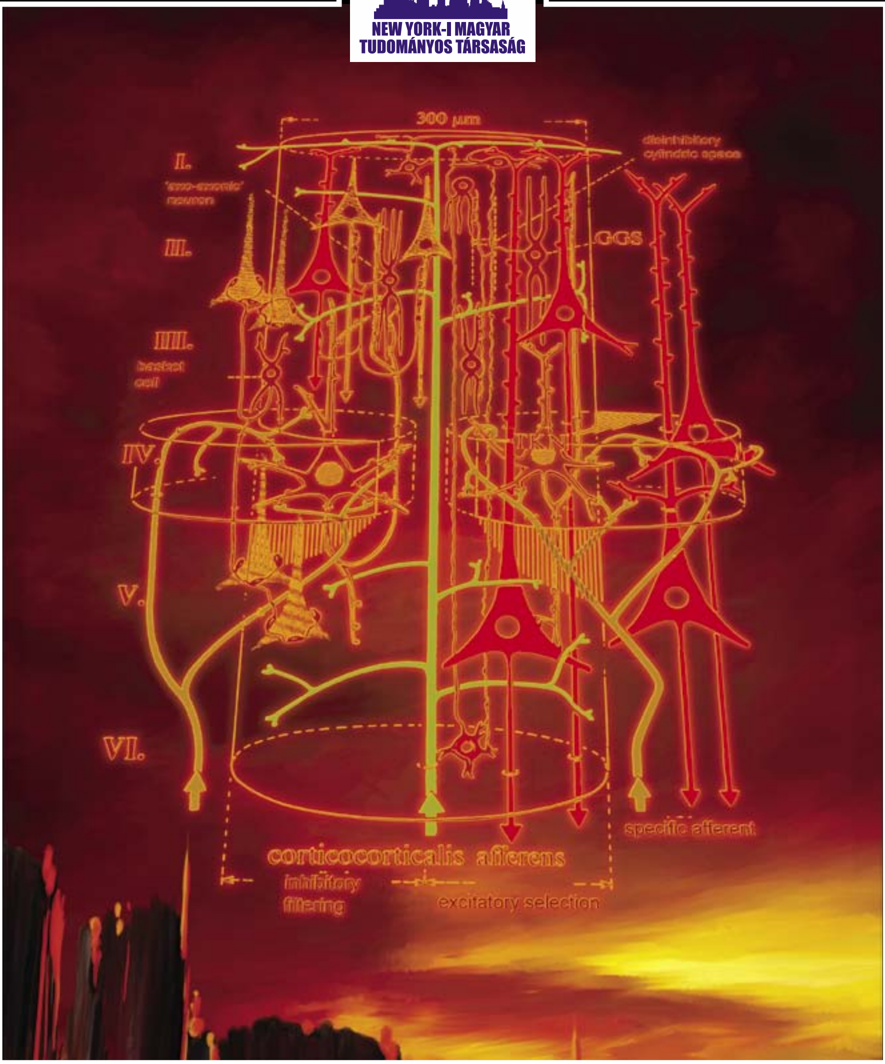
MEMORIAL CONFERENCE ON THE OCCASION OF 100TH BIRTHDAY OF

JÁNOS SZENTÁGOTHAI

(1912-1994)

NEW YORK-I MAGYAR TUDOMÁNYOS TÁRSASÁG



Monday, November 12, 2012 4:00-8:00 PM

Consulate General of Hungary (223 East 52nd Street, New York City)

New York,
November 2, 2012

Dear Guests,

Professor Szentágothati's life portrays all the transformation Hungary has undergone in a century: born into a half German, half Sekler family in Transylvania within the multi-ethnic Austro-Hungarian Empire, educated in Vienna right before World War II, resuming his position in Pécs, Hungary – where he held Bible studies in the darkest years of Communism -, actively participating in the 1956 Revolution, then pioneering neuroanatomical studies by introducing state-of-the art methods when he, just like the rest of the country, was confined to the closest quarters of work, ridden of the expression of free thought and opinion. Slowly rising to become President of the Academy of Sciences, becoming an MP solely on his merits as a scientist in 1985. Actively participating in the work of the first opposition group, he watched closely as Hungary turned into a fully-fledged democracy in 1990, becoming an MP again in the first freely elected Parliament, and remaining an important voice as a leading intellectual until his last day. Today, as his students and successors gather for this conference, we remember him as a towering figure and a kind, unmistakably witty man who represented the best and brightest in mankind to generations.

It is an honor to have you all with us today, and I wish you a great conference that we proudly dedicate to the memory of this great man.

Ambassador Károly Dán

Consul General of Hungary, New York

Memorial conference on the occasion of 100th birthday of
JÁNOS SZENTÁGOTHAI
(1912-1994)

NEW YORK-I MAGYAR TUDOMÁNYOS TÁRSASÁG

Date: **Monday**, November 12, 2012
4:00-8:00 PM
Place: Consulate General of Hungary
(223 East 52nd Street, New York City)

Program

Opening remarks: Karoly Dan, Ambassador, Consul General of Hungary

Welcoming remarks: Sylvester E. Vizi, Past-President, Hungarian Academy of Sciences (HAS)

Welcoming remarks: Laszlo Zaborszky

Pedro and Tauba Pasik (NY): Reminiscing about John Szentagothai

Peter Petrusz (Chapel Hill, NC): Szentagothai, Chair of the Anatomy in Pecs (1946-1963)

Miklos Rethelyi (Former Minister in the Second Cabinet of Viktor Orbán): The Budapest Years (1963-1994): Chairman of the Anatomy, President of HAS, Member of the Parliament

Coffee break

Andras Pellionisz (Sunyvale, CA): The Cerebellum as a Neuronal Machine

Peter Erdi (Kalamazoo, MI): Reconciling the irreconcilable: Self-organization vs Downward causation

Ivan Bodis-Wollner (NY): Szentagothai, Reflexology and Pre-emptive Perception

Sarolta Viola (Wien): The man in the blue dungarees- Memories of the grandfather

Janos Rethelyi (San Diego): An imaginary journey with my grandfather across continents

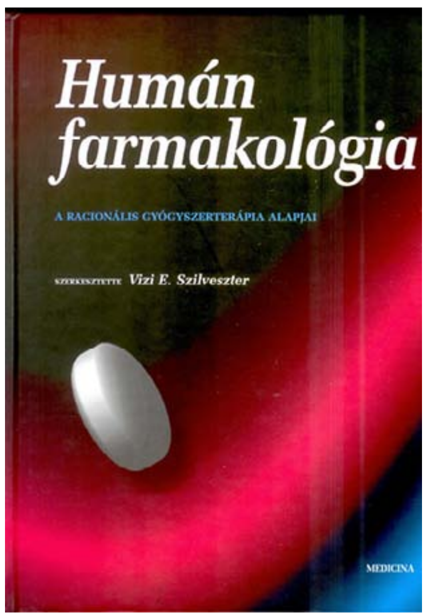
Sylvester E. Vizi (Budapest): Closing remarks

Dr. E. Sylvester Vizi

Dr. E. Sylvester Vizi, M.D., Ph.D., D.Sci., Past-President of the Hungarian Academy of Sciences (2002-2008), President of the Hungarian Atlantic Council (1999-) and President of the Society for Dissemination of Scientific Knowledge (2000-) is an internationally recognised, leading scientist in neuropharmacology. In addition to his highly original scientific publications (over 400), he wrote or edited several books both in his discipline and also on wider scientific issues. He is the member of several learned societies, Vizi is an influential and progressive figure in science policy and in the dissemination of science in Hungary. He is former director of Institute of Experimental Medicine and Emeritus professor of Semmelweis University of Budapest. He spent years as visiting professor in Department of Psychiatry and Anesthesiology at Albert Einstein College of Medicine, N. Y. and Nathan Kline Institute of Psychiatry, N.Y.

Vizi's early studies on cholinergic and monoaminergic transmission with his mentor Sir William Paton in Oxford facilitated the understanding of transmitter release mechanisms and their presynaptic control, and led him later to his formulation of the concept of non-synaptic communication between neurons. His discovery that extrasynaptically localized high affinity presynaptic auto- and heteroreceptors are one of the primary targets of many drugs used in clinical practice; therefore, their heterogeneity is very important in pharmacological research and in the development of new therapeutic agents with fewer unwanted side-effects.

Today hardly anyone questions the existence and importance of non-synaptic transmission; numerous mediators have been shown to be released at non-synaptic sites, and to diffuse tens or hundreds of micrometers in the extracellular space reaching their high affinity extrasynaptic receptors or transporters.



A fundamental consequence of this scenario for pharmaceutical research is that drugs used in pharmacotherapy are likely to act on the extrasynaptic receptors before they reach a concentration that is sufficient to influence the low affinity subsynaptic receptors. Vizi proposed that an understanding of the mechanisms and sites of drug actions requires the definition of the distribution and function of their receptors not only at synapses but throughout the cellular surface.

He has lectured and published newspaper articles in Hungarian and German in "Magyar Nemzet", "Népszabadság", "Népszava", and "Welt am Sonntag" about science and conscience, and the responsibility of scientists in the 21st century. Vizi has advocated that scientists have two paramount obligations: to gain knowledge and to share their knowledge with the public.

One of his most important achievements is that after his election as President of the Academy he initiated the setting up of a TV series "Mindentudás Egyeteme" (University of Knowledge) for broadcasting lectures and debates on science. Vizi was the President of the First World Science Forum in Budapest in 2003. In order to promote a dialogue about the new roles and challenges facing knowledge in the global society of the 21st century, the Hungarian Academy of Sciences established the World Science Forum – Budapest, a world conference series on science, knowledge, and society. Well over 1200 scientists, politicians, decision makers from all over the world have participated in the work of the past meetings, making them unique and highly diverse events. They received world-wide media coverage (e.g. CNN).

Vizi has received several awards and prizes, both international (e.g., Galileo Galilei Award 1998, Italy, European Order of Merit, Hon. memb., Brussel, 1996, The Order of the Sacred Treasure, Gold and Silver Star presented by the Emperor of Japan, 2002, V. I. Vernadszkij Gold Medal – National Scientific Academy of Ukraine, 2005. The Order of the Star, Commander; Romania, 2006, and Hungarian (e.g., Széchenyi Award, 1993; Middle Cross of the Order Merit of the Hungarian Republic, 1997; Széchenyi "Grand Prix" 2012; Corvin Chain 2012).

THE NEUROSCIENCES INSTITUTE

October 3, 2012

Karoly Dan, Ambassador
Consulate General of Hungary
223 East 52nd Street
New York, NY 10022

Dear Ambassador Dan,

Thank you for your kind invitation to attend the celebration of the 100th birthday of Professor John Szentagothai. I can think of no more fitting occasion to commemorate the achievements of one of the great neuroanatomists of the last century. Unfortunately, I have commitments that will prevent my attendance. I hope, however, that you will convey my remarks relevant on this occasion to your colleagues.

John Szentagothati was remarkable for combining precision and interpretive imagination in his work, a rare combination indeed. Among his major contributions was his early analysis and interpretation of cerebral cortical organization.

His approach to science was passionate and generous and had an enormous effect upon his colleagues. He easily belongs to the list of great Hungarian scientists, a number of whom I had the pleasure of knowing. His efforts stand for the highest elements of Hungarian culture which, in science, combines high intelligence, historical sense and imagination in the service of the verifiable truth.

Do extend my wishes to your colleagues and participants in a fitting celebration.

