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Max Planck Institute for Brain Research

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content

Science News: Dragons and Brain Evolution

A molecular atlas of an Australian dragon's brain sheds new light on over 300 million years of brain evolution.

vertebrate evolution took a major turn 320 million years ago when early tetrapods (animals with four limbs) transitioned from water to land, eventually giving rise to three major clades: the reptiles, the birds (an offshoot of the reptilian tree) and the mammals. Because of common ancestry, the brains of all tetrapods share a similar basal architecture established during early development. Yet, how variations on this common "Bauplan" contributed to clade-specific attributes remains unclear. Neuroscientists at Laurent Department the Max Planck Institute for Brain Research tackled this question by generating a molecular atlas of the dragon brain and comparing it with one from mice. Their findings suggest that, contrary to popular belief that a mammalian brain consists of an ancient "reptilian" brain supplemented with new mammalian features, both reptilian and mammalian brains evolved their own clade-specific neuron types and circuits, from a common ancestral set.

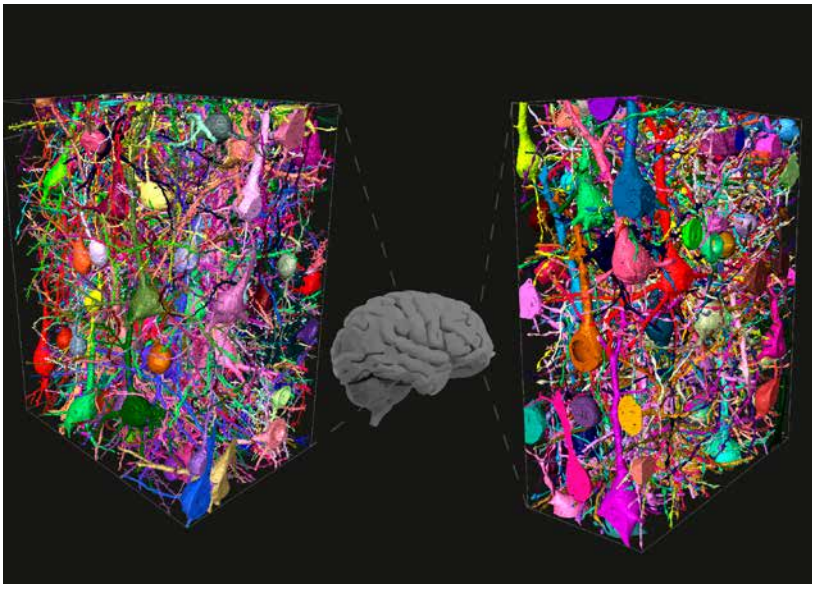
The Australian bearded dragon Pogona vitticeps.

The scientists profiled over 280,000 cells from the brain of the Australian bearded dragon, Pogona vitticeps and identified 233 distinct types of neurons", explains **David Hain**, graduate student in the Laurent Lab and co-first author of the study. "Computational integration of our data with mouse data revealed that these neurons can be grouped transcriptomically in common families, that probably represent ancestral neuron types", says Hain. In addition, he found that that most areas of the brain contain a mix of common (ancient) and specific (novel) neuron types.

"Since we do not have the brains of ancient vertebrates, reconstructing the evolution of the brain over the past half billion years will require connecting together very complex molecular, developmental, anatomical and functional data in a way that is self-consistent. We live in very exciting times, because this is becoming possible" says **Gilles Laurent**.

Silence for thought: special interneuron networks in the human brain

the analysis of the human brain is a central goal of neuroscience. However, for methodological reasons, research has largely focused on model organisms, in particular the mouse. Now, researchers at the Helmstaedter Department gained novel insights on human neural circuitry using tissue obtained from neurosurgical interventions. Three-dimensional electron microscope data revealed a novel expanded network of interneurons in humans compared to mouse. The discovery of this prominent network component in the human cortex encourages further detailed analysis of its function in health and disease.



