IN MEMORIAM

Arvid Carlsson—Pioneering Researcher and Nobel Laureate

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On 29 June 2018, neuropsychopharmacology and the American College of Neuropsychopharmacology (ACNP) lost one of its giants and true pioneers, Dr. Arvid Carlsson, MD, PhD, Swedish pharmacologist and Professor Emeritus at Sahlgrenska Academy at the University of Gothenburg. Arvid was born on 25 January 1923 in Uppsala, the third of four children. At the age of three, his family moved to Lund in southern Sweden, where his father was appointed Professor of History. Arvid grew up in an academic family with a strong tradition in the humanities, a tradition he broke when he began to study medicine at the University of Lund in 1941. Sweden was isolated from the rest of the world, including its neighboring Scandinavian countries, during the Second World War. While Denmark was occupied by Germany from 1940 to 1945, a few Danish medical students managed to go to Lund to study anatomy and Arvid became friends with one of them, Ib Munkvad. Munkvad later became Head of Psychiatry at St. Hans Hospital near Roskilde and was instrumental in developing biological psychiatry in Denmark.

*Image courtesy of Erik Holgersson, Gothenburg

His friendship with Munkvad laid the foundation of Arvid's future connection with St. Hans Hospital and Denmark where he, as in Sweden, inspired a host of young researchers in neuropsychopharmacology. His foundational role in the development of biological psychiatry and neurology in Scandinavia, and beyond, is reflected in the establishment of the Scandinavian College of Neuropsychopharmacology in 1960 with Arvid as its first president. He became member of the Collegium Internationale Neuro-Psychopharmacologicum in 1961 (President 1978–1980) and foreign member (later Fellow) of the ACNP in 1974, where he served on the Editorial Board of *Neuropsychopharmacology* (1988–1991) and the History Committee (2002–2004 and 2008–2010). Arvid not only enriched the ACNP and other meetings with his cutting-edge presentations, but also

by his contributions to the scientific discussions. He could typically be seen sitting in the front row of a session sometimes making sharp, but always highly thoughtful comments that took the discussions to a higher level.

In 1975 Arvid became member of the Royal Swedish Academy of Sciences. Prior to that he had carried out groundbreaking discoveries, which, among many other awards, earned him the Nobel Prize in Physiology or Medicine in 2000. He shared the Nobel Prize with Eric Kandel and Paul Greengard. The Prize rationale was “for their discoveries concerning signal transduction in the nervous system”. Regarding Arvid's work, the Nobel Committee wrote: “The body functions of man and animals are controlled by electric and chemical signals between the cells in our nervous system. Contacts between cells are called synapses, and special substances, called neurotransmitters, send the signals. Arvid Carlsson discovered a neurotransmitter called dopamine in the brain and described its role in our ability to move. This led to the realization that Parkinson's disease is caused by a lack of dopamine, allowing for the development of drugs for the disease” (Arvid Carlsson—Facts. NobelPrize.org. Nobel Media AB 2018. Thursday, 6 September 2018. <https://www.nobelprize.org/prizes/medicine/2000/carlsson/facts/>).

From the beginning of his medical studies, Arvid wanted to conduct research. In 1951, after having received his degree in medicine and defended his doctoral thesis, he was appointed Associate Professor at the University of Lund. A fellowship allowing him to visit Bernard Beryl Brodie at the National Heart Institute in Bethesda, Maryland, introduced him to the field of neuropsychopharmacology, and to the line of research that ultimately led to his Nobel Prize. In Lund, Arvid subsequently discovered that dopamine is an important neurotransmitter in the brain, not merely a precursor for noradrenaline, a finding that in the beginning was questioned by many. His studies showed that injections of reserpine caused depletion of dopamine in the basal ganglia and a loss of motor control resembling Parkinson's disease in humans. He further demonstrated that rabbits immobilized by injections of reserpine improved when given L-dopa, a discovery that led to a revolution in the treatment of this devastating disease. In 1959, Arvid moved to Gothenburg, where he was appointed Professor at Sahlgrenska Academy at the University of Gothenburg. There, he continued to conduct research until he died at the age of 95.

Another scientific breakthrough in the early sixties was the discovery that a common feature of antipsychotic drugs is that

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they reduce dopaminergic tone in the brain. Later, Arvid expanded the dopamine hypothesis to include both glutamatergic and dopaminergic disturbances in parallel cortico-striato-thalamo-cortical loops (Arvid Carlsson. The current status of the dopamine hypothesis of schizophrenia. *Neuropsychopharmacology* 1988;1:179–86), a model that, together with his daughter Maria, he continued to develop in the following years. This revised model of how transmitter disturbances in macrocircuits in the brain can lead to development of psychotic symptoms has been adopted and further advanced by many other researchers.

In collaboration with colleagues at Astra AB, Arvid's group also developed the first selective serotonin reuptake inhibitor, zimelidine. Throughout his life, he focused his research on developing novel compounds to influence brain function in

neurological and psychiatric illnesses. Indeed, as late as 30 June 2018, the day after he died, a paper was published in *Acta Neuropsychiatrica* on which he was the senior author: "A randomised controlled trial of the monoaminergic stabiliser (-)-OSU6162 in treatment of myalgic encephalomyelitis/chronic fatigue syndrome".

Arvid Carlsson was a giant in what might best be called the monoamine era. He will be missed by the many researchers in neuropsychopharmacology for whom he was both a role model and mentor. His pioneering research greatly increased our understanding of the pathophysiology of brain diseases and their treatments. He is survived by his wife, Ulla Lisa, whom he married in 1945, four of his five children, twelve grandchildren and seven great grandchildren.