

Commentary

Professors Henriette van Praag and David Gems give the 2022 Nansen Neuroscience Lectures on “Is ageing inevitable?” in the Norwegian Academy of Science and Letters, Norway

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Abstract. This is a summary of the 2022 Nansen Neuroscience Lectures. On 10 October 2022, Professors Henriette van Praag and David Gems gave the 2022 Nansen Neuroscience Lectures on the theme “Is ageing inevitable?” in the Norwegian Academy of Science and Letters, Oslo, Norway. While van Praag gave a lecture entitled “The benefits of exercise for brain function”, Gems gave the 2nd lecture discussing “What causes ageing? Lessons from The Worm”. Understanding the fundamental mechanisms of ageing will pave the way to the development of future interventions to pre-empt the development of the diseases, including Alzheimer’s disease and other dementias, of later life.

Keywords: Brain aging, mechanisms of ageing, Fridtjof Nansen

The year 2022 is special for the Norwegian legend Dr. Fridtjof Nansen (1861-1930, Fig. 1), as we celebrate the 100th anniversary of his Nobel Peace Prize award. While Nansen is a renowned polar explorer, oceanographer, diplomat, and humanitarian, it is less well known that he was also the first Norwegian PhD in neuroscience, and indeed the first neuroscientist in Norway. Importantly, he is to be credited as a father

of the Neuron Doctrine (the idea that the nervous system consists of separate nerve cells rather than a continuum of tubes, published in two papers in 1886) and for realizing the significance of the neuropil (the ‘dotted substance’ between nerve cell bodies) as the site of communication between the cells. Nansen, Wilhelm His and August-Henri Forel (in that order) independently, unknowing of each other, and almost simultaneously published the idea later called the Neuron Doctrine. While Nansen, and subsequently Santiago Ramon y Cajal, spoke very strongly against the ‘reticular theory’, prevailing at the time, Camillo

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Fig. 1. **Fridtjof Nansen in front of his research desk at Bergen's Museum.** Fridtjof Nansen's Doctoral Thesis work, "*The Structure and Combination of the Histological Elements of the Central Nervous System*" (Bergens Museums Aarsberetning for 1886, printed by John Grieg 1887 Bergen), comprised most types of invertebrate and vertebrate animals. Among our own phylum, the chordates, he focused on the Atlantic hagfish, *Myxine glutinosa*. Photo about 1886 by Johan v.d. Fehr, Universitetsbiblioteket i Bergen.

Golgi strangely stuck to it, in spite of what his own staining method showed. Several authors have emphasized Nansen's contribution, including ones from England, the USA and South Africa (Edwards JS & Huntford R 1998 Fridtjof Nansen: from the neuron to the North Polar Sea. *Endeavour* 22(2):76-80; Huntford R 1997 Nansen – The Explorer as Hero. Reprinted 2009 Abacus, London; Bock O 2019 presentation at the *FENS 130th Anniversary Symposium on Nansens' Doctorate and the Neuron Doctrine*, Det Norske Videnskaps-Akademi, Årbok 2018, pp 207-227, Novus forlag – Oslo 2019, Ed. Gro Havelin <https://dnva.no/sites/default/files/files/2021-08/Akademiet2018cropped.pdf>).

To commemorate the contributions of Nansen to the field of Neuroscience, Linda H. Bergersen and Jon Storm-Mathisen have organized the annual Nansen Neuroscience Lectures on Nansen's birthday since 10 October 2010.

On 10 October 2022, Professors Henriette van Praag and David Gems gave the 2022 Nansen Neuroscience Lectures on the theme "Is ageing inevitable?" in the Norwegian Academy of Science and Letters, Oslo, Norway. As we are living in an increasingly ageing society with unprecedentedly long individual lifespans, it is timely to discuss the topic of ageing, including our current understanding of the molecular mechanisms of ageing and how to achieve healthy longevity with feasible approaches. Professor Henriette van Praag from the Stiles-Nicholson Brain

Institute and Charles E. Schmidt College of Medicine, Florida Atlantic University, USA, gave a lecture entitled "The benefits of exercise for brain function". There is increasing evidence from human and animal studies that aerobic exercise benefits brain function, and may delay or prevent the onset of neurodegenerative conditions. In particular, the hippocampus, a brain area essential for learning and memory, is modulated by exercise training. In rodents, the number of new neurons in the dentate gyrus of the hippocampus is substantially increased by voluntary wheel running. Enhanced adult hippocampal neurogenesis is associated with changes in synaptic plasticity, neurotrophins, neuronal connectivity, spatial navigation and cognitive ability. Recent research indicates that factors secreted from peripheral organs may play a role in exercise-induced changes in the brain. van Praag and collaborators identified the lysosomal enzyme Cathepsin B as a novel myokine that influences hippocampus-dependent memory function across species. Overall, ongoing research in the van Praag laboratory evaluates the relationship between exercise, adult neurogenesis, synaptic plasticity and memory function, and aims to further our understanding of the underlying mechanisms.