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Human neuronal networks, mapped from different parts of the cerebral cortex. Connectomic comparison to mouse revealed massively expanded inter-neuron-to-interneuron networks in human.

At first glance, brains of mouse and human are surprisingly similar: the nerve cells that form our brains have very similar shapes and properties, the molecular mechanisms of electrical excitation are highly conserved, and many biophysical phenomena found in other species seem to also apply to human brains. "So, is it primarily the fact that our brains are 1,000-fold larger, house 1000-fold more nerve cells that allows us to play chess and write children's books, which mice arguably cannot do?", asks **Moritz Helmstaedter**, who led the new study. By analyzing the neuronal networks in mice, monkeys and humans and mapping their complete structure in biopsies of brain tissue, so called connectomes, Helmstaedter and his team have discovered that human cortical networks have evolved a novel neuronal network type that is essentially absent in mice. This neuronal network relies on abundant connections between inhibitory interneurons. Using biopsies from neurosurgical interventions, performed by neurosurgeon **Hanno-Sebastian Meyer** and his team at TU Munich, the researchers applied 3--dimensional electron microscopy to map about a million synapses in human brain samples. Their data revealed, in humans, an unexpected bias of interneurons (enriched in humans) connecting with each other, while the innervation (synaptic connections) to principal neurons largely remained similar. The new discovery suggests a first clear network innovation in humans that deserves intense further study. "It could also be a site of pathological change, and must be studied in the context of neuropsychiatric disorders. None of today's main AI methods uses such interneuron-to-interneuron networks," concludes Helmstaedter.

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Never Forget: A memorial sculpture at the Max Planck Institute for Brain Research commemorates the tragic history of the predecessor institute during the Third Reich

during the Third Reich, the Kaiser Wilhelm Institute (KWI) for Brain Research, then in Berlin-Buch, was the largest brain research institution in the world. Among its directors were Hugo Spatz and Julius Hallervorden, who took part in the taking of innocent lives, exploiting and promulgating the Nazi agenda. For many years, scientists used parts of the brains of these innocent victims, including those of cognitively disabled children for their research.

Never Forget – a memorial sculpture at the Max Planck Institute for Brain Research commemorates the tragic history of the predecessor institute during the Third Reich.

Gilles Laurent, managing director of the Max Planck Institute for Brain Research and Christiane Cuticchio, director of Atelier Goldstein discussing infront of the memorial sculpture, Never Forget.

On May 24, 2022, the current directors (Gilles Laurent, Erin Schuman, and Moritz Helmstaedter) and emeritus directors (Heinz Wässle and Wolf Singer) of the Max Planck Institute for Brain Research in Frankfurt inaugurated a memorial sculpture, called "Never Forget". The memorial evokes the horrific memories of a particularly brutal October day in 1940, when 58 children were removed from their institution for the mentally-disabled and executed in the name of science.

Julius Hallervorden's histopathological collection

In 1984, the journalist and historian Götz Aly revealed that brain tissue originating from 33 children murdered on October 28, 1940 under the instructions of Julius Hallervorden were, unbeknownst to the institute's directors at the time, still held at the institute, located in Frankfurt since 1962. "We decided to set up a memorial at today's Max Planck Institute for Brain Research to keep the memory of the atrocities committed

alive so that history does not repeat itself", says Laurent.

The memorial was commissioned to the world-renowned Atelier Goldstein in Frankfurt, an art studio for artists who are perceived as cognitively disabled. "Atelier Goldstein is the ideal collaborative partner because the studio's artists are people with special needs, a population group cruelly targeted by Hallervorden", noted Laurent before passing the microphone to Christiane Cuticchio, director of Atelier Goldstein.