With all good wishes, I am

Sincerely,

Gerald Edelman

Dr. Gerald M. Edelman

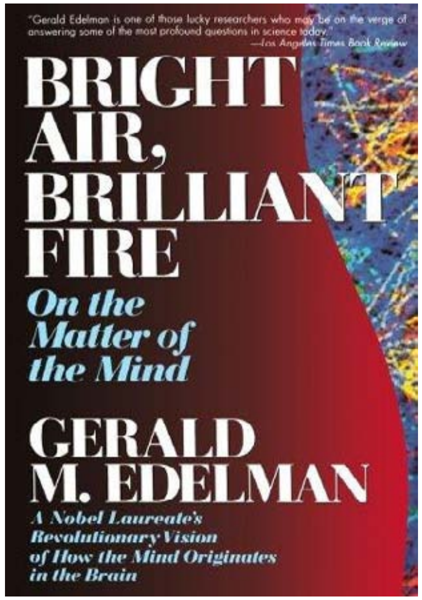
Dr. Edelman is Director of The Neurosciences Institute and President of Neurosciences Research Foundation, the publicly supported not-for-profit organization that is the Institute's parent. Separately, he is Professor at The Scripps Research Institute.

Dr. Edelman has made significant research contributions in biophysics, protein chemistry, immunology, cell biology, and neurobiology. His early studies on the structure and diversity of antibodies led to the Nobel Prize for Physiology or Medicine in 1972. He then began research into the mechanisms involved in the regulation of primary cellular processes, particularly the control of cell growth and the development of multicellular organisms. He has focused on cell-cell interactions in early embryonic development and in the formation and function of the nervous system. These studies led to the discovery of cell adhesion molecules (CAMs), which have been found to guide the fundamental processes by which an animal achieves its shape and form, and by which nervous systems are built. One of the most significant insights provided by this work is that the precursor gene for the neural cell adhesion molecule gave rise in evolution to the entire molecular system of adaptive immunity.

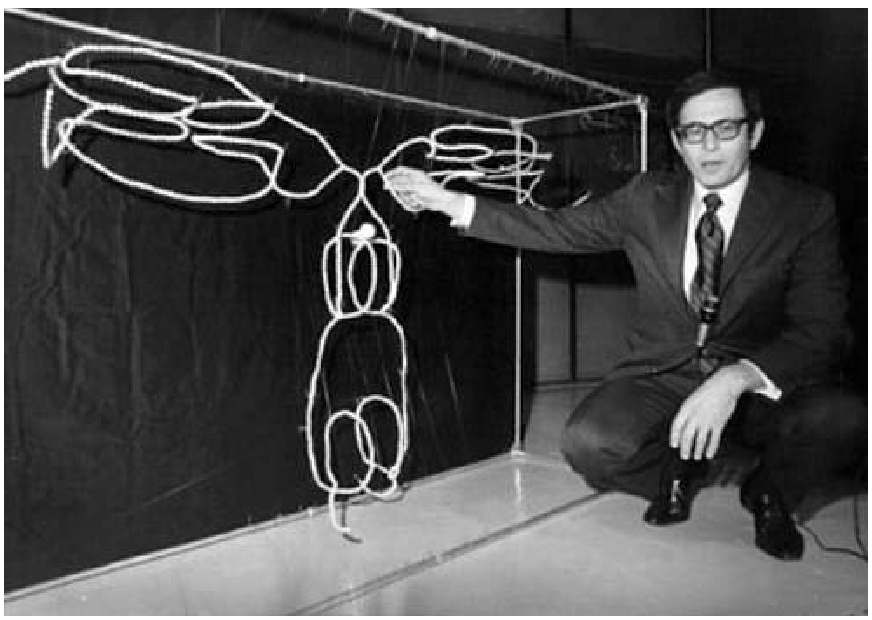
Most recently, he and his colleagues have been studying the fundamental cellular processes of transcription and translation in eukaryotic cells. They have developed a method to construct synthetic promoters and have also been able to enhance translation efficiency by constructing internal ribosomal entry sites of a modular composition. These findings have rich implications for the fields of genomics and proteomics.

Dr. Edelman has formulated a detailed theory in terms of a process known as neuronal group selection. This theory was presented in his 1987 volume Neural Darwinism, a widely known work. Dr. Edelman's continuing work in theoretical neuroscience includes designing new kinds of machines, called Brain-based devices (BBDs), that are capable of carrying out tests of the self-consistency of the theory of neuronal group selection and promise to shed new light on the fundamental workings of the human brain. A new, biologically based theory of consciousness extending the theory of neuronal group selection is presented in his 1989 volume The Remembered Present. A subsequent book, Bright Air, Brilliant Fire, published in 1992, continues to explore the implications of neuronal group selection and neural evolution for a modern understanding of the mind and the brain. His book published with Giulio Tononi, entitled A Universe of Consciousness: How Matter Becomes Imagination, presents exciting new data on the neural correlates of conscious experience. In his book published in 2004, entitled Wider than the Sky: The Phenomenal Gift of Consciousness, Dr. Edelman offers a model of the biology of consciousness. His latest book, Second Nature: Brain Science and Human Knowledge (Yale University Press), appeared in October 2006.

Dr. Edelman was born in New York City in 1929. He earned his B.S. degree at Ursinus College and an M.D. at the University of Pennsylvania. He spent a year at the Johnson Foundation of Medical Physics, and after a medical house officership at the Massachusetts General Hospital, he served as a captain in the Army Medical Corps. In 1960 he earned his Ph.D. at The Rockefeller Institute (now University). In addition to the Nobel Prize, Dr. Edelman has been the recipient of numerous awards and honors, including many honorary degrees. He is a member of the National Academy of Sciences, the American



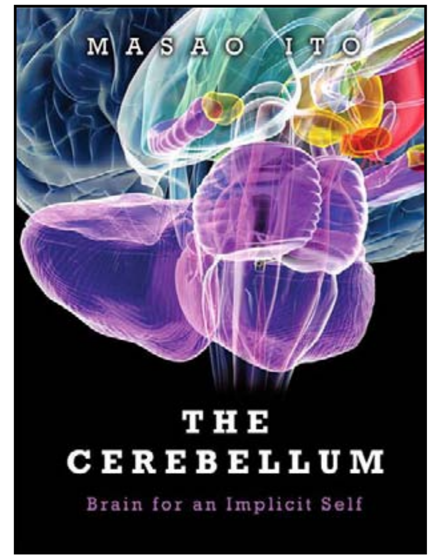
Philosophical Society, and several foreign societies, including the Academy of Sciences, Institute of France. He is author of over 500 research publications.



Gerald M. Edelman with a model of the gamma globulin molecule, 1972(*2)

Masao Ito

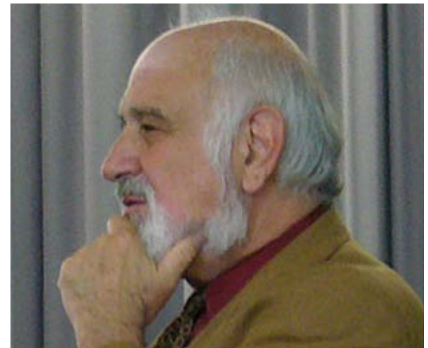
Masao Ito: born on 4 Dec. 1928 at Nagoya, Japan; 1953 graduated from Univ. of Tokyo; 1953 M.D., 1959 Ph.D.; 1959-62 studied in John C. Eccles' laboratory in Australian National Univ; 1970-1989; Professor of Univ. Tokyo and 1986-88 Dean of Medical Faculty; 1989 moved to RIKEN, and 1997-2003 served as Founder Director of RIKEN Brain Science Institute and then as Senior Advisor for it. His major findings are: exclusive inhibitory nature of cerebellar Purkinje cells and long-term depression (LTD) in Purkinje cells. He coauthored the book "The Cerebellum as a Neuronal Machine" by Eccles, J.C., Ito, M. and Szentagothai J. (Springer-Verlag) 1967, and also wrote a monograph "The Cerebellum and Neural Control" (Raven Press) 1984 and "The Cerebellum: Brain for an implicit self" (Pearson) in 2011. He received Japan Prize and Order of Culture (Japan) in 1996, Legion d'Honneur Chevalier (France) in 1998, and Peter Gruber Neuroscience Prize (USA) in 2006. He is member of Japan Academy, Foreign member of Royal Swedish Acad. Sci., Armenian Acad. Sci., Royal Soc. London, Russian Acad. Sci., French Acad. Sci., Indian Acad. Sci., Honorary member of Hungarian Acad. Sci., AAAS Fellow, and foreign associate of NAS USA. He served as presidents of International Brain Research Organization IBRO (1984-1990), International Union of Physiological Sciences IUPS (1993-1997), Human Frontier Science Program (2000-2009), and also Science Council of Japan (1994-1997).



Memoir of the late Prof. Janos Szentagothai

Professor Szentagothai visited Tokyo in 1965 to attend the IUPS Congress held there. He joined also an IBRO symposium on the Cerebellum I organized a week prior to the IUPS Congress. These were indeed marvelous events, in which Professor Szentagothai was a leading figure. For me, an forgettable honor was the co-authorship for the monograph "The Cerebellum as a Neuronal Machine" with Sir John Eccles and Professor Szentagothai (Springer Verlag, 1967). The great achievement of him and his colleagues as cited in this book are identification of the origin of climbing fibers in the inferior olive and also the correct surmise from the pattern of connections among granule cells, Purkinje cells, and basket cells that basket cells are inhibitory neurons. My pleasant memory continues; we invited him to an international symposium held at Nikko, Japan, as the main guest; he so kindly invited me to visit Hungarian Academy of Sciences, in which he was the president then. It was a great time for me. He was a great scholar with authority and dignity and at the same time with much sense of humor and warmness.

The international symposium "Information processing in the cerebellum" was organized by Francis Schmitt, Neuroscience Research Program, MIT, Boston,
MA, USA. It was held on 16–18 May 1967 in Salishan Lodge, near Gleneden Beach, OR, USA. Discussions at the conference were exciting and inspired the audience
of varied disciplines. In this group photo taken during the symposium, we find a number of cerebellar researchers who were considered to be well-established
authorities at that time. In this figure, there are roughly five rows from the bottom (A) to the top (E) one: A, 13 sitting; B, 16 standing; C, 4 standing on left-side; D, 13
standing; E, 12 standing, In these rows, from the left (1) to right (n) side, note the presence of several then-established cerebellar researchers, including: A. Brodal (B,
5), J. Brookhart (E, 10), R. Dow (A, 5), J. Eccles (A, 9), C. Fox (B, 14), D. Mackay (B, 3), R. Snider (A, 2) and J. Szenta´gothai (D, 9), Note also the following then-
younger-generation cerebellar researchers: M. Arbib (E, 7), V. Braitenberg (A, 4), C. Bell (E, 12), J. Hamori (B, 11), R. Kado (B, 6), M. Ito (A, 1), R. Llina´s (B, 10), E.
Mugnaini (A, 7), O. Oscarsson (B, 1), O. Pompeiano (C, 1), K. Sasaki (B, 9), and P. Strata (D, 10). Finally, note the organizer, F. Schmitt (D, 1).



Michael Anthony Arbib

Michael A. Arbib is the Fletcher Jones Professor of Computer Science, as well as a Professor of Biological Sciences, Biomedical Engineering, Electrical Engineering, Neuroscience and Psychology at the University of Southern California (USC), which he joined in September of 1986. He has also been named as one of a small group of University Professors (note the capital letters) at USC in recognition of his contributions across many disciplines.

Born in England in 1940, Arbib grew up in Australia (with a B.Sc. (Hons.) in Pure Mathematics from Sydney University), and received his Ph.D. in Mathematics from MIT in 1963. After five years at Stanford, he became chairman of the Department of Computer and Information Science at the University of Massachusetts at Amherst in 1970, and remained in that Department until his move to USC in 1986.

The thrust of his work is expressed in the title of his first book, Brains, Machines and Mathematics (McGraw-Hill, 1964). The brain is not a computer in the current technological sense, but he has based his career on the argument that we can learn much about machines from studying brains, and much about brains from studying machines. He has thus always worked for an interdisciplinary environment in which computer scientists and engineers can talk to neuroscientists and cognitive scientists. At the University of Massachusetts he helped found the Center for Systems Neuroscience, the Cognitive Science Program (where his contribution focused on the linkage of computer science, linguistics and computational neuroscience), and the Laboratory for Perceptual Robotics, for each of which he served as director. At USC, he was founder and first Director of the Center for Neural Engineering and the USC Brain Project, an interdisciplinary project in neuroinformatics.

