Regeneration Research Newsletter

New Director of ISNR - Dr. Albert C. Lo

At the December 2011 ISNR meeting, Dr. Roger Madison formally informed the ISNR Planning Board that he planned to step down as the Director of the ISNR meeting. After twelve years serving as the ISNR Director (see brief ISNR history below), Dr. Madison is looking forward to being able to concentrate full-time on his laboratory research. Shortly after the 2011 meeting, the Veterans Affairs Central Office and the VA Office of Research and Development (ORD), with input from Dr. Madison and the ISNR Planning Board, began a search for the next ISNR director. The ORD also recommitted ongoing support for the ISNR office and the ISNR symposium series. This search process resulted in the unanimous decision to offer the position to Dr. Albert Lo from the Providence Rhode Island VA Medical Center and Brown University. Over the next year Dr. Madison will be working closely with Dr. Lo to make this transition as seamless as possible. The ISNR is fortunate to have recruited someone of the outstanding caliber of Dr. Lo.

Dr. Albert C. Lo (M.D., Ph.D.) is a board certified Neurologist and an Associate Professor of Neurology and Epidemiology at Brown University. He is the Director of the MS Clinic

and Associate Director of the Veterans Affairs Research and Development Center of Excellence for Neurorestoration and Neurotechnology at the Providence VA Medical Center. Dr. Lo is also the Director of Neuroscience Research at the Mandell MS Center in Hartford CT. His research interests reflect topics relevant to understanding disability due to neurological injury as well as recovery and restitution of neurological function and include work involving clinical translational research for neural repair and rehabilitation as well as epidemiology. Dr. Lo has published on diverse research topics including the influence of neurotrophic factors on programmed cell death, the use of sodium channel blocking agents for neuroprotection in experimental allergic encephalomyelitis and multiple sclerosis, and the clinical effects of robot-assisted rehabilitation for stroke and multiple sclerosis. The VA ROBOTICS Study has been one of the largest robot rehabilitation clinical trials conducted, and the results were published in the May 13, 2010 issue of the New England Journal of Medicine; the study is also notable for being one of the first rehabilitation studies published by the journal. Dr. Lo serves on numerous national and international clinical research committees, and is currently funded by investigator initiated grants from the Department of Veterans Affairs and the National Multiple Sclerosis Society. He serves on the Board of Directors for the American Society for Neurorehabilitation, and he is Vice-President of the Rhode Island Neurological Society. In 2004, Dr. Lo received the Presidential Early Career Award for Scientists and Engineers from the White House Office of Science and Technology Policy. Dr. Lo received his B.A. from U.C. Berkeley, a C.P.H. degree from Harvard University and his M.D. and Ph.D. degrees from Wake Forest University. He completed his neurology residency at Yale University and also served on the faculty of the Yale School Medical School from 2003-2007. He joined Brown University in 2007.

A Brief History of the ISNR

The ISNR is a biennial symposium series where the primary purpose is to present current work in neural regeneration and regenerative medicine, especially in those areas of research in which there has been some notable recent progress or in which some particularly interesting issues have been raised. The symposium series began in 1985 under the directorship of Dr.

For more information about the International Symposium on Neural Regeneration, please contact:

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or visit our website: http://www.rehab.research.va.gov/ISNR/index.html

ISNR STAFF:

Director: Roger Madison, Ph.D.
Director-elect: Albert C. Lo, M.D., Ph.D. (Albert_Lo@brown.edu)
Coordinator: Frances Stuart
Photos: Chris McGee

Fredrick Seil through the Office of Regeneration Research Programs within the Veterans Affairs Medical Center (VAMC) in Portland, Oregon. The symposium organizers arranged for the first meeting in 1985 to be held at the Asilomar Conference Center in Pacific Grove, California, a California State Park, and subsequent meetings have also been held at Asilomar. Dr. Roger Madison, from the Durham, NC Veterans Affairs Medical Center and Duke University assumed the directorship of the symposium in 2000. The ISNR meetings have now passed a twenty-five year milestone and continue to grow and become more popular with every event.

Financial support for the meetings initially came from the Department of Veterans Affairs (VA) and the Paralyzed Veterans of America (PVA). Very quickly the National Institutes of Health (NIH) recognized the importance of the ISNR meetings and began to offer their support beginning in 1987 (and continuing for every meeting since then). Several other foundations began offering support for the meetings such that by 1993 the meeting was being supported by the VA, the NIH, the PVA, the American Paralysis Association (presently the Christopher and Dana Reeve Foundation), and the Eastern Paralyzed Veterans of America/United Spinal Association.

