Nencki Award for George L. Gerstein

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NENCKI AWARD FOR GEORGE L. GERSTEIN

George L. Gerstein
First scientist to win the Nencki Award

In December 2008, the Nencki Institute of Experimental Biology is celebrating its 90th anniversary. On this occasion a prize has been established to honor scientists from all over the world who have contributed significantly to the scientific development of the Institute. The first winner of the Nencki Award is George L. Gerstein, Emeritus Professor of Neuroscience from the University of Pennsylvania School of Medicine

George L. Gerstein was born in Berlin 1933. His family (mother from Grodno and father from Riga) emigrated in 1938 to USA. George finished primary and high school in New York. He then moved to Harvard for college and graduate school (1948–1958) specializing in nuclear physics.

In 1958 Dr. Gerstein decided to switch his field of interest to neurobiology and he became a postdoctoral fellow at MIT, Cambridge. In the next three years he published five papers on computer analysis of electrophysiological signals starting with histogram averaging of single neurons (Gerstein 1960). In 1961–64 he was a junior faculty at MIT and continued his work on application of mathematical methods to physiological data together with Kiang, Fetz, Rodieck and Mandelbrot.

In 1964, George L. Gerstein moved to the University of Pennsylvania as Assistant Professor of Biophysics, built his own laboratory, started teaching graduate students and postdocs. He continued his work on spike train analysis, and published two now classic papers with Perkel and Moore on neuronal trains and stochastic point processes (Perkel et al. 1967). Working over the years at the same University, he changed positions to Professor of Physiology and Professor of Neuroscience but continued the same line of research. Among other achievements, he proposed the theoretical background for studying simultaneous activity of functional neuronal networks (Gerstein and Perkel 1969, Kristan and Gerstein 1970, Michalski et al. 1983) and worked out technology for recording single neurons from cerebral cortex of awake cats (Talwar et al. 2001). He also set up and worked with the nervous system of Aplysia and sensorimotor reflexes of crayfish claw and plasticity of networks controlling the underlying mechanisms. Throughout the years he published about 130 papers on neuroinformatics and sensory neurophysiology with several milestones in both areas (Kristan and Gerstein 1970, Emerson and Gerstein 1977, Gerstein et al. 1985, Abeles and Gerstein 1988, Sillito et al. 1994, Xing and Gerstein 1996, Maldonado and Gerstein 1996, Lindsey et al. 1997, Kisley and Gerstein 1999, 2001, Talwar and Gerstein 2001).

In the 1970s, the University of Pennsylvania received a grant from the Arthur P. Sloane Foundation (arranged by professor Eliot Stellar) to bring over postdocs from the Nencki Institute. In George Gerstein's laboratory several postdoctoral fellows from the Nencki Institute were offered their first research training abroad, which was otherwise difficult to organize that time (A. Wróbel, J. Czarkowska-Bauch, A. Michalski, M. Sarna). Some other researchers from Nencki Institute visiting Penn University at that time collaborated with the team of George Gerstein (R. Tarnecki and K. Turlejski). After that grant ran out, dr. Gerstein secured additional postdoctoral training for P. Musiał (Talwar et al. 2001). From 1970s professor Gerstein has visited the Nencki Institute to take part in several conferences organized by the Department of Neurophysiology. In 1974 he lectured at the "Brain and Behavior" symposium in Jabłonna (Gerstein 1974), and in 2004 he delivered the opening lecture at the workshop "Electrophysiological Semiotics of the Neuronal Systems" supported by a grant establishing a European Center of Excellence at the Nencki Institute (Gerstein 2004). He became a member of the ANE's Editorial Board in 1981. Just the following year, due to the difficulties in printing the Journal during the Martial Low in Poland ANE's lost its position on the ISI list and George Gerstein was among those western scientists who wrote letters in favor of bringing it back, and the action was ended successfully.

Professor Gerstein went on sabbatical leave and research stays in many academic institutions throughout the world: Moscow, Prague, Warsaw, Jerusalem, Tuebingen, London, and more recently Cambridge UK, Freiburg, Newcastle UK, Tel-Aviv, Tokyo. For his full sabbatical year at the Nencki Institute (1978–79) professor Gerstein brought over two laboratory mini-computers, integrated them with laboratory equipment and taught a group of researchers to use and program them to both control and analyze neurophysiological experiments. Although these computers were rather primitive machines by American standards (Z-80) he had to overcome a lot of bureaucratic obstacles in the US before he could export them to the Nencki. The training he offered to the Nencki staff started a new era of computational neuroscience in our Institute. He lived (with his children Mark, then age 14 and Eva, age 10) in the Ursynów district not long after it was built – still with raw countryside and forest nearby. It was a year of heavy snowstorms, and he still recalls that at one point the trains were so blocked by snow that the power plants almost ran out of coal. That year, however, he brought his warm and friendly personality to the atmosphere at the Nencki Institute, although the time was difficult and the situation was swelling for big changes of the Solidarity years, 1980–81.