His research has long included a focus on mechanisms underlying the coordination of perception and action. This is tackled at two levels: via schema theory, which is applicable both in top-down analyses of brain function and human cognition as well as in studies of machine vision and robotics; and through the detailed analysis of neural networks, working closely with the experimental findings of neuroscientists. His group prepared the first computational model of mirror neurons and conducted some of the key initial imaging studies of the human mirror system. He is now developing further insights into the monkey brain and using them to develop a new theory of the evolution of human language.

In addition to his research in artificial intelligence, brain theory and cognitive science, Arbib has been actively involved in theory of computation and system theory. His concern for the social implications of computer science was given textbook expression in Computers and the Cybernetic Society. In 1983 he and Mary Hesse delivered the Gifford Lectures in Natural Theology at the University of Edinburgh, since published as The Construction of Reality, extending schema theory to provide a coherent epistemology for both individual and social knowledge. Arbib was also a founding member of the board of the Institute for Advanced Study in the Humanities at the University of Massachusetts and the Institute for Advanced Studies at the University of Western Australia.

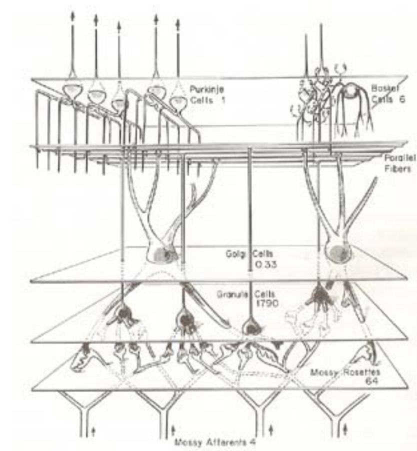
2012 marks the publication of Arbib's 40th book, How the Brain Got Language: The Mirror System Hypothesis (Oxford University Press). Three edited volumes will follow from the MIT Press in the coming year: From Neuron to Cognition and From Brain to Function (two textbooks in computational neuroscience) and Language, Music and the Brain: A Mysterious Relationship (based on a Strüngmann Forum he organized in Frankfurt in May 2011).

This name of this alley way – Impasse of the Little Model – next to a hotel Arbib stayed at during a summer school on "Mathematics and the Brain" in Paris expresses his attitude to developing a Brain Theory for cognition.

János Szentágothai: A Brain Theorist's Personal Memoir

As a graduate student at MIT (1961-63), I was supported after my first semester by a research assistantship from Warren McCulloch, whose paper with Walter Pitts, "A logical calculus of the ideas immanent in nervous activity" (McCulloch & Pitts 1943) played a seminal role in the early development of brain theory. Through

my time with McCulloch, I got to know many of the world's leading brain researchers as they came to his office and discussed their latest ideas. As far as I can recall, Szentágothai was not one of them, but it was through McCulloch that I met Frank Schmitt, who founded the Neurosciences Research Program (NRP) as an adjunct to MIT located in a great mansion in the Boston suburb of Brookline. As a result of this, I was invited to speak at the NRP Work Session on "Mathematical Concepts of Nervous System Function," in February, 1964. This in turn led to my invitation to serve as a Research Scientist at the NRP in Brookline in the Summer of 1966. John Eccles, János Szentágothai and Robert Dow of the Good Samaritan Hospital had persuaded Schmitt to make the cerebellum a focal topic for the NRP, and so four of us were invited to spend that summer together: Masao Ito, a former post-doc of Eccles in Canberra; Ray Kado, a neurophysiologist at UCLA; Curt Bell, a protégé



of Dow who worked on cerebellum-like systems in the electric fish; and myself, a brain modeler. As a result, my interest in the work of Eccles, Ito and Szentágothai was greatly stimulated, and the cerebellum was added to my list of modeling targets.

In due course, Eccles, Ito and Szentágothai published their seminal book, The Cerebellum as a Neuronal Machine (Eccles et al 1967). Despite the title, it did not develop a machine model of the cerebellum, but it was an inspiration to modelers – combining the overall neurophysiology of Eccles with the surprising discovery by Ito that the Purkinje cells, the only output cells of cerebellar cortex, were inhibitory, and the gorgeous anatomical drawings of Szentágothai laying bare the beautiful quasi-crystalline geometry of the cerebellar cortex (see the figure).

The best known outcome of this book for brain theory was the publication by David Marr of his theory of cerebellar cortex (Marr 1969) in which he treated each Purkinje cell as a Perceptron (basically, a McCulloch-Pitts neuron with adaptive synapses) and hypothesized that the synapses were Hebbian, so that simultaneous firing of parallel fiber input to a Purkinje cell and firing of the cell itself would strengthen the synapses between them. Two year later, Jim Albus (1971), stressing that Purkinje cell were inhibitory, suggested to the contrary that coincident firing would weaken the synapses. This work in brain theory, especially Marr's, stimulated Eccles and Ito among others to search for neurophysiological evidence of learning in cerebellar cortex. Finally, Ito and his colleagues (Ito et al 1982), with their evidence of climbing fibre induced depression of both mossy fibre responsiveness and glutamate sensitivity of cerebellar Purkinje cells, found evidence that supported Albus's version of what is now known as the Marr-Albus hypothesis.

Over the years, this interest in the cerebellum inspired the theses of

three of my PhD students:
C. Curtis Boylls, Jr. (1976): The Function of the Cerebellum and its Related Nuclei as Embedded in a General Paradigm for Motor Control.
Nicolas Schweighofer (1995): Computational Models of the Cerebellum in the Adaptive Control of Movements
Jacob Spoelstra (1999), Cerebellar Learning of Internal Models for Reaching and Grasping: Adaptive Control in the Presence of Delays.

The first thesis turned its back on Marr-Albus by stressing that although Purkinje cells were the output of cerebellar cortex, they only affected the rest of the brain by modulating activity in the cerebellar nuclei, and so developed a dynamic but non-learning model inspired by the Russian school of motor control founded by Nikolai Bernstein. The two later theses combined this large system (cortex + nuclei + motor pattern generators outside cerebellum) framework, building upon the perspective offered by Eccles, Ito and Szentágothai, and learning models that refined the original Marr-Albus-Ito insights.

I do not know when I first met Szentágothai, but it was certainly no later than at the Conference on Information Processing in the Cerebellum, at Salishan, Oregon, in May of 1967, where his height, deportment, booming voice, and superbly detailed anatomical drawings made him a commanding presence. The meeting marked the welcome that Szentágothai and others gave to the rapprochement of experiment with theory in neuroscience, since a goodly number of the speakers were experts on neural network theory or adaptive control theory. But not all participants were convinced, as witnessed by my response to Alf Brodal, the great Norwegian neuroanatomist (with a nod to the Beatles as well as Eccles, Ito and Szentágothai):

The brain's too complex
Said Doctor Brodal
For a computer program
To ever code all.
Model makers, what I mean
The cerebellum's not such a clean machine

At the same meeting, I penned a tribute to the Purkinje cell, inspired by Szentágothai's neuroanatomy and the attendant neurophysiology:

When compared with the great Purkinje
Other cell's dendrites look so stingy
That we surely must be critical
Of models not enough dendritical.
It won't suffice to note with unction
The size of a climbing fibre junction.
We surely must stress the intermingling
Of its message with the parallel ting-a-lingling
Which duly serves to give the preference
To only the smoothest of all efferents
So that we may duly work our will
Whether running, jumping or standing still.

However, in due course I found myself on the committee planning an NRP workshop under the chairmanship of Szentágothai. The original plan was to focus on stereology, bringing new numerical precision to neuroanatomy. For better or worse, I subverted this plan, and we ended up with a meeting developed to further uniting modelers and experimentalists with studies, among others, of cerebellum and the visual system. Szentágothai and I worked with the NRP staff to turn the proceedings into a book, *Conceptual Models of Neural Organization,* with a clear overall narrative, rather than a collection of papers (Szentágothai & Arbib 1975).

Our paths crossed several times in the years following, both in the United States and in Europe, including Budapest where I enjoyed the hospitality of Janós's wife Alice in their apartment.

But the most significant encounter for our later collaboration was at the International School on Neural Modeling and Neural Networks held in Capri, September 27-October 3, 1992, organized by Francesco Ventriglia. At this meeting we celebrated Janós's eightieth birthday. But we also got to talking about the possibility of updating *Conceptual Models of Neural Organization.* Janós was enthusiastic but also felt that he would need someone nearby to help him in the effort. Fortunately, Peter Érdi – a dynamic system theorist with a keen interest in diverse systems, including the brain – was also in Capri, and it was agreed that the three of us would produce the new book together.

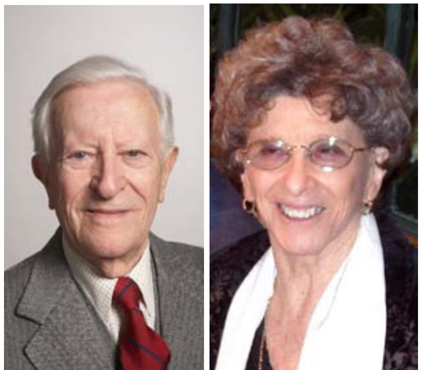
I visited Budapest twice to work on the book. On the first visit, I stayed in the guest apartment of the Institute of Chemistry. When I had previously visited Hungary it had been under the sway of the Soviet Union, but now it was a free country – and I had the bizarre experience in Budapest of watching on CNN Soviet troops invading the White House, but the White House in Moscow, the invasion repelled by Boris Yeltsin. A somewhat less bizarre experience was walking to Janós's Institute of Anatomy and passing a shop called the University Sandwich Club – with the shop sign in the colors and format of the University of Southern California logo. And then there was lunch with Janós and Peter at a Budapest restaurant. It was busy and as we were near finishing, Janós saw a writer he knew waiting with a friend for a table, so he hailed them over to join us for ten minutes while we were finishing. The friend was George Soros and we had a fascinating conversation on his plans for the future of Sarajevo, then under siege. Nonetheless, the highlights of the visit were the intense discussions on the book at the Institute and at Janós and Alice's home. We settled on the title *Neural Organization: Structure, Function, and Dynamics*, with principal responsibility for the three themes going to Janós, myself, and Peter, respectively. The book was finally published in 1998 (Arbib et al 1998).

Janós died after the second visit was arranged, but before the visit. Nonetheless, my wife Prue and I went to visit Peter to decide how best to meld what Janós had written, including a fine array of neuroanatomical drawings of diverse systems whose models we were discussing, into the final version (apparently, he had been working on the ms. the morning he died), as well as to visit Alice and other family members. This time, we stayed at a downtown hotel. When I went to pay the bill, I was informed that "Professor Szentágothai had already paid the bill" – apparently he had arranged the payment through the Academy of Sciences before he died. A spooky moment, with Janós as a living presence in that hotel.

As, of course, he is a living presence today to so many neuroscientists who continue to value the intellectual rigor and graphic beauty of his anatomical investigations.

La Jolla, October 19, 2012

References: Albus JS. 1971. A theory of cerebellar function. *Math. Biosci.* 10: 25-61
Arbib MA, Érdi P, Szentágothai J. 1998. *Neural Organization: Structure, Function, and Dynamics.* Cambridge, MA: The MIT Press.
Eccles JC, Ito M, Szentágothai J. 1967. *The Cerebellum As A Neuronal Machine.* Berlin, Heidelberg, New York: Springer-Verlag.
Ito M, Sakurai M, Tongroach P. 1982. Climbing fibre induced depression of both mossy fibre responsiveness and glutamate sensitivity of cerebellar Purkinje cells. *J Physiol* 324: 113-34
Marr D. 1969. A theory of cerebellar cortex. *The Journal of Physiology* 202: 437-70
McCulloch WS, Pitts WH. 1943. A logical calculus of the ideas immanent in nervous activity. *Bull. Math. Biophys.* 5: 115-33
Szentágothai J, Arbib MA. 1975. *Conceptual Models of Neural Organization.* Cambridge. MA: The MIT Press (Also published as Neurosciences Research Program Bulletin Volume 12, No. 3, October 1974, pp. 307-510).