The meeting is organized with a single session format to allow participants the opportunity to participate in each session. The symposium boasts a committed following of participants and continues to attract new students and researchers year after year. Many of the participants who attended their first ISNR meetings as students have returned to more recent meetings as speakers and organizers, indicating the long-term impact that the ISNR meetings have had on these highly recognized international experts in the field of regenerative medicine.

A primary purpose of the ISNR meetings is to foster an atmosphere that is both stimulating and conducive to a free interchange of ideas among investigators, or between seasoned investigators and students. The target audience of the symposium is a mixture of faculty, physicians, students, and laboratory staff brought together in a forum to discuss strategies for discovering methods of recovery from injury or dysfunction of the nervous system. For students, this meeting provides an opportunity to interact directly with leading scientists in the field. Students and trainees comprise approximately 30% of the participants at this meeting and they make a significant contribution to the interaction among the overall participant population. With the help of our sponsors the ISNR symposia have become established, regularly occurring events with high attendance by both students/trainees as well as internationally recognized experts in the field of regenerative medicine.

In addition to the biennial event of the symposium, an overview from each meeting and various articles of interest are presented yearly within the Regeneration Research Newsletter. The newsletter has a worldwide distribution, mainly through email and provides up to date information on the advances in this field of research as supported by the symposium. The long-range plan of this event is to continue to hold these symposia on alternate years and to vary the programs of successive symposia, so that coverage of the broad field of regenerative medicine over a period of years will be as extensive as possible. The continued success of this symposium series is largely dependent on the ongoing support by each of the participating organizations. Each organization makes it possible to encourage and support the participation of students and leaders in the field of regeneration research to attend this meeting year after year. The ISNR has a rudimentary website that lists information from previous symposia http://www.rehab.research.va.gov/ISNR/index.html or you may contact the ISNR office by phone 919-286-0411 ext. 7691; or via email at ISNR@mc.duke.edu. Dr. Albert Lo (Director-elect) may be contacted via email at: Albert Lo Albert_Lo@brown.edu.

15th ISNR Symposium Session Proposals

Please submit session proposals via email to:

Roger Madison, Ph.D.
Director, International Symposium on Neural Regeneration
Email: madis001@mc.duke.edu

If your favorite topic has not recently been presented at one of the international symposia, we encourage you to submit a proposal for a symposium session. The program planning committee is meeting in November 2012 to formulate the program for the Fifteenth International Symposium on Neural Regeneration (ISNR) scheduled for December 2013. Proposals may be received in the ISNR Office as late as October 26, 2012 and still be considered, but earlier submission is recommended for advance distribution to committee members. Proposals will not be considered, however, if they are not submitted in an appropriate format (see guidelines below).

Submission Guidelines: Symposium sessions are chosen for their timeliness, current interest and recent progress. One of the goals of these symposia is to cover the field of neural regeneration and regenerative medicine as broadly as possible. This cannot be done in a single year, and therefore an attempt is made to vary the programs in successive symposia so that eventually the spectrum of neural regeneration research is covered. A symposium session proposal should define a session topic and include a few words about why the topic should be presented. A chairman should be indentified (often the symposium proposer), along with four first choice speakers. Information on the speakers should include institutional affiliation, email and mailing address, telephone number (if available) and a few words on what area this speaker would cover. At least one (preferably more) alternate should be listed for each speaker or chairman, along with institutional affiliation and other identifying data, as the first choice speaker is not always available. In addition, you may submit suggestions for the Symposium Keynote speaker and possible Featured Speakers. Potential speakers should not be contacted in advance, as invitations are issued by the Director's office if the program planning committee accepts the session. Some thought should also be given to whether a potential speaker has previously been a recent symposium presenter, as an attempt is made to vary the individuals participating in the program. If you are interested in reviewing a list of speakers from past symposia, please contact the ISNR office or visit the symposium website at (http://www.rehab.research.va.gov/ISNR/index.html). Proposals should be submitted to ISNR@mc.duke.edu.

Summary of the Fourteenth International Symposium on Neural Regeneration

The Fourteenth International Symposium on Neural Regeneration (ISNR) was held at the Asilomar Conference Center in Pacific Grove, California from December 7-11, 2011. The meeting was co-sponsored by the U.S. Department of Veterans Affairs (Biological Laboratory Research and Development and Rehabilitation Research and Development Service), the Paralyzed Veterans of America (Spinal Cord Research Foundation), the National Institutes of Health (National Institute of Neurological Disorders and Stroke), the California Institute for Regenerative Medicine (CIRM), the International Society for Neurochemistry (ISN), and Mission Connect - A Project of TIRR Foundation.