Andrzej Wróbel

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Epilogue

George Gerstein: Obituary (1933–2018)

Ad Aertsen and Moshe Abeles

On March 28, 2018, our colleague and friend George Gerstein passed away.

George Gerstein was a great scientist, a dedicated teacher, and a true friend—in short, a real character, one of a kind. George had many facets: in science, in teaching, in interacting with students and colleagues, and in private. We will try to capture some of these aspects in the following paragraphs, being aware that we can only scratch the surface, based on our personal interactions with George. Fortunately, we could also draw from a manuscript by George's Ukrainian friend Dr. Valya (Valentina) Zelinskaya, and from our private correspondence with George's former wife Linda and their children Mark and Eva.

George Gerstein as a Neuroscientist

George was a truly unique person, in many ways. He profoundly influenced the development of scientific methodology in the neurosciences. His mission was as straightforward as it was ambitious, as formulated already in the abstract of

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his seminal paper with Benoit Mandelbrot in 1964, one of the very first papers ever to develop a mathematical model of single-neuron spiking activity (Gerstein and Mandelbrot 1964): *"Quantitative methods for the study of the statistical properties of spontaneously occurring spike trains from single neurons have recently been presented. Such measurements suggest a number of descriptive mathematical models. One of these, based on a random walk towards an absorbing barrier, can describe a wide range of neuronal activity in terms of two parameters. These parameters are readily associated with known physiological mechanisms."*

Here, in this short abstract, we meet several terms that characterize George Gerstein's approach to neuroscience, inherited from his solid background in physics: quantitative methods, statistical properties, mathematical models, model parameters, clearly linked to physiological mechanisms.

These various notions continued to be prominently present, in one way or the other, in all of George Gerstein's scientific contributions, throughout his long and productive academic career. From his very first papers in the early 1960s until his final ones in the late 2010s, all his contributions focused on a single, unifying scientific goal: to measure and quantify single and multiple neurons' spiking activities from experimental recordings in relation to behavior and, from the results of such analyses, to gain insight into these neurons' contributions to the functional role of the networks they participated in, preferably in the form of an appropriate mathematical model. Meanwhile, it is almost impossible to imagine neuroscience research without the many fruitful quantitative methods and measures developed by George Gerstein over the years.

Fortunately, we do not need to go through the many individual instances of George's work to document and illustrate these contributions. The various chapters in this Volume, introducing and reflecting on George Gerstein's scientific contributions to a wide range of topics in neuroscience research, written by a selection of his former students and close associates over the years, document and illustrate these contributions more than convincingly.

George Gerstein as a Teacher

George Gerstein was an influential teacher. Starting in his early years at MIT, throughout his long career at UPenn, and via his many extended research periods at Universities and scientific institutes all over the world, George was able to attract many students and postdocs into his unique way of thinking science. Among others, this is reflected in the large number of George's former students making their way successfully into academia and in the type of neuroscience research they contributed ever since, as is also wonderfully illustrated by their contributions in the various chapters of this Volume.

George took a great pride in contributing to the training of neuroscience students from Eastern European countries, especially from Poland. Thus, he spent a sabbatical year (1978–1979) at the Nencki Institute in Warsaw (Poland), together

with his wife Linda and their children Mark and Eva. Moreover, he hosted an impressive series of Postdoctoral students from the Nencki Institute in his lab at UPenn over the years. When going to Poland in 1978, George managed to bring two Z-80 minicomputers to the Nencki Institute (not a trivial task at the time) and got them to work. These were the very first minicomputers available for neuroscience research in Poland at the time. The spike train cross-correlograms computed on these machines were henceforth, quite appropriately, called "Georgeograms." Hence, very appropriately, the very first Nencki Award was awarded to George Gerstein in 2008 (see 'Nencki Award for George L. Gerstein' this Volume).

Such activities did not go unnoticed in the USA at the time. George told me (AA) years later that some time after his stay in Poland, he received an unannounced visitor, dressed in a long trench coat and with a fedora hat, who insisted on interviewing him on which advanced technologies and scientific insights he had transferred to the "enemy," Needless to say that George threw him out and continued his dedicated contribution to training neuroscience students and postdocs, both from within and beyond the USA.