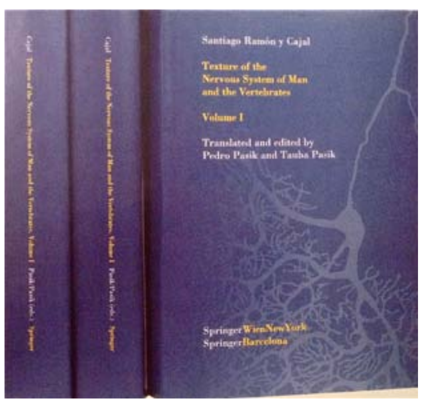


Tauba Pasik, M.D. and Pedro Pasik, M.D.

Tauba Pasik, M.D. and Pedro Pasik, M.D. have been associated with Mount Sinai's Department of Neurology for almost 60 years. They were raised and educated in Argentina and, after graduating from medical school at the University of Buenos Aires and serving a year as Neurology residents at Bellevue Hospital, started the first Laboratory of Experimental Neurology in 1955, under the auspices of Dr. Morris B. Bender. They climbed the ranks from Research Assistants and Neurology Residents at the Hospital to full Professors in the Medical School.

Their research, uninterruptedly supported by the NIH for 35 years, used exclusively monkeys to study as wide fields as behavioral aspects of brain function and the intrinsic organization of neuronal networks in the visual and basal ganglia systems, resulting in over 100 articles in first-rate peer-reviewed journals, and as many chapters in books. A major accomplishment was the annotated and edited translation of Cajal's original Texture of the Nervous System in Man and the Vertebrates, a 3-volume set that has been considered as the "definitive" Cajal. They were awarded the highest academic title of the University of Buenos Aires, Professorships honoris causa. They carried the banner of Mount Sinai to the four corners of the world, as Visiting Professors or Scholars in Academic institutions of Argentina, China, Hungary, Israel, Mexico, Russia, Spain and Ukraine. The Pasiks were named Professors Emeriti of Neurology in 1998.

While Tauba retired earlier for health reasons, Pedro invested part of his time in education. Many of the 200 students that took his graduate course change careers into neuroanatomical fields. He directed a new Brain and Behavior Course for medical students for 11 years. Many considered him a role model, particularly for his capacity to integrate the basic neuroscience and clinical neurology. At his retirement he was recalled to continued the teaching of the course for another 13 years, constantly updating it to fulfill the demands of new educational trends. For the past 10 years he also gives a course on Advanced Topics in Clinical Neuroscience. He was recently named Professor Emeritus of Medical Education.

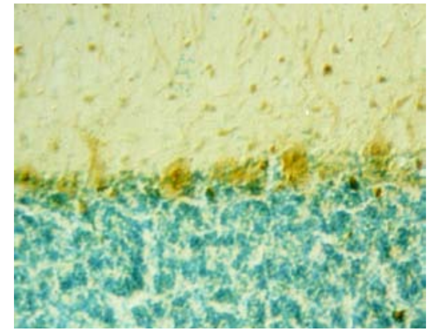


John Szentágothai's pet project
To the Memory of János (John) Szentágothai
1912–1994

Reminiscing about John Szentágothai
Tauba Pasik and Pedro Pasik
Mount Sinai School of Medicine
New York, NY

The memories of John Szentágothai, dearest friend, inspiring teacher, mentor and role model, are helped by a most precious collection of his correspondence with us that covers over 30 years of his life and ours. Fortunately Maria Déak, his faithful secretary, typed about half of his letters. The other half are hand-written approaching the old Süterlin German calligraphy and rather laborious to decipher.

Visiting with us in Jerusalem (1993)



Cerebellar cortex (GABA antibody, methyl green)

But all time spent is overcompensated by the delightful descriptions and insights into the thoughts and feelings of the great man.We shall be very pleased to share with the participants and the audience a minute portion of these epistolary documents on such diverse subjects as pure science, science politics, philosophical and religious stands, as well as his views of World and Hungarian events.

Celebrating John's 70th birthday in New York City

Dr. Peter Petrusz

Dr. Peter Petrusz received his MD diploma in 1963 at the Medical University of Pécs, Hungary. In 1959, still a medical student, he joined the Anatomy Department of the University headed by Professor János Szentágothai, where he continued to work until 1966 under the direction of Prof. Béla Flerkó, one of the world's leading neuroendocrinologists at the time. Subsequently he spent 5 years in Stockholm, at the Karolinska Institute, where he obtained a PhD degree in Reproductive Endocrinology. Since 1971, he lives and works in the United States, where he is currently Professor of Cell Biology and Physiology at the University of North Carolina at Chapel Hill.

While still in Pécs, he was the first to demonstrate that the mechanism of androgen-induced male sexual differentiation involves a reduction in the feedback sensitivity of hypothalamic structures and other estrogen-sensitive tissues. It is only recently, with the advent of epigenetics, that the molecular mechanism of this effect can be understood.

In Chapel Hill, starting in the 1970s, he pioneered the development of immunohistochemical techniques, widely used today both in research and in pathological diagnosis. He introduced specific criteria for the validation and interpretation of immunohistochemical results. Beyond his leading role in the establishment of this indispensable technology, he and his collaborators applied this technique to major problems of contemporary research. They were the first to demonstrate calcitonin-producing cells in the thyroid gland of the rat and to publish detailed descriptions on the distribution in the central nervous system of several neuropeptides (somatostatin, enkephalins, beta-endorphin, gonadotropin-releasing hormone, thyrotropin-releasing hormone, corticotropin-releasing hormone, growth hormone-releasing hormone, etc.) as well as serotonin. These studies, documenting the widespread distribution of biologically active peptides in the brain and in other tissues, contributed to current concepts about the chemical nature of cell-to-cell communication within and beyond the brain.

The third field in which Dr. Petrusz made significant contributions is male reproductive biology, specifically the understanding of the regulation of the complex processes of spermatogenesis. He and his co-workers carried out fundamental studies on the biological role and regulation of Androgen-Binding Protein (ABP), produced by the Sertoli cells of the testis. They designed and produced transgenic mice, in which the testis produces ABP in excessive amounts. This model helped them to gain new insights into the role of this protein as an autocrine regulator of Sertoli cell function essential for the maintenance of spermatogenesis and led to the identification of a set of androgen-regulated genes in the testis

by microarray analysis. Other studies described new fertility-regulating proteins in the epididymis and the molecular mechanisms behind recurrent prostate cancer.

Dr. Petrusz published a total of more than 130 peer-reviewed publications in addition to abstract, book chapters, books (as editor) and book reviews. He was elected President of the Histochemical Society in 1992 and the Hungarian Medical Association of America in 2001.

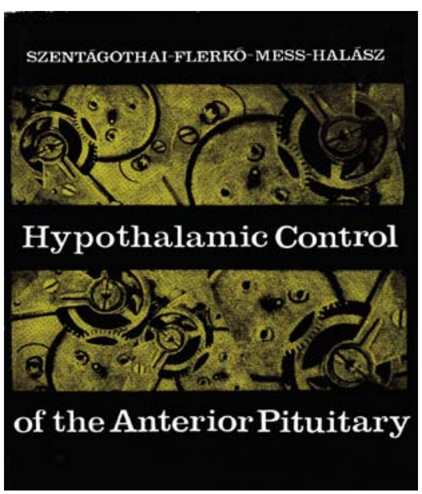
The Hungarian Academy of Sciences elected Professor Petrusz as its External Member in 2004.

Szentágothai: Chair of the Anatomy Department in Pécs 1946-1963 - the heydays of neuroendocrinology

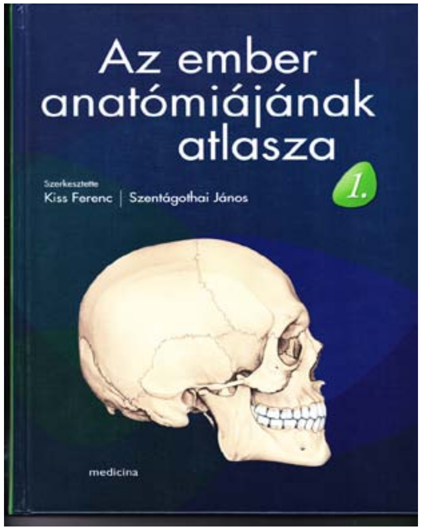
Neuroendocrinology as a scientific discipline did not exist at the time (1946) when János Szentágothai arrived to Pécs. It was Flerkó and Szentágothai in 1957 who first formulated, and provided experimental support for, the hypothesis that estrogens inhibit the production of gonadotropins from the anterior pituitary gland *not by acting directly on the pituitary*, as it was believed by almost everyone at that time, but by *acting on the brain* through a negative feedback mechanism. Due to the peculiar anatomical connections between the brain and anterior pituitary, this had to mean (as it had been proposed by the English physiologist G. Harris) that the signal controlling the anterior pituitary must be humoral, i.e., it must be a substance (hormone?) produced in the brain and reaching the anterior pituitary through the hypothalamo-hypophysial portal circulation. But how would this hypothetical substance enter the blood vessels (portal capillaries), which did not seem to be in direct contact with any nerve cells? In 1964, Szentágothai was the first to describe the existence of a system of small neurons in the hypothalamus ("the

parvocellular tubero-infundibular system") whose axons terminated – in a highly unusual manner – on capillary loops of the portal system in the median eminence and proposed that these neurons produced the missing humoral signal. These two fundamental observations (feedback mediated by the hypothalamus and the parvocellular neurosecretory system) provided a defining influence for the burgeoning new field of neuroendocrinology and they essentially stand today as were originally described.

The group continued to introduce new techniques, observations, and concepts. B. Török and his coworkers observed in living animals that blood flow in the portal system may be reversed under certain circumstances and introduced the concept of short-loop or internal feedback. Flerkó's group studied the effects of hypothalamic lesions on gonadotropin secretion and demonstrated that such lesions can result in anovulation and polyfollicular ovary – a condition very similar to the human disease of polycystic ovary, the most frequent cause of infertility in young women. B. Halász and his coworkers implanted pituitary tissue into the hypothalamus and introduced the concept of the "hypophysiotrophic area". Halász also designed an ingenious stereotaxic

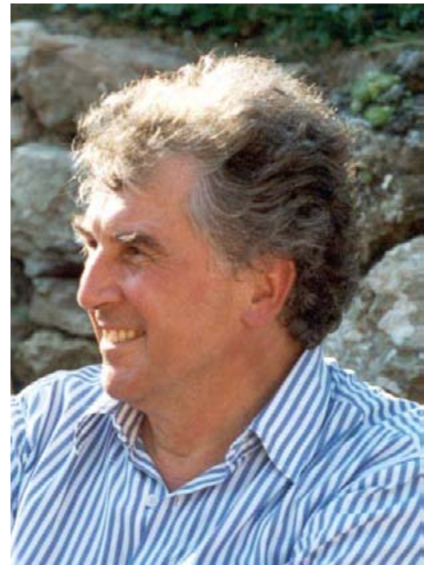


knife, known as the "Halász-knife", by which it became possible to carry out very fine, targeted cuts in brain areas; observations made



this way contributed greatly to our understanding of afferent connections of various hypothalamic nuclei and their influence on neuroendocrine function. B. Mess and his co-workers established the role of the habenular nuclei in the regulation of thyrotropic function and in the negative feedback effect of thyroid hormones on TSH production. They also demonstrated direct feedback by thyroid hormones to the anterior pituitary.