A picture of emptiness and desolation

"Never Forget is a picture of emptiness and desolation. It is the collection of nine children's chairs, arranged on a platform, in which the names of 38 of those children killed in Brandenburg-Görden are engraved. They are hard and awkward looking sharp-edged objects, nothing that invites one to sit on them", shares Cuticchio. "Some are still standing, others are tilted, as if a child had been pulled away from them by force. Nothing to tell of child-like treatment, but to remind us of the daily torment and pain of those who were labeled „unworthy of life" by their tormentors."

A reminder and warning

"The sculpture will serve as a warning and reminder to future scientists that there are ethical boundaries that must never, under any circumstances, be crossed. We hope that this memorial will, on the scale of this institute and institution, contribute to giving back some dignity to the victims of these crimes", concludes Laurent.

The unveiling ceremony in the foyer of the Max Planck Institute for Brain Research was followed by an emotional flower ceremony. Forty employees, a majority of them students or post-doctoral fellows, of the MPI for Brain Research read the names of the children and for each child, laid down a unique flower on the memorial.

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A flower ceremony was held during the inauguration of Never Forget on May 24, 2022.

More information:
https://brain.mpg.de/544615/never-forget

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Gender Politics and the Perception of Excellence in Brain Sciences

The MPI for Brain Research hosted a panel discussion on the recent biography of Cécile Vogt, a pioneer of brain sciences and co-founder of the Kaiser Wilhelm Institute for Brain Research.

neuroscientist Cécile Vogt (1875-1962) is one of the important pioneers in 20th century science, and has regrettably been overshadowed by the memory of her husband Oskar, also a neuroscientist, after her death. Gender and politics in German science were some of the themes of a panel discussion, held on July 4 at the MPI for Brain Research, with Professors Erin Schuman and Gilles Laurent, both directors at the Institute (and incidentally also married to each other), with Birgit Kofler-Bettschart, the author of the biography of Cecile Vogt, and with MPI Director Emeritus Professor Heinz Wässle, who has written extensively about the history of the Max Planck Society. Science journalist Regina Oehler moderated the discussion.

Cécile and her husband Oskar Vogt founded the world's largest and most modern brain research institute, the Kaiser Wilhelm Institute for Brain Research in Berlin-Buch. Oskar became director, while Cécile, head of a department, became a scientific member of the Kaiser Wilhelm Society but never a director. Both were repeatedly nominated for the Nobel Prize for their work on brain anatomy, and both were members of renowned academies such as the Leopoldina. „But after Oskar's death, only his achievements were appreciated, especially in Germany. Cécile was pushed out of perception." This summary can be read in the biography of Cecile Vogt, which the Austrian author Birgit Kofler-Bettschart wrote after extensive research.

Cecile Vogt was a brilliant scientist but also raised three daughters who also became outstanding scientists. „Cécile was ahead of her time. She recognized the challenges faced by female scientists in their daily lives and organized support for female colleagues in the lab, for instance, in the form of household support," Erin Schuman noted.

The life story of Cécile Vogt and her unknown legacy shines light on questions that are still relevant today: why are women scientists still often not recognized for their achievements, ignored or forgotten, and not given a full voice in dictating science policy? Should scientists take a clear stand in times of crisis? How should a scientist's legacy be treated and viewed after their death? These are some of the complex questions that were discussed by the panel.

More information:
https://brain.mpg.de/550313/cecile-vogt

The panelists and moderator in the lecture hall of the Max Planck Institute for Brain Research (left to right):
Dr. Regina Oehler,
Prof. Erin Schuman,
Prof. Gilles Laurent,
Dr. Birgit Kofler-Bettschart,
Prof. emeritus Heinz Wässle.

