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In memoriam of Liliana Lubińska

Professor Liliana Lubińska was a first–class neurobiologist with a great talent for scientific work. She had a unique intellectual capacity for grasping and solving scientific problems and a remarkable way of theoretical thinking in which synthesis blended with an analytical approach. Mental performance was her forte, but this was backed by her talent for observation and dedication to laboratory work. She also had a gift for a logical and clear presentation of her results and ideas. Elegant English and a perfect style of her papers were exemplary. Her most outstanding quality was her addiction to scientific work. When she had decided that it was time to give up science, she virtually lost all interest in life.

In her youth, she had the courage and ingenious mind to secure for herself the best education that continental Europe could provide. Following the example of Mme Curie-Skłodowska, she went – almost penniless – to Paris, entered the Sorbonne and graduated there in general physiology and biochemistry. After having worked at the Department of Physiology with Professor Lapicque as his research assistant, she attained, at the Sorbonne, the degree of Doctor of Biological Sciences. She could have stayed in Paris to continue her research, as she proved to be a bright and promising scientist: she was awarded a grant for her studies, graduated with honours, and her Doctor Thesis received a special prize of the French Academy. Yet she returned in 1933 to Poland to work at the Nencki Institute of Experimental Biology. At the beginning of the Second World War, she fled together with her husband Professor Konorski to the USSR where she spent the war years at Sukhumi, working on nerve regeneration. After the war, both of them returned to Poland to restore, conjointly with others, the Nencki Institute, and to build up Polish neuroscience. Without any ostentation, Liliana Lubińska acted as a responsible and selfless Polish citizen.

During her work on nerve regeneration and on isolated living axons Liliana Lubińska acquired a great understanding of the neuron as a metabolically integrated cell. In the fifties, the anatomical image of the neuron as a static structure – a carrier of ionic membrane changes and polarized electrical currents – was gradually eroded by Paul Weiss' idea that the neuron is a perpetually growing cell. According to his hypothesis, axonal material synthesized in the cell body is steadily but slowly propelled in a solid column moving from the perikaryon towards the endings at a rate of 1–2 mm a day, replacing the used–up constituents. However, Lubińska did not believe that a neuron with its long processes could be kept alive by slow unidirectional "growth".

During a short stay of Liliana Lubińska in Prague at the end of the fifties, we made a nerve–crush experiment and found that acetylcholinesterase–active particles piled up in lesioned axons not only above, but also below the lesion. This fortuitous finding prompted Liliana Lubińska to develop a dynamic concept of the neuron as a cell with a relatively fast *bidirectional* transport in its processes. Without Lubińska, the result would have been published with an ambiguous interpretation and forgotten. Liliana Lubińska discovered the true meaning of the experiment and elaborated carefully her working hypothesis. She carried out almost simultaneously – in collaboration with Stella Niemierko, Barbara Oderfeld and Lucyna Szwarc – a series of biochemical experiments concerning acetylcholinesterase activity in peripheral nerves. The results confirmed her hypothesis. Concurrently she reread and critically re–evaluated existing neurobiological literature from the point of view of the relation of neuronal perikarya to their long axonal processes.

Her effort culminated in writing the review article on "Axoplasmic streaming in regenerating and in normal nerve fibres" published in Progress in Brain Research 13, in 1964. It is a master–piece in the category of overviews: a thorough synthesis and critical analysis of past and recent data concerning the neuron as a dynamic cell, with the logical conclusions endorsed by the experimental results on bidirectional transport of acetylcholinesterase.

Lubińska's review had a great impact on neurobiology and became one of the milestones in the rapidly progressing neuroscience. At first the new concept of a bidirectional axonal transport met with objections wherever it was presented. Paul Weiss apparently perceived it as a personal affront. Even the scientists not involved in neurobiology felt obliged to protest. However, Lubińska's ideas gradually gained ground. Her review article affected a whole generation of neurobiologists and triggered a new line of experiments. Particularly the use of retrograde tracers such as horseradish peroxidase played an important role in corroborating the existence of retrograde axonal transport, as it had opened the possibility of studying it in intact axons. Moreover, the application of horseradish–peroxidase methods opened a new field for studies of the connectivity in the central nervous system. In fact, this approach helped to map out the brain. The

experience with the usefulness of retrograde tracking further substantiated the validity of Lubińska's dynamic concept of the neuron. Former objections were long forgotten. The existence of retrograde axonal transport has been accepted as a matter of course.

After twenty years, Lubińska's discovery of retrograde axonal transport holds true. Its research has, of course, made great progress, moving to the molecular level to analyzing the mechanisms of movement on polarized microtubules. As regards the rates of axonal transport, Lubińska initially favoured the idea that axonal flow is generally fast. This assumption, though not correct, was nevertheless stimulating, as it focused the attention of neurobiologists on the research of fast transport, the existence of which was not fully acknowledged before 1964. In her second review of 1975, Lubińska already accepted the fact of the coexistence of different rates of movement of axonal constituents within the axon; she reserved separate chapters to the fast and slow axonal transport, but was still puzzled by the latter, as she could not see its functional significance. That has been clarified in the following years.

Liliana Lubińska had few pupils. This is to be regretted. However, her strong personality impressed and affected most people she had met. I worked conjointly with her for a couple of months only, but she became my esteemed teacher and beloved friend for the following thirty years.

I have the same feeling of deep sorrow after the departure of Liliana Lubińska as I had after the death of Ernest Gutmann. Although their scientific work survives, their original way of thinking is lost forever. Alas, we are unable to preserve the matrix of their unique intellectual qualities for the future. Liliana Lubińska left, however, her distinctive mark in the development of neuroscience, and this should be remembered with gratitude.

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