In addition to many original papers, the group (Szentágothai, Flerkó, Mess, and Halász) published a monograph entitled "*Hypothalamic Control of the Anterior Pituitary*" in 1962 (Second Edition 1968, Third Edition 1972), which became a true scientific bestseller in its time. Today they are remembered among the most influential pioneers of the now well-established research field and clinical discipline of neuroendocrinology.



Miklós Réthelyi

Miklós Réthelyi was born in Zalaegerszeg (Hungary). He is Emeritus Professor of Anatomy in the Department of Anatomy, Histology and Embryology at Semmelweis University, Budapest, Hungary. He graduated from Medical School, Pécs University, Hungary (1963). He was the Rector Magnificus at Semmelweis University between 1991 and 1995. Upon his initiatives started the series of Semmelweis Symposia in Budapest in 1992, and he personally was involved in the launching of the postgraduate (PhD) training at Semmelweis University. He was the Chairman of the Department of Anatomy, Histology and Embryology at Semmelweis University between 1994 and 2004. Among his predecessors as chairmen of the department were Mihály v. Lenhossék and János Szentágothai.

He was the Director of the Szentágothai János Neuroscience Postgraduate School at Semmelweis University (2000-2009). Between 2010 and 2012 he was the Minister of National Resources in the Hungarian Government overseeing health care, education, social-, family- and youth affairs, culture and sport. Recently he is the Chairman of the Hungarian National Committee of UNESCO.

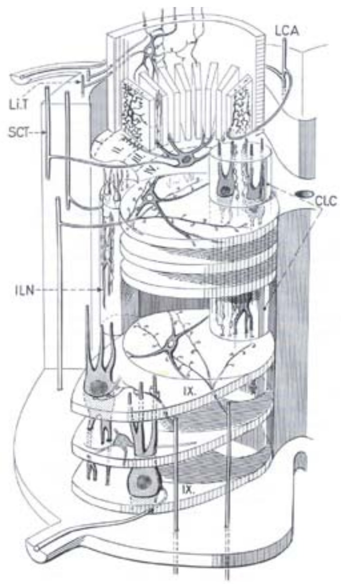
His scientific interest is in the synaptic organisation of various regions of the spinal cord (substantia gelatinosa, Clarke's column, intermediolateral nucleus, lateral spinal nucleus, Onuf's nucleus, filum terminale). His long-time collaboration with Edward R. Perl and Alan R. Light (Chapel Hill, NC, USA) resulted in several publications dealing with the involvement of the dorsal horn neurons in the transmission and blocking of neuronal impulses leading to pain sensation.

Szentagothai: Chair in the Anatomy in Budapest (1963-1977)

The teacher and public man

In the fall of 1963 John Szentágothai returned to his alma-mater and took the chair of the Department of Anatomy in Budapest. He started his studies in Budapest in 1930 and graduated in 1936. As early as 1933 his master, Micheal v. Lenhossék presented Szentágothai's results about the autonomous nervous system in the Hungarian Academy of Sciences.

Szentágothai was impatiently waited in the Department by numerous enthusiastic scientists. Laboratories were formed working with various neurohistological techniques and researchers could select among a vast array of topics, like cerebellum, thalamic nuclei, auditory system, visual system, spinal cord, peripheral nervous system. Szentágothai returned from his European and US trips with pieces of first hand information about new techniques, interesting results. Although Hungary was at that time separated from the Western World, our boss was the true mediator of new results and ideas. A small size table-electron microscope helped several of us to study neurons, simple synapses and complex synaptic glomeruli. Szentágothai's basic knowledge in the light level structure of neurons was a great asset for all of us for the correct orientation in the electron microscopic dimension.



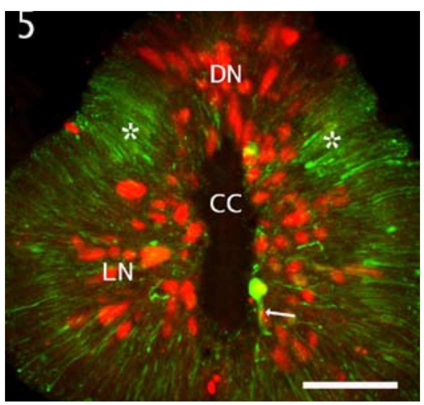
Cyto-and neuropil architecture of the spinal cord.
(Rethelyi-Szentagothai, 1973)

Due to the fact that people lived in rented apartments at that time and to the customary low speed of administration – the Szentágothai family was reunited in their Budapest apartment only in 1964, one year after they left Pécs. Meantime John and his wife, Alice stayed in the Anatomy Department. This "golden age" meant that he was available not only daytime, but also early morning and late night for looking at a freshly prepared histological preparation or admiring the black and white beauty of the electron microscopic pictures.

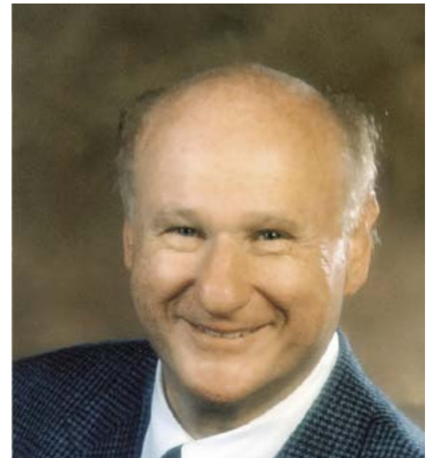
He lectured regularly in jam-packed auditorium to medical and dental students, visited the dissecting room, and was the head of the exam committee at the final oral and practical exams.

This idyllic situation was gradually interrupted by increasing chores in the Hungarian Academy of Sciences and later in the Hungarian Parliament. In spite of his multifarious activity, he not only kept his office in the Department, but he spent hours there almost each day. His interest turned more and more towards the columnar structure of the cerebral cortex. Also the problems of the brain-mind-faith triangle moved in the forefront of his thoughts.

The author met John Szentágothai for the last time one day before his unforeseen death in the yard of the Anatomy Department as he set into the car. They agreed that the Atlas of the human body, – a classical work of Szentágothai published first time in 1946 – must be revived. His final wish has been realized since then.



Neurons of the filum terminale
(Boros et al., 2008)



András Pellionisz

András Pellionisz is a Hungarian cross-disciplinary biophysicist. Having won competitions in physics and mathematics and the National Championship in Physics faced the trilemma or entering Budapest University of Medicine, Technology or Physics. Graduated in Engineering, put his skills in biophysics in Semmelweis University Medical School (joining the Szentágothai Lab). He holds triple doctorates; in Computer Engineering, Biology and later in Physics. Started his USA career by invitation to Stanford. Later accepted Professorship to New York University (1976-1992), a member of the New York Academy.

Pioneered the paradigm shift from AI to Neural Nets, as Founder ot the International Neural Network Society. His Tensor Network Theory explaining the coordinator function of cerebellar neural nets was awarded by the Humboldt Prize for Senior Distinguished American Scientists by Germany (1990), an MIT book "Neurocomputing" and his first patent, used by NASA and US government defense technology. His second paradigm shift was Internet from government project exploding to global industry (1994-2000). In Silicon Valley of California served as chief software architect at NASA and at private companies, including Ernst & Young.

With the advent of genomics, based on his decades of experience with cerebellar neural nets, he never believed the twin axioms of "Junk DNA" and "Central Dogma". Instead, discovered FractoGene in 2002, the biophysical utility of understanding growth of fractal organisms governed by fractal genome. From the same year when LeRoy Hood declared that genomics became informatics, he pioneered a third paradigm-shift. The Founder of International HoloGenomics Society, he held its Inaugural in Budapest in 2006 as the new science of genome informatics he proposed suitable for Hungary. Later the US ENCODE concluded likewise; first in 2007, when he published "The Principle of Recursive Genome Function" (2008). Based on sound genome informatics, his work sets forth new mathematical principles for proceeding with interpretation of the whole genome. Dr. Pellionisz' fractal approach to genome function is now corroborated by recently published findings about the fractal folding of DNA structure by Presidential Science Adviser Eric Lander (2009).

Dr. Pellionisz founded HolGenTech, Inc. (2010) as a Genome Analytics company in Silicon Valley of California to leverage defense-validated high-performance hybrid computer hardware with a novel, fractal algorithm-based approach for genome analysis and recommendation. He serves Academia by Foundership of Societies, Editorships, Visiting Professorship Worldwide and 150+ publications. A recent entry is a Springer Textbook, subtitled "Geometric Unification of Neuroscience and Genomics" (2012). Dr. Pellionisz spearheads industry with HolGenTech and by serving on the Board of Informatics companies in the USA, India. Global competition heated up recently when ENCODE finally gave up on half-a-century dogmas in Sept. 2012, with industrial players in genome informatics escalating to the scale of SAMSUNG and SIEMENS. Recently decorated in India, now Dr. Pellionisz deploys his new FractoGene US patent 8,280,641 to outsourced software development for genome-based pharma-testing and development, combined with also outsourced clinical trials, to gain their secured access to US markets.

The Cerebellum as a Neuronal Machine – *Tempora mutantur, nos et mutamur in illis*

János Szentágothai (Sz.J.) cherished abundantly quoting from the many languages he so eloquently spoken. The Latin hexameter "The times move on, and we too move along in them" certainly applied to his co-authoring the above-titled book; one of the two books that defined my life, along with János von Neuman' "The Computer and the Brain". The "Neuronal Machine" was what these days we call "an encyclopedia" – and Sz.J. along with co-authors Sir John, Masao Ito did

not shy away to move on with an astounding admission literally on the last page of the corrected proof Sz.J. gave me (at that time more practical than buying the book in dollars, and now with his hand-written dedication esteemed beyond anything money can buy). The Computer and the Brain – also in its last page – admitted that the mathematical language of brain function was unknown; defining an ample general agenda for my lifetime and beyond. The Cerebellum as a Neural Machine specified the challenge by its confession that beyond all the so-well-known cogwheels of the functional anatomy and physiology, how the "machine", beyond "working" actually produced sensorimotor space-time coordination was out of reach for the authors, and Sz.J. had to move on to a "cybernetist" or whatever to make mathematical sense of the beloved "neural machinery". I was captivated by the curiosity of the true scientist who not only admitted his boundaries but in a rare unselfish manner wanted to move beyond them, rather than follow "turf war" instincts of lesser minds. I was hired. So many decades later have arrived at geometric unification of neuroscience and genomics.

Ever since my first day as a scientist admitted to the Sz.J. school I use his measure of a true thinker; to recognize no boundaries, let alone "turfs". My late friend Ed Teller was likeminded; changing history with his physics he told me "the 20th Century was that of Physics – the 21st will be that of Biology".

The Szentágotai School carried the long legacy of Lenhossék, Hőgyes, Bárány – and connected their seminal notions of neurons, vestibulo-ocular reflex-arcs to go beyond them. He turned disadvantages of history to find a way to benefit from. His School flourished in Hungary in part because so few could tunnel the Iron Curtain. Those who stayed did remarkably well – not one of them even became cabinet members of modern Hungary. Sz.J. as the Chairman of Hungarian Academy of Science had to be cautious linking parts of his school within and beyond the limit of borders; now he would probably lead a worldwide network of leading minds of Hungary.

"As times move on, we too have to move along". One wonders how his free spirit would induce with changed times some timely changes today. Globally, I am most curious at this juncture how Sz.J. as a biologist would welcome genomics gone from biochemistry to informatics!

Jim Watson and András Pellionisz at his presentation of FractoGene in Cold Spring Harbor

Péter Érdi

Péter Érdi has degrees in chemistry and chemical cybernetics from Budapest, Hungary. From 2002 he serves as the Henry R. Luce Professor of Complex Systems Studies at Kalamazoo College (Kalamazoo, Michigan, USA). He was the Head of Department of Biophysics KFKI Research Institute for Particle an Nuclear Physics of the Hungarian Academy of Sciences (1993-2011). He is now a scientific counsellor of the Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics. He is also the Co-Director of the Budapest Semester in Cognitive Science, a study abroad program mostly, but not exclusively for North-American students.