The Symposium was organized by Dr. Roger Madison (Symposium Director, VA Medical Center and Duke University, Durham,

NC), and the program planning committee which included Drs. John Steeves (International Collaboration on Repair Discoveries/University of British Columbia), Michael Sofroniew (University of California, Los Angeles), David Gardiner (University of California, Irvine), Jane Lebkowski (Geron Corporation), Jacqueline Bresnahan (University of California, San Francisco), David Shine (Baylor College of Medicine) and James Guest (University of Miami). Guest attendees representing co-sponsoring institutions at the planning meeting were Drs. Vivian Beyda (United Spinal Association), Naomi Kleitman (National Institutes of Health - NINDS) and Audrey Kusiak (Department of Veterans Affairs, Rehabilitation R&D Service).

The keynote speaker for the symposium was Mark Tuszynski from the University of California, San Diego and the VA San Diego Healthcare System. Featured talks were given by Hunter Peckham from Case Western Reserve University/Cleveland VAMC, Colin McCaig from University of Aberdeen (Scotland), Dwight Bergles from Johns Hopkins School of Medicine, Stefan Heller from Stanford University School of Medicine and Ed Boyden from Massachusetts Institute of Technology.

2011 Highlights

The International Symposium on Neural Regeneration celebrated another successful gathering at the 2011 conference which was attended by 180 participants, including 65 students, with 88 posters being presented. All of the symposium events were of great interest to the participants with the debate, Route 28 Summit, and trainee awards drawing the most interest.

The debate session of the symposium was another successful event. The focus was "The future of functional recovery is robotics not regeneration" and was chaired by David Shine (Baylor College of Medicine). Vivian Mushahwar (University of Alberta), Chet Moritz (University of Washington), Doug Weber (University of Pittsburgh and Pittsburgh VAMC) and Alan Harvey (University of Western Australia) along with Hunter Peckham (Case Western Reserve University and Cleveland VAMC), Linda Noble-Hauesslein (University of California, San Francisco), Jerry Silver (Case Western Reserve University) and Arthur Prochazka (University of Alberta) participated. The debate session had the highest attendance of any session at the symposium. The format included a group presentation of each side's argument followed by a rebuttal period. The debate sparked much conversation throughout the remainder of the symposium.

The Fredrick Seil Trainee Award, which was established to honor the first director and founder of ISNR, was awarded for 2011 to Brad Lang representing Case Western Reserve University and Farida Hellal representing the German Center for Neurodegenerative Diseases (DZNE). Each received a $250 cash award, and their names have been engraved on the Fredrick Seil Trainee Award perpetual plaque. Additional poster awards were presented to Leanne Ramer and Greg Duncan (International Collaboration on Repair Discoveries and University of British Columbia), Deevee Sanchez (University of Florida), Nathan Neckel (Georgetown University) and Brian Sauer (Mayo Clinic College of Medicine). Each recipient received a $50 cash award and a certificate. All awards were chosen by senior faculty and planning board members who reviewed the poster entries.

l to r: F. Hellal, R. Madison, F. Seil and B. Lang.

A new segment was introduced in 2011 during the "Emerging Topics" session. The Route 28 Summit Presentations allowed three teams of students to work with faculty mentors and present "Novel ways to exploit stem cell for recovery of CNS function". The session was organized and chaired by Theo Palmer (Stanford University). Team presentations were voted on by audience members and the winning team received a $1,000 award provided by California Institute of Regenerative Medicine. The winning Route 28 team for 2011 included Zijia Zhang (Oklahoma State University), Todd White (Morehouse School of Medicine), Teresa Evans (Case Western Reserve University) and Francisco Benavides (University of Miami School of Medicine). ISNR congratulates all of these winners.

l to r: Z. Zhang, T. White, F. Benavides and T. Evans pictured with Theo Palmer

Following the format of preceding neural regeneration symposia, the program was divided into six sessions, which included: 1) Brain Machine Interface (BMI), chaired by Doug Weber; 2) DEBATE: The future of functional recovery is robotics not regeneration, chaired by David Shine; 3) Stem Cells - The promises and challenges, chaired by Itzhak Fischer; 4) Translational Approaches - "Lost in Translation", chaired by Naomi Kleitman; 5) ISN Symposium on Neurochemistry and Neurobiology, chaired by Jacqueline Bresnahan; and 6) Route 28 Summit Presentations - Novel ways to exploit stem cells for recovery of CNS function, chaired by Theo Palmer.