While van Praag's scientific work has significance as an 'ageing intervention', Professor David Gems (Institute of Healthy Ageing, and Department of Genetics, Evolution and Environment, University College London, United Kingdom) gave the 2nd lecture discussing "What causes ageing? Lessons from The Worm". Ageing is now the main cause of serious illness worldwide, yet its underlying biology remains poorly understood. Understanding ageing is key to developing effective treatments for late-life disease and improving late-life health. It is perhaps the most important unanswered question in biomedical science. The nematode worm *Caenorhabditis elegans* shows amazing plasticity in ageing. Recent studies of this animal model have contributed to a new, emerging understanding of the fundamental causes of ageing. According to a recent prototype paradigm, the process of ageing, including development of its constituent diseases, can be understood in terms of a relatively small number of general principles of senescent pathophysiology. Most important among its causes are programmatic mechanisms specified by the normal (wild-type) genome. The pathogenic effects of normal processes in late life are an evolutionary consequence of an age decline in the force of natural selection, combined with the effects of biological constraint. New work also suggests that the



Fig. 2. **The 2022 Nansen Neuroscience Lecturers David Gems (left) and Henriette van Praag (right).** The speakers are standing in front of the portrait of Fridtjof Nansen in the Kavli Lecture Hall, in the building of the Norwegian Academy of Science and Letters, Oslo, Norway. Photo by Evandro F. Fang.

remarkable plasticity of the ageing process in *C. elegans* is, unfortunately, not typical of higher animals. Instead, it may reflect suicidal reproductive effort (reproductive death) typical of semelparous organisms such as Pacific salmon, and also of altruistic adaptive death, as seen in some colonial microbes. Decades of innovative scientific work in the Gems laboratory has advanced our understanding of the fundamental mechanisms of ageing, paving the way to the development of future interventions to pre-empt the development of the diseases of later life.

The event was opened by Professor Lise Øvreås, President of The Norwegian Academy of Science and Letters, and attracted a large audience with a wide range of ages and scientific backgrounds. The Nansen Neuroscience Lecturers, Professors van Praag and Gems, and the Nansen Memorial Lecturer (this year Professor Janmyr speaking “On the Nansen Passport and the refugee situation in Europe – then and now”) were welcomed by His Majesty King Harald Vth of Norway, at Dinner on the 10th October 2022. Videos of the lec-

tures shall be available at the designated website (dnva.no/detskjer/2022/09/ageing-inevitable).

ABOUT PROFESSOR HENRIETTE VAN PRAAG

Henriette van Praag is an Associate Professor of Biomedical Sciences at the Charles E. Schmidt College of Medicine and Florida Atlantic University (FAU) Stiles-Nicholson Brain Institute since 2018, and serves as co-Editor-in-Chief for the Open Access IOS Press journal Brain Plasticity (www.iospress.nl/journal/brain-plasticity). After completing her graduate studies at Tel-Aviv University (Israel), she carried out postdoctoral work at Robert Wood Johnson Medical School (New Jersey) and was a staff scientist at the Salk Institute for Biological Studies (California). Before joining FAU she was a Principal Investigator at the National Institute on Aging, NIH (Maryland). Her laboratory studies how exercise affects structural and functional plasticity of brain areas that are important for learning and memory.

ABOUT PROFESSOR DAVID GEMS

David Gems is a Professor of Biogerontology at University College London, working in the Institute of Healthy Ageing, of which he is a founder member and Research Director. He read Biochemistry as an undergraduate at Sussex University, and then Genetics as a doctoral student at Glasgow University. As a postdoc he worked on nematode parasitology at Imperial College London, before moving to the University of Missouri-Columbia, USA, to work on ageing with Prof. Don Riddle. He returned to the UK in 1997 to start his own research group at UCL with a Royal Society University Research Fellowship. The aims of his research are to understand the

causes of ageing, and identify general principles of pathophysiology for late-life diseases. Much of his work uses the nematode worm *C. elegans*, but he has also contributed to studies of ageing in other nematodes, *Drosophila* and the mouse, and penned articles on ageing and ethics. He is currently writing a book about recent developments in the ageing field.

ABOUT THE NANSEN NEUROSCIENCE LECTURES (NNLS)

The annual Nansen Neuroscience Lecture event (dnva.no/detskjer/2020/10/nansen-neuroscience-lectures) was started on 10th October 2010 to memorize the milestone contribution of Fridtjof Nansen to neuroscience (<https://dnva.no/sites/default/files/files/2021-09/Nansen%27sContributiontoNeuroscience%26130yrSymp.pdf>). The event is held on Nansens' birthday and is part of the Norwegian Academy of Science and Letters' annual Nansen celebration, which also comprises the Nansen Memorial Lecture and subsequent festive Dinner. The NNLS are given by speakers selected from the top tier of science research; a couple of NNLS speakers have later become Nobel Prize laureates. The organizers are Linda H. Bergersen and Jon Storm-Mathisen on behalf of The Norwegian Academy of Science and Letters (dnva.no), in cooperation with the University of Oslo (www.uio.no), and the Nansen Neuroscience Network (www.nansenneuro.no).

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CONFLICT OF INTERESTS

None.