Érdi has an interdisciplinary research interest, as his major books reflect:

Péter Érdi and János Tóth: Mathematical Models of Chemical Reactions: Theory and Applications of Deterministic and Stochastic Models. Princeton University Press (1989)

Michael A Arbib, Péter Érdi and János Szentágothai: Neural Organization: Structure, Function, and Dynamics. The MIT Press. (1997/98)

Péter Érdi: Complexity Explained. Springer, 2007

Érdi's main research field is computational neuroscience, and recently he is working on understanding psychiatric symptoms based on the concepts of dynamical diseases and/or functional disconnectivities. In the last several years he has an active research program on computational social science, too. His research group's newer findings about prediciting emerging field of technologies based on the analysis of the USPTO database got some media reflection.

Among others he is a member of the board of governors, international neural network society, served in the FENS-IBRO european neuroscience schools programme committee (2008-2012), and member of the advisory board: Springer Complexity: Cutting Across All Araditional Disciplines. In April 2012, as a keynote speaker of European Meetings on Cybernetics and Systems Research in Vienna he gave the Luigi M. Ricciardi memorial lecture. During the fall of 2012 he is a fellow of the Insitute of Advanced Studies at Durham University (UK).

Reconciling the Irreconcilable: Self-organization versus Downward Causation

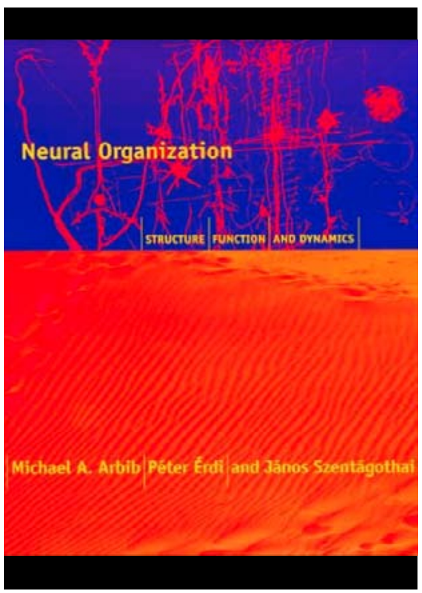
János Szentágothai's (JSz) had two main theoretical efforts. First, he considered self-organization "... as the basic paradigm in the framework of which the essence of the neural can be better understood...". Self-organization is a spontaneous process where macroscopic order arises out of the local interactions among components; so it is a basic bottom-up mechanism of the emergence of complexity. Second, he felt that the concept of ‘’downward causation’’, i.e. that mental agents can influence the neural functioning, (obviously a top-down mechanism) may offer a third option between radically monistic or explicitly dualistic philosophical approaches. The latter was famously suggested by Sir Karl Popper and Sir John Eccles in 1977. JSz finely-tuned arguments gave orientation how to reconcile the irreconcilable.

JSz argued that the old “reflex paradigm” should be abandoned, since the basic principle of neural functions is their self-organizing character. The emergence of complexity by self-organizing mechanisms has been demonstrated both on ontogenetic and phylogenetic scales. According to embryological, anatomical and physiological studies, the wiring of neural networks is the result of the interplay of purely deterministic and random mechanisms. Fluctuations may operate as “organizing forces” in accordance with the theory of noise-induced transitions. Self-organizing developmental mechanisms (considered as “pattern formation by learning”) are responsible for the formation and plastic behavior of ordered neural structures.

While “downward causation” was suggested by Roger Sperry, he was criticized by stating that the postulate that physiological mechanisms of the brain are directly influenced by conscious processes is unclear. Alternatively, it was cautiously suggested, that the nervous system can be considered as being open to various kinds of information, and that there would be no valid scientific reason to deny the existence of downward causation; or more precisely, of a two-way causal relationship between brain and mind.

The central component of JSz’s arguments was that the brain is neither purely deterministic nor random. Cerebral cortex might be considered on a large scale as a mosaic of vertical columns interconnected according to a pattern strictly specific to the species. Motivated by the pioneering work of Katchalsky on the dynamic patterns of neural assemblies, JSz offered to interpret the cortical order in terms of ‘dynamic structures’ instead of applying some ‘crystal-like’ approach.

The second component was close to Donald MacKay’s information-engineering approach, who emphasized the existence of two types of causal analysis, namely physical and informational one. We were thinking whether the relationship between entropy and information may be the key between self-organization and downward causation, but the answer, I am afraid, remained elusive.



Ivan Bodis-Wollner

Ivan Bodis-Wollner, MD, DSc, was born in Szeged, Hungary, where he attended Szt.Istvan Elementary School and Radnoti Gimnazium. However he learned to read and wrote in the concentration camp in Bergen-Belsen from his grandfather who also taught him about Schopenhauer, the stars and relativity. He is still “indebted” to the Communist leaders in his youth for firing Szeged university professors deemed unfit to teach in university under the socialist regime because of their background. After the matura in 1956 he was accepted as a medical student at Szeged University. In October 1956 he joined the National Guard (Nemzetorseg). At the urging of his mother and stepfather he left Szeged November 12th passing through Yugoslavia where he was under house arrest with his relatives in Szabadka until he left for Austria where he received his medical degree from the University of Vienna. Being a poor refugee student meant also some isolation. Studying from the Kiss –Szentagothai anatomy helped to provide some spiritual an intellectual links. Kiss came to lecture once, but not, unfortunately, Szentagothai. It took him many years to finally meet him and Mrs .Szentagothai in New York.

After becoming a country hospital doctor in Horn, was appointed in the Physiological Institute of the University and then he received a scholarship to the Physiological Laboratory of Cambridge University, England where he studied vision and visual perception which has been his basic research interest ever since. After Cambridge he was a graduate student at the Department of Machine Intelligence and Perception, Edinburgh University (UK). Internship and neurology residency were both completed at Mt. Sinai Hospital, NY, where he became professor in Neurology and Co-Director of the Parkinson Disease and Related Disorders Center. Since the beginning of his career he has combined patient care with basic and clinical research. His paper in Science (1972) established contrast sensitivity as a clinical measure. His interest is in the role of dopamine in vision and voluntary eye movements in Parkinson Disease. He is currently Professor of Neurology and Ophthalmology and Director of the Division of Movement Disorders at SUNY Downstate Medical Center. He was elected (1973) member of the American Neurological Association (ANA) and a current Fellow of the Hanse Institute for Advanced Studies of Germany.

He received a Doctor of Sciences degree from the Hungarian Academy of Sciences. Professor Janos Szentagothai was the head of his dissertation committee. He maintained contacts with him and the neuroanatomist, friend Jozsef Hamori whom he first met at Mt Sinai Med Center NY when Joska Hamori was visiting professor at Mt Sinai. He was elected foreign member of the Hungarian Academy of Sciences (neurobiology) in 1994.

Other honors include a Fogarty Senior Fellowship, Humboldt Research Prize, Doctor Honoris Causa from Szeged University, associate faculty at Szeged University and corresponding membership of the German Clinical Neurophysiology association.

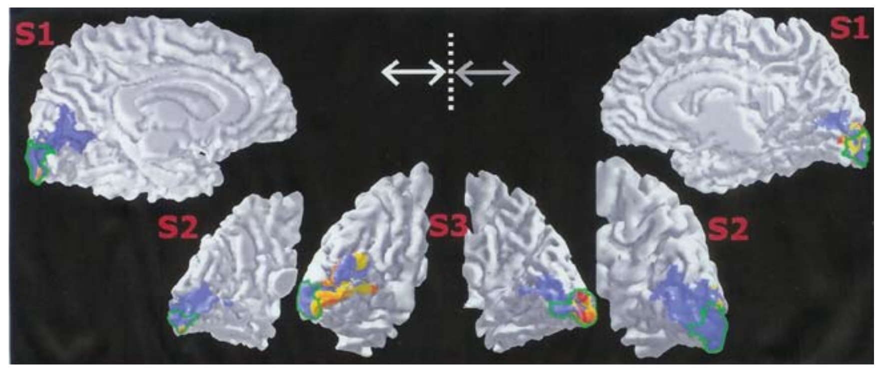
Szentagothai, Reflexology and Pre-Emptive Perception

The presumption that physical phenomena are exclusively determinate has had a nearly all-inclusive effect on modern behavioral science. The underlying, often not explicit axioms of the classical behaviorists, as Glimcher aptly stated (2005), were explicitly anchored to a fully deterministic worldview, and this anchoring clearly influenced the experiments that those scientists designed.This trend in experimental approaches to cognition has been largely initiated by Sherrington by studying spinal cord reflexes: the integrative actions of the nervous system (Sherrington1906). The experiments of Pavlov (1927) reinforced the view that paired stimuli evoke obligatory behavioral responses, (even though Pavlov himself was somewhat less dogmatic, according to his notebooks). One of the first serious attempts to bridge reflexology, behavior and higher nervous system activity stems from Konorski(1948). He perceived the difficulty of linking inhibition of central conditioned reflexes to a plausible model based on lower nervous sytem activity Konorski 1948, Chapter IX). He recognized that in paring reinforced and not reinforced conditioned stimuli, the two have to be differentiated. The process of differentiation is difficult to fit into pure reflexological concepts of higher nervous system organization. Konorski attempted to extend basic reflexology by postulating reflex inhibitory processes which arise when two stimuli are concurrently given. In essence the experimental paradigms of reflexology are wedded to pairing in proximate time several stimuli. . However, he did not question the assumption that all of behavior including inhibition, can be regarded as fundamentally deterministic in character. One fundamental, almost axiomatic experimental basis of reflexology is based on pairing external stimuli in proximate time. Konorski stopped short of challenging a deterministic point of view of the brain. One reason may be that he did not consider in the inhibitory process internal mechanisms which may rely on earlier experimental manipulations and the total milieu of the experimental subject. Janos Szentagothai (JSz), a neuroscientist, worked with anatomical tools to reveal the first time that the pyramidal tract does not directly synapse on motor neurons. This seemingly simple anatomical fact, however struck a piercing questionmark into the core of reflexology. He emphasized that the cortical organization may modulate sensory inputs on motor neurons. He also emphasized the ability of the cortex to inhibit the motor action, a question which was not answered by Konorski.Szentagothai's contribution is here to emphasize the NON "AUTOMATIC",non reflex element of inhibition by cortical mechanisms.

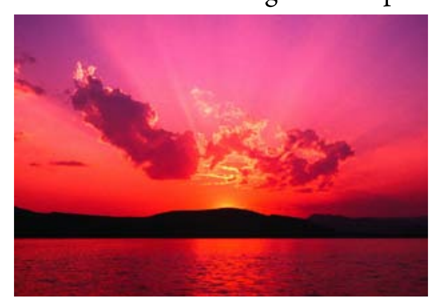
Here J.Sz formulated (1958) (in lose translation from the original german) that: the premotor system synthesizes and leads to the motor neurons, as a final common site, different cortical, extrapyramidal and peripheral signals. His studies of the Nucleus InterstitialisCajal (1950) led him to propose that this organization essentially serves for movement of the eyes, head and body,functions which we consider today as part of the brain circuits devoted to spatial orientation. Our studies in humans, using electrophysiological and imaging tools , led us to identify the distributed premotor cortical organization for voluntary eye movements. We termed perisaccadic brain processes as Pre-Emptive Perception (PEP) (Bodis-Wollner 2008). The period of PEP may be subdivided into time segments : preceding the movement , which includes intent to act and goal selection) and the time during the movement, which includes internal monitoring and error correction in reference to the motor plan, prior to completion of the action. In essence he proposed the synthesis of pre-actional neuronal activity and the not monosynaptic inhibitory role of cortical pathways on pre-motor circuits.