George Gerstein as a Person

Here, George's Ukrainian friend Dr. Valya Zelinskaya writes:

"George Gerstein was born in Berlin in 1933 to an intellectual Jewish family, which had emigrated from Riga a year before the October Revolt in 1917. In 1938, when he was 5 years old, the family left Nazi Germany, literally by 'the last train,' for the United States. There, at home in New York, according to his stories, there was everything necessary to satisfy the intellectual requests of his family, but never anything excessive. Thus he remained an ascetic for the rest of his life. In everyday life he lived minimally. In his opinion, for instance, a car requires 4 wheels to drive, but does not need any frills. Also, he was extremely modest in clothing and food. "I'm not posh" he often said. However, one luxury he didn't reject was books, art and travel. He had a highly developed feeling of beauty. He found it and admired it not only in the arts, but also in everything that surrounded him—a beautiful flower, an autumnal leaf."

"George's school years passed in New York. During these years George had read every book, from A to Z, available in the public library. Incredible, but he told me about this as we passed by the library, walking around Manhattan one day. At age 15, he moved to Harvard to continue his education. As he no longer lived with his family anymore, he did not speak Russian—sometimes for years, and he always wondered, how he had retained this language for life. He enjoyed speaking Russian, and liked when we called him by his Russian name '*Yura*.'"

"George liked to travel the world and share his scientific expertise/inspiration with others. He spent Sabbatical leaves in the Soviet Union, Poland, Israel, Germany, and England. In 1968 he came to a conference in Kiev (then still part of the Soviet Union). There he teamed up with Dr. Valentina Zelinskaya (alias Valya)

and her husband who worked on data recorded by Valya in the Basal Ganglia of normal and 'Parkinsonian' rats. A couple of years later he spent half a Sabbatical year in Moscow and visited Kiev again. That half year was used by his, then, spouse Linda to study Churches in the region. Later, George spent many hours organizing the multitude of pictures she had made in a well-organized data base."

In Israel, George spent 5 extended research periods with Moshe Abeles at the Hebrew University in Jerusalem. A year before his third visit, Valya and her family (spouse, children, and grandchildren) emigrated to Israel. Valya came to work in the lab of Moshe Abeles, who did not know about her acquaintance with George. Imagine her and George's surprise and joy, when meeting on the first day he came to the lab. During this visit, he joined the retreat of students and teachers of the ICNC at the Hebrew University in Kibbutz Ein Gedi. Moshe Abeles remembers:

"In these retreats I always organized a half-day hike in the Judean desert. This breaks the barriers between students and professors and allows for honest discussions of problems. At this particular retreat, we hiked along a gorge of a dry river-bed running down towards the Dead Sea. All of a sudden, I saw Valya and George depart from the group and walking towards a paved path running on the elevated bank of the gorge. I caught up with them to inquire what had happened. Valya told me that George had eye problems that made it difficult for him to walk over the boulders and the uneven river bed. Prior to this, I did not notice any problems, but she was by far more sensitive than I was. This was the first sign of the progressive deterioration of George's eye sight. Later on, he had eye surgery that improved his eye sight a bit. He could read and write, work on the computer, developing software for analyzing data, and carry on his data analyses. In his next two extended visits to Israel, together with his new companion Janet, they both enjoyed the science and the country tremendously."

George Gerstein as a Colleague and Friend

For us, writing this obituary is a bit like riding a roller coaster, oscillating between reliving fond memories of our many constructive interactions with George and feelings of sorrow, due to George's deteriorating health and growing isolation in spite of his clear mind in his final years. We decided to focus on and rejoice our fond memories in the following and keep the sorrow to ourselves.

Interacting with George on neuroscience was a true pleasure and a headache at the same time. The pleasure came from his ceaseless creativity in suggesting new measures for quantifying neuronal spiking in relation to behavioral tasks, in relation to other neurons' spiking, and in relation to neuronal population activity measures such as LFP and EEG. The headache came from his stubborn insistence on truly understanding these measures and his highly detailed approach of calibrating them vis-a-vis a comprehensive set of possible neuronal interaction scenarios, each one implemented in a detailed neuronal network simulation scheme. Not unexpectedly, this typically took forever and, hence, application of his new measures to experimental data took considerably longer than the experimentalists had hoped

for. Nevertheless, whenever these measures finally emerged from these hard testing grounds, they invariably proved to be extremely worthwhile and insightful.

George was not religious, but he was keenly aware of his Jewish ancestry. When he spent his sabbatical year in Tübingen in 1986–1987, he told me (AA) that he had had a very hard time to decide spending longer time in Germany, the nation that had erased all his relatives, except for his own small private family that managed to escape Germany in the very last moment. What ultimately convinced him was that he would be visiting and working with two non-Germans in Germany: Valentino Braitenberg (Fig. 1, from Italy) and myself (from NL). On several hikes we made on the Swabian Alb or elsewhere in the vicinity of Tübingen, George would invariably ask: "Just look at this country, it's just so beautiful! Why on earth did they leave this wonderful place and march east to claim more 'Lebensraum'?"