Brief summaries of the keynote and featured speakers presentations are given below followed by a listing of session chairmen and speakers.

Keynote Speaker

Sprouting, Regeneration and Relay Formation After SCI: Realistic Targets for Translation? (Mark Tuszynski, University of California, San Diego and VA San Diego Healthcare System)

Dr. Tuszynski reviewed the substantial progress that has been made in the last 30 years in understanding fundamental responses of the nervous system to injury, and in elucidating mechanisms limiting central axonal regeneration. This included therapeutic discovery efforts aimed to minimize the early effects of injury and to reduce secondary injury (neuroprotection), as well as other efforts focusing on improving the nervous system's ability to recover from injury, targeting either: 1) enhancement of functional reorganization of the nervous system (e.g., through rehabilitation or electrical stimulation), 2) post-injury pharmacological modulation of spinal neurotransmitter systems, 3) enhancement of intraspinal compensatory collateral sprouting, 4) promotion of true axonal regeneration into and beyond a lesion cavity, and 5) formation of novel circuitry across a lesion site, i.e., neuronal relay formation. Dr. Tuszynski emphasized that enhancement of endogenous sprouting, induction of bridging axonal regeneration, and formation of novel relay circuits all constitute distinct and intriguing mechanisms for enhancing outcomes after spinal cord injury. All of these phenomenon must be taken into account when developing translational approaches for treatment of nervous system injuries and disease.

Featured Speakers

The Role of Neural Prosthesis and Neural Stimulation in the Restoration of Function (Hunter Peckham, Case Western Reserve University and Cleveland VAMC)

Dr. Peckham reviewed major advances that have been made over the past decade in the use of neuroprostheses for restoration of motor function. These advances have been built on the fundamental science of neural excitation and the technologies for implantable stimulation and control. The technologies have advanced to provide operational systems that can function in the human body for decades, and include implantable electrodes, stimulation devices, and sensors. The neural interface between the excitable tissue and the delivery electrode are enabling evermore powerful control and precision in the delivery of stimulation, not only providing for excitation but also blocking of neural activity (e.g. for annihilation of pain or spasticity) and selective stimulation. Distributed implantable systems and brain control interfaces are currently in development that will provide greater flexibility in implementation and performance. Areas of practical application for this work include people with spinal cord injury, including hand grasp, standing and walking, breathing, and bladder and bowel control. Dr. Peckham provided examples of both upper and lower extremity neuroprostheses that restore full arm mobility and levels of standing and ambulation.

Electrical signals control multiple cell behaviours. (Colin McCaig, University of Aberdeen)

Dr. McCaig reviewed the long history of the use of electrical stimulation in medicine. For instance the Romans used the discharge from electrical fish to treat a number of pathologies, including gout and migraine. More recently, it has been shown that many tissues generate their own electrical signals which are present generally in the extracellular spaces, for minutes, hours, even days. A host of basic behaviours such as the cell cycle, cell division, cell shape, cell migration and cell growth may all be controlled by these small electrical signals during normal development. Following damage in several systems, steady electrical signals rapidly re-appear and again seem to regulate a range of coordinated cell activities. In epithelial tissues such as skin and cornea, there is direct evidence for electrical regulation of the axis of cell division, the rate of cell proliferation and the direction of cell migration. These events need to be coordinated for successful wound healing. Since there is evidence that these electrical signals may be the earliest to appear at a wound and that they may override coexisting chemical signals, they could act as a master regulator signal to kick start an integrated array of coordinated cell behaviours. Similar electrical signals have been measured following injury to the central nervous system and spinal cord.

Fate And Function Of NG2+ Glial Progenitors In Health And Disease (Dwight Bergles, Johns Hopkins School of Medicine)

The mammalian CNS contains an abundant, widely distributed population of glial cells that expresses the chondroitin sulfate proteoglycan NG2 (CSPG4) and the alpha receptor for PDGF. Although initially defined as a class of astrocytes, studies completed over the past two decades indicate that these cells represent a third class of macroglia, with properties distinct from astrocytes and oligodendrocytes. NG2+ cells serve as progenitors for oligodendrocytes (OLs) during early development, and are often referred to as oligodendrocyte precursor cells (OPCs). However, NG2+