Our own and other current studies do suggest that two essential propositions of J.Sz(1943,1952,1958) on the integrated premotoric organization of eye movements for exploring the space around us arenow amenable for experimental proofs.

The synthesis of pre-action internal states, i.e.context and inhibition, are part and parcel of the voluntary motor system. The voluntary motor system is not deterministic, not in temporal synchrony with the external world, but neither is completely free. Our proposition (bodis-Wollner 2008) is that The Will, in the Schopenhauerian view, may be implemented by these two determinants of the action (Fukui and Gomi 2012). I wish we would not have been too late to discuss the Will with Janos Szentagothai.



Eye movements without visual input: striate cortical control in egocentric spa


Breaking from fixation

Márta Sarolta Viola

Márta Sarolta Viola was born 1979 in Budapest and moved 1989 with her family to Vienna. She studied medicine and Finno-Ugric linguistics with a minor in neurolinguistics at the University of Vienna and spent one semester at the Semmelweis University Budapest. She has worked at the Neurolinguistic Department of the Austrian Academy of Sciences, the Department of European Language and Literature Studies as well as the English Department of the University of Vienna. Currently she is writing her PhD thesis on sentence comprehension in Hungarian as a second language and is teaching pre-graduate and graduate linguistics courses.

János Szentágothai has often been referred to as a Renaissance man, it is well known that he was not only interested in the natural sciences, but also the arts, history and religion, to name but a few and he never ceased to try to pass on his enthusiasm to his children and grandchildren. Not only mushrooms were hunted and wild strawberries collected together during the weekends and summer weeks spent together in the family's week-end house in Leányfalu, but also moles dissected and beehives inspected. After the Sunday family lunches he'd read from his favourite poems and books - although these were not always age appropriate and therefore, admittedly, not always highly appreciated. That all of his eight grandchildren are fluent in several languages also partly goes to his credit: at a time when bilingualism was regarded as disadvantageous to children's linguistic development, he would only talk German and English respectively with his grandchildren who were (mainly) growing up in Hungary.
While the previous papers described the scientist, teacher, colleague and friend Szentágothai, this paper shall give a short, be it very subjective, glimpse into his life as a family man and grandfather.

János Réthelyi

János Réthelyi graduated from Semmelweis Medical University in Budapest, Hungary in 1999. After completing his PhD at the Institute of Behavioral Sciences under the supervision of Professor Mária Kopp, he began his clinical training in psychiatry in 2003 at the Department of Psychiatry and Psychotherapy. Currently he is associate professor at the same department. Until recently he has been the Head of the Acute Psychiatric Ward and the Deputy Director for Education. Since July 2012 he is on sabbatical at the Salk Institute for Biological Studies in La Jolla, California, working in the laboratory of Professor Rusty Gage. He participates in research aiming to model psychiatric disorders using patient derived induced pluripotent stem cells. His research during the recent years focused on the genetic background of schizophrenia and bipolar disorder and the genetic basis of cognitive dysfunction in these disorders. He is the author 45 scientific publications and received the precious Károly Schaffer Prize for young psychiatrists in 2008.

János Réthelyi
Budapest, La Jolla

Growing up as grandchildren of a "homo universalis" all of us enjoyed the company, the endless knowledge, and strong influence of our grandfa-

From Budapest through Gettysburg to Vancouver, then from La Jolla back to Budapest: An imaginary journey with my grandfather, János Szentágothai across continents

ther, but also had to cope with difficult tasks and face challenges. As the third grandchild in age my tasks included garden work, digging, mowing the lawn, and the pruning of bushes. As any small boy would have, I enjoyed working in the garden together a lot, but found it difficult to know the English names of the spade, the pitchfork, and the rake. He would

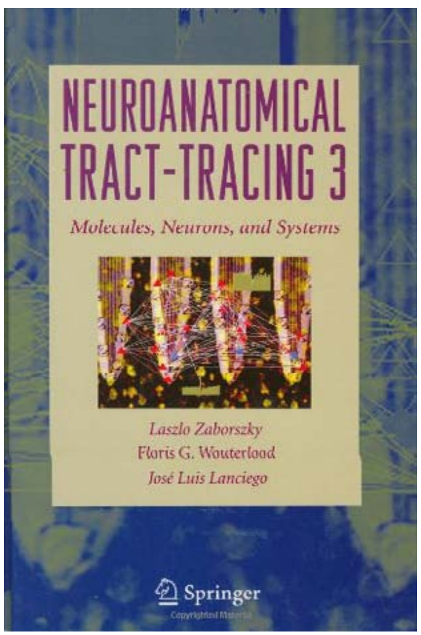
only communicate with us in English or German. Coming of age I often had to drive my grandparents to their weekend house in Leányfalu. I can recall colorful memories of his visits during the periods that my family spent in the United States. Visiting the Gettysburg Memorial together, he read us and explained the significance of Lincoln's Gettysburg Address. Later that year we met again in Vancouver, where we discussed the history of American Indians, and I watched him giving a lecture and debating with his scientific peers. He also followed, commented on, and probably influenced profoundly his grandchildren's academic interests. He was content when I told him I about my decision to study medicine rather than history, but became rather displeased when he heard about my plans to study psychology as well. Nevertheless he was reassured that I passed my final anatomy exam with good results. As a great teacher János Szentágothai found it important to pass on his ideas, knowledge and opinion about life's important questions to colleagues, students, and even the general public. As a family man he followed the same obligation, sometimes maybe a bit more biased and subjectively. 18 years after his death his example and opinion is still an important source of guidance in our lives.

The Szentágothai family

Laszlo Zaborszky

Laszlo Zaborszky, is Professor of Neuroscience at Rutgers-Newark, NJ. He received his MD at Semmelweis University with Sub Auspicis Rei Publicae Popularis (1970), and earned his PhD (1981) and Doctor of Science (DSc, 2000) from the Hungarian Academy of Sciences. He joined the faculty of the Department of Anatomy, Semmelweis University headed by Janos Szentagothai in 1969 where he worked until 1981. Before his faculty appointment he was Demonstrator and member of the Student's Scientific Association in the Department of Anatomy. He had worked as Assistant Professor in the Department of Anatomy at the University of Wurzburg, Germany (1973-1974). In 1981 he was invited to join the laboratory of Professor Heimer at the University of Virginia, Charlottesville, where he was appointed Associate Professor of Neurology, with a joint appointment in the Department of Neurosurgery in 1986. Later, he served there as Director of the Laboratory of Cellular and Molecular Neuroanatomy (1992). He moved to the Center for Molecular and Behavioral Neuroscience at Rutgers University in 1993, where he was promoted to Professor with tenure in 2004. He spent short sabbaticals in the Max Planck Institute for Biophysical Chemistry in Gottingen, Germany (1976), in the Montreal General Hospital, Canada (1986), at the National Institute for Physiological Sciences, Okazaki, Japan (2000), in the Vogt Institute for Brain Research in Duesseldorf (2000) and in the Institute of Neuroscience and Biophysics, Research Center Juelich, Germany (2005). He published 113 scientific papers, including book chapters and a monograph on hypothalamic connections (Springer, 1982). He is co-editor of the text books Neuroanatomical Tract-Tracing Methods 2 (Plenum, 1989) Neuroanatomical Tract-Tracing 3: Molecules, Neurons, Systems (Springer, 2006). He held more than 80 invited lectures at various international conferences and institutions and served on various international and federal scientific advisory boards. He chaired and organized numerous symposia in the United States, Australia and in Hungary. He advised more than 50 Undergraduate, Graduate Students and Postdoctoral Fellows. He is recipient of numerous private and federal research grants. He is Founding Editor-in-Chief, Brain Structure and Function (www.springer.com/429). He was elected foreign member of the Hungarian Academy of Sciences (2007) and was awarded Dr. habil. of Semmelweis University (2004), Hungary. He is incoming President of the New York Hungarian Scientific Society.

Dr Zaborszky Laszlo has made important contribution through his pioneering efforts to understand the functional organization of one of the most complex brain areas, the basal forebrain, which contains the cholinergic, cortically-projecting neurons ("nucleus basalis") that deteriorate in Alzheimer's disease. Using a combination of electron microscopy and double immunolabeling techniques, he was first to identify synaptic inputs to these cholinergic neurons, including catecholaminergic, GABAergic terminals, as well as projections from the cerebral cortex, nucleus accumbens, amygdala and hypothalamus. He developed -in collaboration with a German scientist-, a software tool that allows to extract the volume of cholinergic space from MRI brain scans of living persons to use as a biomarker for early diagnosis of Alzheimer's disease. In his recent work, he and his collaborators provided evidence that neurodegeneration in the nucleus basalis can occur in patients with mild cognitive impairment. He also coined the term 'core and shell' to describe the subdivisions of the nucleus accumbens, a forebrain area important in drug addiction and reward mechanism. His work has profound implications in the field of the neural basis of attention as well as for such disorders as Alzheimer's disease, Parkinson's disease and schizophrenia. His research was featured in Star Ledger (1994), Rutgers Focus (2008) and recently in Rutgers Magazine ("The Brain Trust", Fall 2012). URL: http://zlab.rutgers.edu/



Epilogue: Szentágothai, The Renaissance Man

Professor Szentágothai was a towering figure in the neuroscience research of the 20th century. His discoveries, including the description of the monosynaptic trigeminal stretch reflex and the elementary vestibulo-ocular reflex arch, the discovery of the source of the cerebellar climbing fibers, the description of the hypothalamic parvicellular neurosecretory system, the elaboration on the cerebellar neuron network, and the 'module concept' of cerebral cortex architecture quickly became text book data and part of the general neuroscience knowledge. However, Szentágothai not only established the basic architectural features of many brain systems, but looked beyond the mere facts and contributed to the development of many fundamental neurobiological concepts that shape our present day neuroscience research. His work has had a significant impact on such diverse fields as neurology, cognitive psychology, psychiatry and philosophy as this small conference attests. He claimed with the words of Karl Popper that "It is not the possession of knowledge that

makes the man of science but his persistent and relentlessly critical quest for truth." He was a romantic figure endowed with an exceptional imagination. He was convinced that science was not simply about gathering facts, creativity played an enormous role in interpreting these facts. He had a keen vision, he saw things that could not seen by others and he examined whether the facts fit together with his concepts. His imaginative models of neural circuitry in which he combined light and electron microscopic techniques for the definition of neuronal pathways -in the time when computers hardly existed- are unparalleled among his peers. He inspired and guided generations of neuroanatomists in Hungary and worldwide. As his successor, the then president of the Hungarian Academy of Sciences, Domokos Kosáry remembered him: "He showed me that science should be sacred and at the meantime could be fun, very serious fun..." He unselfishly helped his students and despite the still existing practice he did not want to be included as authors of the publications of his students. He encouraged young people, showed the level to be achieved and when he saw genuine effort and talent of the candidates he helped them In no way, however, did he stand behind the ones with only political and other non-scientific merits.

He has also been an enthusiastic educator of medical doctors and physicians through generations in Hungary. In his lectures, he talked about the three-dimensional functional structure of the brain and body and enthusiastically carried his listeners to a new world never seen before. As a real renaissance man he easily quoted the great authors of literature, arts and the Bible. It was not easy to follow his lectures, but all who managed, arrived to real profoundness. Very few scientists has this capacity. Thus, he has been a unique mentor/teacher not only in science but also in humanities. He was also a socially committed person, who often raised his voice under difficult political conditions.

The participants of this conference had the great privilege to work with Dr. Szentágothai and to live, in one time or another in our career, in the special intellectual environment provided by his radiant and vibrant personality. The torch was given to us and his legacy oblige us to pass his heritage and our knowledge on the young generations for the betterment of humankind.

