

Paul G. Allen

(1953–2018)

Microsoft co-founder who established the Allen Institute for Brain Science.

The world knew technology billionaire Paul G. Allen as the other founder of Microsoft — Bill Gates's erstwhile partner in revolutionizing personal computing. Sports fans knew him as the owner of Super-Bowl-winning football team the Seattle Seahawks. To scientists, he was the philanthropist behind the Allen Institute, known for its pioneering brain-mapping research and cell science, and the Allen Institute for Artificial Intelligence.

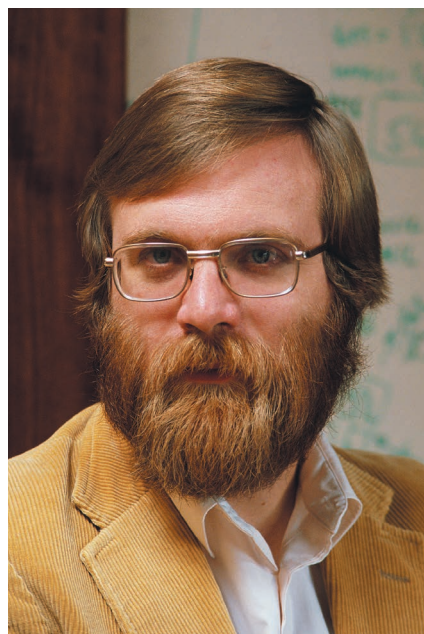
Allen, who died on 15 October, was born on 21 January 1953 in Seattle, Washington, a city to which he remained faithful throughout his life. With school friend Bill Gates, in 1975 he founded Micro-Soft, purveyors of operating systems for the nascent desktop computer market. Bereft of its original hyphen, it grew into one of the world's most valuable companies, netting Allen a vast personal fortune.

In 1983 he withdrew from day-to-day involvement in the company to deal with early stage Hodgkin's lymphoma (although he remained on the board until 2000). This close encounter with death and his wealth freed him to pursue passions seeded in his youth — music, sports, the environment, science fiction, space travel and science.

Paul was attracted to the vast complexity of biology. He was intrigued by how the 3.2 billion nucleotide letters arrayed as strands of DNA in a single fertilized egg give rise to the 30 trillion cells that make up a human. In March 2002, after the success of the Human Genome Project, Paul convened meetings with geneticist James Watson and others to focus on a big biology project of his own.

Paul wanted deliverables and milestones. He had been burned by an attempt in the 1990s to seed innovation at his technology incubator Interval Research in Palo Alto, California, where he hired talents from Stanford University, the Massachusetts Institute of Technology and Bell Labs, and gave them carte blanche to work on Internet-related ideas. On the initiative of neurobiologist David Anderson at the California Institute of Technology, Paul and his sister Jody Allen started the Allen Brain Atlas in 2003 at the Allen Institute for Brain Science in Seattle. With the leadership of cell biologist Allan Jones, the project was delivered on time and under budget in 2006, and yielded a map of the spatial expression of 20,000 genes throughout the entire brain of the adult laboratory mouse, in a highly reproducible 3D framework.

The Allen Brain Atlas fulfils what biologist



Sydney Brenner calls the CAP criteria — a community resource that is complete, accurate and permanent. Its 3D coordinate system has become the pole star by which thousands of labs working on the mouse brain orient themselves. The mouse atlas now gets hundreds of thousands of page visits a year, twice as many as when it was created.

In quick succession, the institute produced gene-expression snapshots of the developing and mature brains of mice, non-human primates and humans. At Paul's insistence, and unusually for the time, all data, metadata and methodological white papers, were, and continue to be, freely and publicly available before associated discoveries are published. This has had a transformative effect on the field, and is now mandated by many funders.

Flushed with success, Paul was emboldened to ask harder questions concerning how the 100 billion neurons in the human brain give rise to intelligence, vision and action. He thought about this in terms of coding and programming. What is the code used for perception? Can our cognitive abilities — visual perception, short- and long-term memory, planning, reasoning, imagination, language and so on — be conceived of as applets running on the highly specialized hardware of the brain? What can theories of cortical computation teach us about the brain? Can we engineer cortical circuits in a dish? What is the difference between natural and artificial intelligence? (Paul started the Allen

Institute for Artificial Intelligence in 2014.)

I was recruited in 2011 to be the chief scientist for the second decade of his brain institute. Fired up by having survived a second bout of lymphoma in 2009, Paul tripled the institute's size and budget. He tasked us to carry out a census of all cell types in the mouse (see B. Tasic *et al.* *Nature* <https://doi.org/10.1038/s41586-018-0654-5>; 2018) and in the thousand-fold-bigger human brain, and to build the Allen Brain Observatory (see C. Koch and R. C. Reid *Nature* **483**, 397–398; 2012). This observatory is dedicated to large-scale surveys (similar to those in astronomy) of cellular level activity in mice, conducted using optical fluorescent microscopy and high-density electrical recordings.

In 2014, Paul started the Allen Institute for Cell Science, focused on visualizing the organelles inside engineered human cardiac cells. In 2015, the brain-mapping and cell-science efforts were amalgamated into a single Allen Institute, with more than 500 staff in a sleek new building in Seattle, led by Allan Jones.

Paul wasn't a scientist and didn't aspire to be. He was a gifted and intensely curious outsider who kept asking hard questions. His way of fuelling discovery was to empower entrepreneurial teams of scientists, engineers and staff, challenging them to draw up tangible, time-stamped goals and milestones. He was keen on knowing the answers, and kept pushing for them: "If not yet, why not? What is holding us up?" He asked us to make hard choices if the stated goals could not be achieved, including shutting down underperforming research programmes.

In person, Paul was discreet, almost diffident. At scientific advisory board meetings, he sat quietly in the back until asking the one critical question that galvanized the room and changed the project's trajectory (without ever presuming to know the answers; he was too humble for that).

At the time of his death from the same cancer he'd weathered in 2009, he was considering how his unique brand of mission-oriented, team-based science could answer some of biology's most persistent mysteries — in evolution, development, neuroscience, immunology, health and ecology. As captured in the title of his 2011 autobiography, Paul was ever the Idea Man. ■

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