cells remain abundant in the mature CNS after myelinated tracts have been established, accounting for approximately 5% of all cells, and they retain the ability to proliferate throughout life. These cells undergo dramatic morphological changes and increase their proliferation following acute CNS injury and in neurodegenerative diseases. Over the past several years new lines of transgenic mice have allowed the manipulation of gene expression within these progenitors to track their fate, monitor their dynamics on timescales of minutes to months in vivo, and selectively ablate these cells from the adult CNS. Genetic fate tracing studies indicated that NG2+ cells are lineage restricted progenitors that either remain as progenitors or differentiate into oligodendrocytes, but do not transdifferentiate into astrocytes or neurons, a behavior that is maintained in neurodegenerative disease (amyotrophic lateral sclerosis). In vivo, time lapse imaging revealed that NG2+ cells are highly dynamic in the adult mouse cortex. They continually reorient their processes and migrate through tissue to sites of injury to participate in the formation of glial scars. Together, these results suggest that NG2+ glial cells have prominent roles in regeneration and repair in the adult CNS.

Inner Ear Sensory Cells From Stem Cells (Stefan Heller, Stanford University School of Medicine)

Dr. Heller raised the issue that despite elegant biophysical analyses, the molecular mechanisms that underlie our senses of hearing and balance are not fully understood. A major reason for this lack of knowledge is the paucity of material, a few thousand well-hidden sensory hair cells per inner ear, compared to, for example, the 140-150 million photoreceptor cells per retina. His laboratory's goal was to devise an efficient in vitro guidance protocol for generation of functional hair cell-like cells from a renewable source. This was achieved by utilizing, for the most part, known principles of early embryonic development and inner ear induction. Recapitulation of specific signaling events in the culture dish led to otic progenitor cells that were able to differentiate into clusters of nascent and maturing sensory epithelia, featuring cells with hair and supporting cell characteristics. Cytomorphological assessments revealed that hair cells generated in an in vitro environment grow typical hair bundles of single kinocilia and stereocilia of graded heights. Bundle-bearing cells responded to mechanical stimulation with currents that were reminiscent of transduction currents. His guidance method offers a platform for molecular studies on hair cells, which are otherwise difficult to obtain in large numbers. Likewise, intermediate presumptively otic cell types, generated by applying inner ear developmental principals, are emerging as useful in vitro tools to study specific signaling pathways that function during inner ear development. The fact that in vitro-generated hair cell-like cells are functional shows that generation of replacement hair cells from pluripotent stem cells is feasible, a finding that justifies the development of stem cell-based treatment strategies for hearing and balance disorders.

Optogenetics: Tools For Controlling Brain Circuits With Light (Ed Boyden, Massachusetts Institute of Technology)

Dr. Boyden's work seeks to determine how different kinds of neurons in the brain work together to implement brain functions, and to assess the roles that specific sets of neurons play within neural circuits. He and his collaborators have developed a number of genetically-encoded tools that enable the electrical activity of neurons to be activated or silenced by pulses of light. These molecules are microbial opsins, seven-transmembrane proteins adapted from organisms found throughout the world, which react to light by transporting ions across the lipid membranes of cells in which they are genetically expressed. Beginning with the light-gated inward cation channel channelrhodopsin-2, adapted from the green alga C. reinhardtii and the light-

driven inward chloride pump halorhodopsin, adapted from the archaeon N. pharaonis, they have mined genomic resources from across the tree of life to discover reagport high-performance, multiple-color, and control of the electrical activity of defined neural substrates in the brain. Recently for example they demonstrated that molecules from different kingdoms of life enable powerful, multi-color silencing of different sets of neurons. They have also discovered molecules that enable 100% shutdown of neural activity in awake behaving mice and non-human primates, in response to light. They have also developed microfabricated light sources capable of delivering light into complexly-shaped, 3-D, distributed neural circuits. These tools are enabling the causal assessment of the roles that different sets of neurons play within neural circuits, and are accordingly being used by hundreds of groups to reveal how different sets of neurons contribute to the emergent computational and behavioral functions of the brain. These tools are also being explored as components of prototype neural control prosthetics capable of correcting neural circuit computations that have gone awry in brain disorders.

Brain Machine Interface (Chaired by Doug Weber, University of Pittsburgh/ Pittsburgh VAMC)

Andrea Kubler (University of Wurzburg) presented "Out Of The Frying Pan Into The Fire - BCI Faces Real World Application". Bradley Greger (University of Utah) presented "Micro-Electrodes In And On The Cerebral Cortex For Decoding And Encoding Information ". Chet Moritz (University of Washington) presented "Leveraging Neural Plasticity For The Treatment Of Paralysis And Other Movement Disorders". Jennifer Collinger (University of Pittsburgh and Pittsburgh VA Medical Center) presented "Is BCI Technology Ready For Prime Time? The Science Is Mature And The Consumers Are Willing- What Are We Waiting For?"