Celebrating International Day of Women and Girls in Science

On the occasion of International Day of Women and Girls in Science, the gender equality officers and their colleagues of the Max Planck Institutes for Brain Research and of Biophysics organized an emotion-packed night featuring Girl Rising, a documentary that tells the stories of nine girls, striving beyond circumstance and overcoming nearly insurmountable odds to achieve their dreams.

on February 10, over sixty participants from the two organizing institutes, in addition to guests from other Max Planck Institutes, and the Ernst Strüngmann Institute (Frankfurt am Main) as well as a group of female high school students from the St. Angela School (Königstein) viewed the film Girl Rising. The viewing was followed by online-moderated discussion groups in German and English to engage in conversations on gender inequality and potential solutions to the global poverty problem, acknowledging Girls' education as a powerful first step. While not strictly about women in science, the movie conveyed powerful messages about girls' education, a pre-requisite for a career in science and solution to many of the worlds' most pressing problems. The participants were captivated both on an emotional and rational level – they expressed strong emotions such as "sadness and hope, empathy, empowerment, frustration, inspiration, respect" and even "rage".

„It was a really wonderful opportunity for all of us to stop and reflect and also realize how privileged we are", shared Prof. Erin Schuman, director at the Max Planck Institute for Brain Research.

© Girl Rising

Girl Rising is a nonprofit organization focused on girls' education and empowerment. The organization works with local partners by providing customized tools and curricula to build confidence and agency in girls and to change attitudes and social norms so that entire communities stand up for girls and against gender discrimination.

The event was jointly organized by the equal opportunity and PR officers of the MPI for Brain Research and MPI of Biophysics.

More information: https://brain.mpg.de/534052/celebrating-international-day-of-women-and-girls-in-science?c=80619

Selected Awards and Honors

Erin Schuman

Erin Schuman wins the FEBS | EMBO Women in Science Award 2022

The neuroscientist is honored for her exceptional achievements in the life sciences and for being an inspiring role model.

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Otto Hahn Medal for Young Researcher

Caspar Glock is recognized by the Max Planck Society for outstanding scientific achievements during his doctoral work in the Schuman department.

Caspar Glock

Julijana Gjorgjieva is awarded the Heinz Maier-Leibnitz Prize

DFG and BMBF award the neuroscientist with the most important prize for early career researchers in Germany.

Julijana Gjorgjieva

Continued Selected Awards and Honors

Hiroshi Ito secures two individual DFG research grants for his studies on spatial navigation.

Hiroshi Ito

Erin Schuman receives her third ERC Advanced Grant to study the diversity of neuronal synapses.

Erin Schuman

Alison Barker is awarded an ERC Starting Grant for her project on "Neural circuits for social communication" in naked mole-rats.

Alison Barker

PhD graduations

Congratulations to Drs. **Anjali Gour** (Helmstaedter Lab), **Hua-Peng Liaw** (Laurent Lab, IMPRS), **Leonidas Richter** (Gjorgjieva Lab), and **Joeri van Wijngaarden** (Ito Lab, IMPRS) for completing their PhD projects in 2022!

Selected publications 2022

Hain, D.; Gallego-Flores, T.; Klinkmann, M.; Macias, A.; Ciirdaeva, E.; Arends, A.; Thum, C.; Tushev, G.; Kretschmer, F.; Tosches, M. A. et al.:
Molecular diversity and evolution of neuron types in the amniote brain. Science (2022)

Richter, L. M. A.; Gjorgjieva, J.:
A circuit mechanism for independent modulation of excitatory and inhibitory firing rates after sensory deprivation. PNAS (2022)

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Loomba, S.; Straehle, J.; Gangadharan, V.; Heike, N.; Khalifa, A.; Motta, A.; Ju, N.; Sievers, M.; Gempt, J.; Meyer, H. S. et al.:
Connectomic comparison of mouse and human cortex. Science (2022)

Gemmer, A.; Mirkes, K.; Anneser, L.; Eilers, T.; Kibat, C.; Mathuru, A.; Ryu, S.; Schuman, E. M.:
Oxytocin receptors influence the development and maintenance of social behavior in zebrafish (Danio rerio). Sci. Rep. (2022)

Contact
Friends of the MPI for Brain Research
Max-von-Laue-Str. 4
60438 Frankfurt am Main
friends@brain.mpg.de
www.brain.mpg.de/friends