful candidate would join a highly interactive and dynamic group of more than 60 "Brains and Behavior" faculty at Georgia State University in Atlanta, Georgia. Atlanta, site of the 1996 Olympics, is a vibrant, expanding city with numerous cultural and recreational opportunities (mountains and seashore within easy driving distance). Lottery- and business-funded support of higher education in Georgia allows us to maintain state-of-the-art equipment and facilities. The Georgia State / Georgia Tech / Emory University research community offers unparalleled opportunities for collaborative neuroscience research. In addition, we have several inter-departmental and inter-institutional research centers that focus on neuroscience, including the NSF Science and

Technology Center of Behavioral Neuroscience, the Brains and Behaviors Initiative, the Molecular Biology of Disease Center, the Center for Neuromics, and the Language Research Center.

See http://www.biology.gsu.edu/brains&behavior/ and http://biology.gsu.edu/neurosci/ for details of these programs.

Interested candidates should send a c.v. and names of three references to Professor Sarah L. Pallas, Graduate Program in Neurobiology and Behavior, Dept. of Biology, Georgia State University, Atlanta, GA 30303, USA; fax: 404-651-2509, email: spallas@gsu.edu; lab webpage: http://www2.gsu.edu/~bioslp/

Postdoctoral position in insect neurobiology, Case Western Reserve University, Cleveland, OH, USA

Applications are invited for an immediate postdoctoral position to study neural control of legged turning behaviors in insects. We are examining how cockroaches react to barriers and generate turning behaviors. The specific project for this position will examine how signals descending from brain regions alter control of local circuits within thoracic ganglia, ultimately leading to changes in leg movement from forward locomotion to turning (for background see Mu et al. 2005, J. Comp Physiol. A 191:1037-1054). In addition to neurobiological experiments, the postdoc will work closely with engineers who are developing a robotic leg that is controlled by a reflex based controller and is intended as a hardware model for testing neurobiological hypotheses. She or he will also interact with personnel working on related projects involving recording from and lesioning brain regions that are thought to influence turning behaviors. Experience in electrophysiology is preferred. The project is currently funded for three years by AFOSR.

Interested applicants should send curriculum vitae, statement of research interests, and names and addresses of 3 references to: Roy E. Ritzmann, Department of Biology, Case Western Reserve University 10900 Euclid Ave., Cleveland, OH 44106, USA or by e-mail to roy.ritzmann@case.edu. Further information can be obtained by e-mail or by phone at 216-368-3554. More information on our laboratory can be obtained at:

http://www.case.edu/artsci/biol/people/ritzmann.html .

Postdoctoral position in sexual reproduction and development, Indiana University, Bloomington, IN, USA

An NIH T32 training grant to Indiana University has an open line for a postdoctoral fellow and invites applications. The training grant is supported by NIH-CHHD and is entitled, 'Common Themes in Reproductive Diversity.' It offers broadly integrative training in the areas of sexual reproduction and development with a focus on behavior, largely but not exclusively of animals. Research conducted by the participants addresses key questions in the development and expression of sex differences, as well as maternal and paternal effects on morphological, sexual, and social development. Indiana University's excellent support for research and its globally recognized strengths in animal behavior, endocrinology, human sexual health, and evolution of development ensure high quality training. Fellowships include a competitive salary based on current NIH pay scale commensurate with experience, and funds to support research and travel. The successful applicant will help foster collaborations among faculty and serve as a professional model for pre-doctoral trainees. Ph.D in biology, psychology, neuroscience, chemistry, gender studies or related field required. Candidates are invited to make initial contacts with training faculty. To apply, please visit the following website to find instructions and forms to download: http://www.indiana.edu/~reprodiv/apply/

Please e-mail your completed application to Dee Verostko at:

dverostk@indiana.edu>dverostk@indiana.edu

or send to 1001 East Third Street, Bloomington, IN 47405, USA. The email subject line should read: Postdoc-Ketterson. For full consideration, applications should arrive by 15 August 2007 but later applications will be considered. Please note that the traineeship must begin in April 2008. Trainees must be citizens, non-citizen nationals, or permanent residents of the US. The search will continue until the position is filled. Indiana University is an Equal Opportunity / Affirmative Action Employer.

Material for Future ISN Newsletters

The Editor would welcome, indeed wholly depends upon, material for future newsletters to fill the various sections of each issue. Reference to past issues will reveal the scope and style of contributions, the breadth of their variation and the depth of their originality. Material is solicited for meetings, courses, and job opportunities which might include some aspect of neuroethology and therefore be of interest to readers of the Newsletter. Advertisements for positions (faculty or trainees) should generally aim to be not longer than 200 words, or 300 words for multiple jobs advertised in a single submission. Announcements of new books (copyright 2005) *written or edited by ISN members* should include the full citation information (including ISBN) *plus* a 40-50 word description of the book. (Note that books containing chapters contributed by an ISN member are not appropriate for inclusion.) We also welcome announcements of awards to ISN members, and of courses and future meetings, reports on recent meetings, discussions of research areas or topics of interest to neuroethologists, laboratory profiles, and editorials. We also regretfully publish occasional obituaries and memorials. Word limits depend on the type of article.

Material should be submitted no earlier than one month before the next issue (in this case, November, 2007). Have an idea for an article that you or someone else would write? Contact the Secretary prior to submission to determine the length and suitability of material to be submitted. For those who may feel their particular interest (research field, geographical region, chromosomal complement, age group, whether to dress to the left or right, etc) has been under-represented in past Newsletters, please see this as both an invitation and challenge to offset the perceived lack of representation. Remember: the Newsletter represents us all, but an empty Newsletter represents nobody, or worse still, may actually represent nothing. All material must be submitted electronically, preferably as an attached file to an e-mail prepared in MS Word and sent to Ian Meinertzhagen at iam@dal.ca

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