DEBATE - Proposition: The future of functional recovery is robotics not regeneration (Moderated by David Shine, Baylor College of Medicine)

Vivian Mushahwar (University of Alberta), Chet Moritz (University of Washington), Doug Weber (University of Pittsburgh/Pittsburgh VAMC) and Alan Harvey (University of Western Australia) presented an "Affirmative" position for the statement. While Hunter Peckham (Case Western Reserve University/Cleveland VAMC), Linda Noble-Hauesslein (University of California, San Francisco), Jerry Silver (Case Western Reserve University) and Arthur Prochazka (University of Alberta) presented a "Negative" position for the statement.

Stem Cells - The promises and challenges (Chaired by Itzhak Fischer, Drexel University)

Mathew Blurton-Jones (University of California, Irvine) presented "Can Neural Stem Cells be used to treat Alzheimer disease?". Itzhak Fischer (Drexel University) presented "Transplanting neural progenitors to reconnect the injured spinal cord". Nicholas Maragakis (Johns Hopkins School of Medicine) presented "Scientific and Clinical Challenges in using Stem Cells for

l to r: A Harvey, C. Moritz, D. Weber, V. Mushahwar, L. Noble-Hauesslein, A. Prochazka, J. Silver, H. Peckham

Investigating and Treating Amyotrophic Lateral Sclerosis". Gary Steinberg (Stanford University School of Medicine) presented "Neural Stem Cell Therapy for Stroke: Underlying Mechanisms and Clinical Translation".

Translational Approaches - "Lost in Translation" (Chaired by Naomi Kleitman)

Naomi Kleitman (NIH/NINDS) presented "Implications Of Replications: Improving The Quality Of Preclinical Research". David Howells (University of Melbourne) presented "Avoiding Bias at the Bench". Dan Lammertse (Craig Hospital/University of Colorado) presented "The Challenges of Translation: a Clinical Perspective". Jan Nolta (University of California, Davis) presented "Working toward cellular therapies to treat Huntington's disease".

ISN Symposium on Neurochemistry and Neurobiology of Repair (Chaired by Jacqueline Bresnahan, University of California, San Francisco)

Linda Noble-Haeusslein (University of California, San Francisco) presented "Matrix Metalloproteinases As Modifiers Of Injury And Recovery Processes After Spinal Cord Injury". Herb Geller (NIH/NHLBI) presented "The Sour Side of Sugars: Chondroitin Sulfate Signaling in Axonal Guidance". Roman Giger (University of Michigan) presented "Identification and Functional Characterization of Novel Receptors for Inhibitory Chondroitin Sulfate Proteoglycans". Klaus Nave (Max Planck Institute of Experimental Medicine) presented "Oligodendrocyte Support Of Axon Function And Integrity".

Emerging Topics - Route 28 Summit Presentations (Chaired by Theo Palmer, Stanford University)

The Route 28 Summit Presentations provided an opportunity for three teams of graduate and post-graduate students to work with faculty mentors and present "Novel ways to exploit stem cells for recovery of CNS function". The session was organized and chaired by Theo Palmer (Stanford University). Additional official mentors for the Route 28 session included Phil Horner (University of Washington), Giles Plant (Stanford University), Audrey Kusiak (VA Rehabilitation Research and Development - Washinton, DC), Chet Moritz (University of Washington) and Mark Tuszynski (University of California, San Diego and the VA San Diego Healthcare System), along with participation by many of the attending faculty members. Teams were formed at the beginning of the symposium, were provided the assigned task and paired with mentors to develop potential solutions to the assigned topic. The outcomes were presented during the emerging topics session at the end of the symposium. Team presentations were voted on by audience members and the winning team received a $1,000 award, which was provided by the California Institute of Regenerative Medicine.

ISNR Planning Board Members and sponsor representatives pictured with 2011 ISNR Poster award recipients.
(l to r: N. Neckel, D. Shine, M. Sofroniew, J. Steeves; front row - A. Kusiak, D. Sanchez, G. Duncan, L. Ramer, B. Sauer, N. Kleitman, R. Madison and J. Bresnahan).

ISNR 2011

Fritz Seil and Roger Madison

Fritz Seil

Warren Alilain

Roger Madison and Frances Stuart

Sasha Rabchevsky

ISNR 2011

Poster Sessions