Several years later, in 1998, George joined me (AA) for the FENS Forum in Berlin. After enjoying a late afternoon coffee with us in a street café in downtown Berlin, George silently left, without notifying any of us. It was only 2 hours later that he returned. He had gone to re-visit the house where he had been born in 1933 and had spent a happy youth until the age of five. Remarkably, he said, he remembered it all—and nothing much had changed since then.

Fig. 1 George Gerstein (left) and Valentino Braitenberg at the MPI for Biological Cybernetics in Tübingen in summer, 1987

Over the years, George was drawn again and again to spend sabbatical (and otherwise) time in Israel, to be together with his Israeli colleagues and friends, and to practice his Hebrew and to enjoy speaking his Russian. Together with one of us (MA), he spent many hours looking for repeating spike patterns (Fig. 2). Until the present day, we do not know if they found any—that is, above chance level. But in some instances, that does not even matter—when the ultimate charm is in the search, not in the finding (Fig. 3).

Fig. 2 Moshe Abeles (left) and George Gerstein in the Judean Desert in the late 1990s

Fig. 3 Moshe Abeles, George Gerstein, and Ad Aertsen. Picture taken by our colleague Bill Newsome at Moshe's home, on the occasion of the "Being on Time" Symposium for Moshe Abeles at the Hebrew University in Jerusalem, January 3–5, 2007. We thank Bill for making this picture available to us for this purpose

Apart from science, George loved the arts, especially music. He loved to play the piano and, even more so, his clavichord that he kept in a "wohltemperiertes Zimmer" in his beloved home at Whitemarsh Road in Ardmore, PA. There, with spikes, amplifiers, computers, and math out of the way, he loved to spend time with his dearest friend, Johann Sebastian Bach, enjoying his preludes and fugues. After his last sabbatical leave in Freiburg in 2010, he wrote: "The social and cultural aspects of my stay in Freiburg were delightful. I was able to attend a good many concerts, particularly a series of organ recitals and various interesting performances at the Hochschule für Musik. And the Augustiner Museum provided a fascinating look at medieval art and architecture."

George Gerstein presented a rare and unique combination of human qualities. On behalf of those of us who had the privilege to work with him, to interact with him, and to learn from him, we thank him for this privilege. His passing away is a great loss, for all of us—but his being among us was a great experience and a true pleasure. His legacy as a scientist, a person, a colleague, and a friend will always remain with us.

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Backside

This book brings together a selection of papers by George Gerstein, representing his long-term endeavor of making neuroscience into a real science—inspired by physics, where he had his roots. In this, George was many years ahead of the field, consistently striving for quantitative analyses, mechanistic models, conceptual clarity, and, foremost, real understanding. In doing so, George Gerstein pioneered Computational Neuroscience, many years before the term was even conceived.

In this book, we collected a selection of George Gerstein's many seminal contributions to neuroscience, be they experimental, theoretical, or computational, into a single, comprehensive volume. We also intend to provide the readers, especially the younger ones who may not even be aware that there was ever a time in neuroscience without the PSTH, the cross-correlation approach, or stochastic neuron models, with the fresh introduction of these various concepts in the original literature. Thus, in this sense, this book also serves as an introduction to various fields of neuroscience, experimental, theoretical, and computational.

We organized the material in a series of chapters by subject, ordered in time, each one containing a few reprints of George Gerstein's papers. Several of George's former students and collaborators kindly contributed an Introduction to these chapters, putting the reprinted papers in their historical and present context and adding the personal touch of their involvement in generating them. Taken together, we hope that this book may help the reader appreciate how much our current thinking on brain function owes to George Gerstein's research and the insights gained from it. George was not only an innovative thinker, in theory, experiment, and analysis methodology, but he also inspired by his mode of thinking science. This book is both a product of this inspiration and a tribute to it.

A. Aertsen et al. (eds.), *Introducing Computation to Neuroscience*, Springer Series in Computational Neuroscience, https://doi.org/10.1007/978-3-030-87447-6

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Pedro E. Maldonado earned a Bachelor's and a Master's degree at the Faculty of Sciences of the Universidad de Chile. He obtained a Ph.D. degree in physiology as a student of George L. Gerstein, at the University of Pennsylvania. He is now a Full Professor and the Chairman of the Department of Neuroscience at the Faculty of Medicine, Universidad de Chile, and an Associate Researcher at the Millennium Institute of Biomedical Neuroscience (BNI).

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