

NEUROSCIENCE

A history of the metaphorical brain

Analogies abound and inform our quest to understand the nervous system

By Alex Gomez-Marin

Physicists, biologists, psychologists, philosophers, mathematicians, and computer scientists work (sometimes together) to unravel the mysteries of how the brain, and by extension the mind, operates. This makes neuroscience a peculiar community—a wild confluence of different approaches, backgrounds, and specific interests. *The Idea of the Brain* by Matthew Cobb is a history of this struggle. Spanning approximately five centuries, the book reveals that there are many ways to think about what brains are, what they do, and their relation to the mind. Cobb's erudition and engaging writing style take readers on an enthralling journey, rich with accidental discoveries, controversies, and rejected hypotheses.

For centuries, in many traditions, the heart was considered the seat of thought and feeling. In the 17th century, things slowly started to change. The French philosopher René Descartes suggested that hydraulic automata in the brain could move “animal spirits” through the nerves, producing behavior. The Danish anatomist Nicolaus Steno proposed that the brain is a machine: To figure out how it works, we must take it apart. Gottfried Leibniz, a Ger-

man polymath, protested. If one could enter the brain as one enters a mill, he argued, there would be only mechanical parts, but one would not be able to observe thoughts.

The Italian scientists Luigi Galvani and Alessandro Volta experimented with the role of electricity in animal flesh in the mid-18th century. In the 19th century, the German physicist Hermann von Helmholtz coined the term “action potential” to describe the electrical impulse transmitted down the nerves, and the brain analogy was updated: Nerves were now akin to wires, and the nervous system was conceived of as a telegraph. The Spanish anatomist Santiago Ramón y Cajal preferred a natural metaphor: “The cerebral cortex,” he wrote, “is like a garden full of an infinite number of trees.”

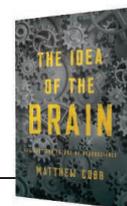
In the 20th century, American researchers Walter Pitts and Warren McCulloch proposed the first mathematical model of a neural network. Biology and technology hybridized, and the brain became a computer.

Throughout the book, Cobb stresses the productive but also pernicious role of metaphors in how we conceive of the brain. He gives the impression that theoretical speculation can and should be avoided while conducting empirical science. But without theory, how can we decide what should be observed?

In the second part of the book, Cobb reveals how much progress (however lacking

The Idea of the Brain: The Past and Future of Neuroscience

Matthew Cobb
Basic Books, 2020. 496 pp.



in major conceptual innovations) we have made in the past 70 years, detailing the elusive quest to find the physical manifestation of memory, the many advances in brain-machine interfaces and neuromodulators, the improvement in mapping neural circuits, the invention of functional magnetic resonance imaging, and the progress made on understanding the neural correlates of consciousness. Despite our endless refinement of tools and our ability to collect massive amounts of data, many fundamental questions remain unanswered.

The book's final section, focused on the future of neuroscience, is the shortest, offering a brisk stroll through some caveats to currently accepted approaches and a sketch of alternative scenarios. Cobb acknowledges that “we may indeed be approaching the end of the computational metaphor. What is not clear, however, is what would replace it.”

Cobb's goal, as explained in the book's introduction, is to navigate the many ways people have conceived of the brain. He definitely accomplishes it. However, there are topics and areas of research that I would have liked to have seen covered in greater detail, for example, brain development, the idea of embodied cognition, and the concept of distributed intelligence (as seen in ant colonies), as well as artificial intelligence. In trying to identify the author's philosophical commitments, the reader may detect a certain ambivalence: Does Cobb buy the mechanistic, reductionistic, and materialistic zeitgeist of molecular biology, for example, or not?

The path toward understanding the brain is long, winding, and littered with dead ends. In the words of the Argentinian writer Jorge Luis Borges, “The solution to the mystery is always inferior to the mystery itself.” As *The Idea of the Brain* demonstrates, the mysteries of the mind may not just be stranger than we suppose; they may be stranger than we can suppose. ■



A paralyzed individual uses a brain-computer interface to manipulate an apple with a robotic arm.

The reviewer is at the Instituto de Neurociencias (CSIC-UMH), Alicante, Spain. Email: agomezmarin@gmail.com

PHOTO: © MAGIEK JASIK

A history of the metaphorical brain

Alex Gomez-Marin

Science **368** (6489), 375.
DOI: 10.1126/science.abc0421

ARTICLE TOOLS

<http://science.sciencemag.org/content/368/6489/375>

PERMISSIONS

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

Science (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science* is a registered trademark of AAAS.

Copyright © 2020 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works