References: Szentágothai, J. (1952) Die Rolle der einzelnen Labyrinthrezeptoren bei der Orientation von Augen und Kopf im Raume. Budapest: Akadémiai Kiadó.

Szentágothai, J., Flerkó, B., Mess, B., Halász, B. (1962 First English, 1965 second Russian, 1968, 1972 third English revised, enlarged) Hypothalamic Control of the Anterior Pituitary. Budapest: Akadémiai Kiadó.

Eccles, J.C., Ito, M., Szentágothai, J. (1967) The Cerebellum as a Neuronal Machine. Berlin, Heidelberg, New York: Springer-Verlag.

Szentágothai, J. (1971) Functional Anatomy. A textbook for medical students (in Hungarian). Budapest: Medicina. (Numerous editions; since 1985 with M. Réthelyi as co-author.)

Szentágothai, J., Arbib, M.A. (1975) Conceptual Models of Neural Organization. Cambridge, Mass., MIT Press.

Arbib, M.A., Érdi, P., Szentágothai, J. (1998) Neural Organization: Structure, Function, and Dynamics. Cambridge, Mass., MIT Press.

Záborszky L., Palkovits, M., Flerko B.(1992) János Szentágothai: A life-time adventure with the brain. An appreciation on his eightieth birthday. J. Comp Neurol, 326: 1-6.

Gulyás B., Somogyi P (2012) Biographical Memoirs of Fellows of the Royal Society: Szentágothai János 1912-1994.

Zsófia Trombitás

To mark the second anniversary of the establishment of the New York Hungarian Scientific Society we are celebrating the life and work of Janos Szentagothai, one of the greatest Hungarian scientists of the 20th century. When I recommended the creation of the Society in August 2010 I could not have imagined that this initiative would be so well received from New York to Budapest and beyond. As we all knew from the beginning - having a good idea is just the start. To realize its full potential takes commitment, enthusiasm and team work. After two years I am proud to say, that we have all that and more. That's why we are here today (myself in spirit even if thousands of miles away) - to use the Society as it was intended to: for effective networking, for the exchange of ideas, for communicating the excitement and importance of scientific endeavor and last but not least for commemorating Hungarian scientists like Janos Szentagothai.

To my great regret I didn't have the opportunity to organize this celebration myself. I am very grateful that Professor Laszlo Zaborszky, an internationally acclaimed brain scientist himself, embraced the idea and worked tirelessly to organize this celebration of Janos Szentagothai and the Hungarian brain research and science himself.

I cannot imagine what the founding members of the New York Hungatrian Scientific Society may have envisioned about the development and growth of the Society in 2010, but I do not think they ever dreamed that the Society would have such a growth in numbers and in success. We are proud to have world famous scientists among the founders of the Society, including Peter D. Lax, the winner of the Wolf and Abel Prize, György Buzsáki Co-Winner of the „Brain-Prize" and Endre Szemerédi winner of the Abel Prize. Within two years we have organized several successful lectures and one mini Conference at the Columbia University in April, 2011. In 2012 the Society was registered as a non- profit corporation and the number of its members tripled within the two years of the Society's existence.

I would like to thank again the invaluable support and the collective efforts of the Hungarian Scientists living in the New York area in general, and of the former Chairman of the New York Hungarian Scientific Society, Professor Janos Bergou and of Chairman Professor Zaborszky in particular and also Karoly Dan, Consul General of Hungary, for his patronage. I would also like to thank my husband Zoltan Tardos for preparing this beautiful brochure.

Now I would like to pass the baton to my successor Anita Demeter in the hope that your friendship and support will make her new role as Secretary of the New York Hungarian Scientific Society as enjoyable as it did for me.

JÁNOS SZENTÁGOTHAI
Chronology

1912 born János Schimert to Dr. Gustáv Schimert and Margit Antal on October 31, 1912

1938 married Alice Biberauer (three daughters, Katalin, Klára and Mária Krisztina)

1994 died Budapest 8 September 1994

Education and Positions

1930-1936 Pazmany Peter University, MD
1936-1946 Instructor, Assistant, Associate Professor, Department of Anatomy, Pazmany Peter University, Faculty of Medicine
1946-1963 Professor and Chair, Department of Anatomy, University Medical School of Pecs
1963-1977 Professor and Head, Department of Anatomy, University Medical School, Budapest
1973-1977 Vice President of the Hungarian Academy of Sciences
1977-1985 President, Hungarian Academy of Sciences
1986-1994 Emeritus Professor and Head of the Neurobiology Group, Semmelweis Medical School
1985-1994 Member, Hungarian Parliament

Honors and awards

1950: Kossuth Award, Hungary
1970: State Prize, Hungary
1977: Ferrier Lecture, Oxford, England
1984: F.O.Schmitt Prize of Neuroscience, USA
1985: Golden Medal of the Hungarian Academy of Sciences
1992: Order of Merit of the Hungarian Republic (Commander with Star)

Membership of learned societies and professional bodies

Hungarian Academy of Sciences, , National Academy of Sciences USA, Leopoldina German Academy of Naturalists, Academy of Sciences of the USSR, Royal Society, American Academy of Arts and Sciences (Boston), Finnish Academy of Sciences, Mainz Academy of Sciences, Pontifical Academy of Sciences, Royal Belgian Academy of Medicine, Royal Norwegian Academy, Royal Swedish Academy of Sciences, Serbian Academy of Sciences

Honorary degrees

University of Oxford, University of Turku, University of Pécs

FUNDING PROVIDED BY

BETHLEN GÁBOR
Alapkezelő Zrt

NEW YORK HUNGARIAN SCIENTIFIC SOCIETY
New York

GENERAL CONSULATE OF HUNGARY
New York

The following persons supported with additional funds before printing closure

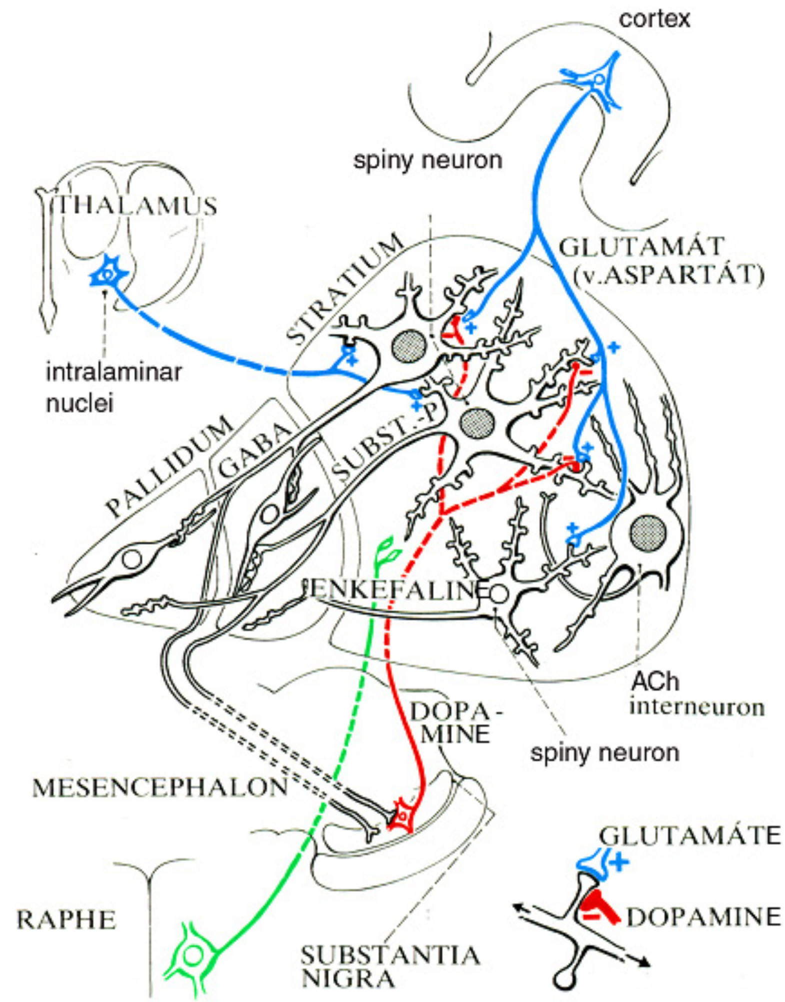
Abel Lajtha

Tamas Perenyi

Gyorgy Kralik

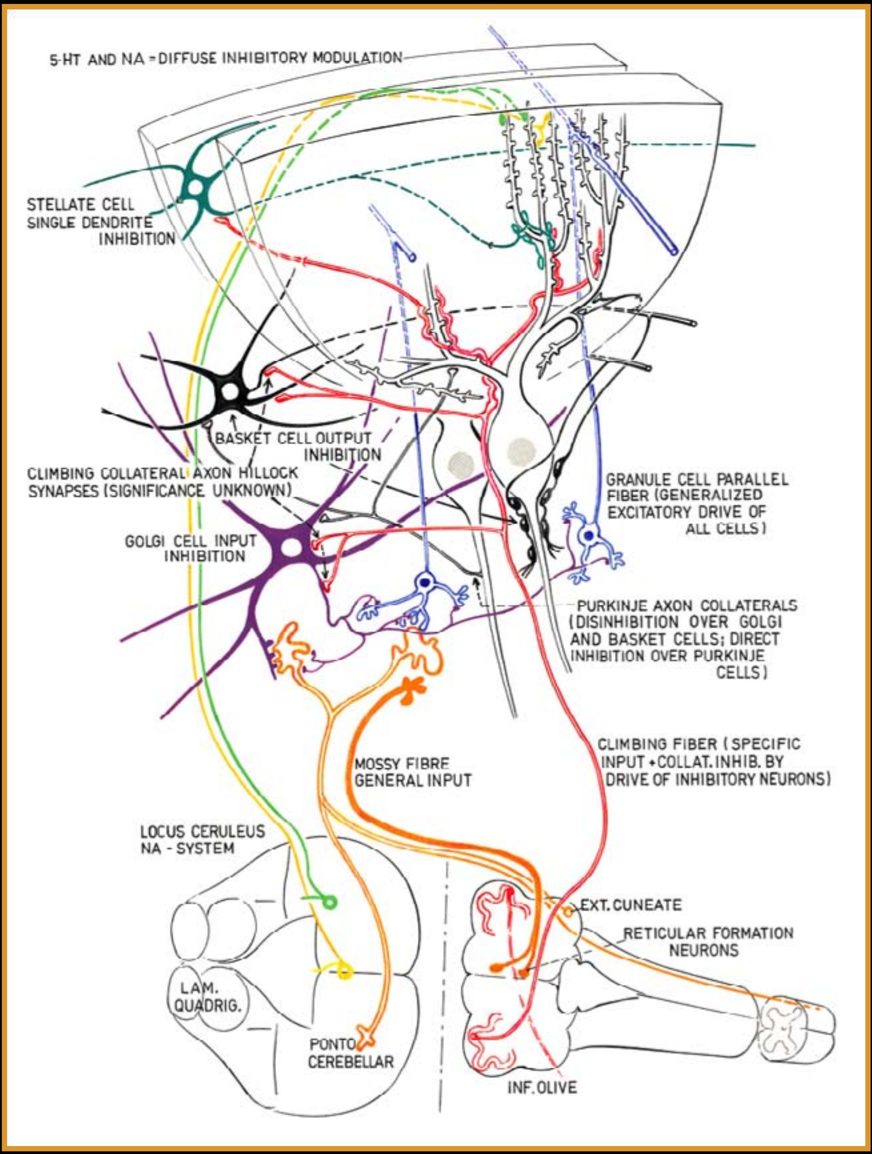
Peter Lengyel

Tamas Molnar



NEURONAL TYPES AND SYNAPTIC CONNECTIONS
IN THE BASAL GANGLIA

Szentagothai-Rethelyi: Functionalis Anatomia,
Semmelweis Kiado, Budapest, 1994



Cerebellar connections

(From the collection of Miklos Palkovits)