

Art historian Benjamin Rifkin's insightful overview of anatomical works, from Andreas Vesalius and Jan Stefan van Kalkar's *The Fabric of the Human Body* (1543) to *Anatomy, Descriptive and Surgical* (1858) by Henry Gray and Henry Vandyke Carter, is largely given over to brief biographies of the anatomists and portfolios of their plates. In the closing chapter, biomedical engineer Michael Ackerman considers the present and future of anatomical illustration. With the latest scanning technology, it is no longer necessary to create the illusion of three-dimensionality or to suffer inaccuracies of placement or relative dimension. And yet one cannot help but mourn the loss of images created by informed human observation rather than digital data sets. The book's only disappointment, aside from its wee format, is the inclusion at the end of "illustrations" from the *New Atlas of Human Anatomy* (2000). They may be accurate. They may be the way of the future. But they also suggest, by their lack of subtlety and garish colors, that we are made of plastic.

Still, all is not lost. That eclectic publishing house, Taschen, has released a truly extraordinary volume, *Atlas of Human Anatomy and Surgery*. Where the Abrams book serves as a handy guide to possible journeys through the art of anatomy, the Taschen publication is the Grand Tour itself. Its 714 pages contain all the plates from the eight volumes produced by French anatomist Jean Baptiste Marc Bourguery (1797–1849) and his primary artistic accomplice, Nicolas Henri Jacob (1782–1871).

The original plates were printed using lithography, a technique that allows both remarkable detail and a lifelike softness when practiced by artists of Jacob's caliber. His illustrations are so successful in capturing both the procedures and the sense of human life that the surgical plates—showing, for example, how to remove a leg step by step, so to speak—are not for the squeamish. On the other hand, the illustrations of specimens observed through the microscope are worth the journey all by themselves, and the book's double foldouts take your breath away.

The care with which this book has been produced, not to mention the fact that it was pro-

duced at all, is a fitting tribute to Bourguery, whose work never received the recognition he felt it deserved. The original work was without doubt a tour de force, and so, appropriately, is this new edition.

—David Macaulay

## Gray Matters

IN *Second Nature*, NOBEL Prize-winning neuroscientist Gerald Edelman proposes what he calls "brain-based epistemology," which aims at solving the mystery of how we acquire knowledge by grounding it in an understanding of how the brain works.

Edelman's title is, in part, meant "to call attention to the fact that our thoughts often float free of our realistic descriptions of nature," even as he sets out to explore how the mind and the body interact. He favors the idea that the brain and mind are unified, but has little patience with the claim that the brain is a computer. Fortunately for the general reader, his explanations of brain function are accessible, buttressed by concrete examples and metaphors.

Edelman suggests that thanks to the recent development of instruments capable of measuring brain structure within millimeters and brain activity within milliseconds, perceptions, thoughts, memories, willed acts, and other mind matters traditionally considered private and impenetrable to scientific scrutiny now can be correlated with brain activity. Our consciousness (a "first-person affair" displaying intentionality, reflecting beliefs and desires, etc.), our creativity, even our value systems, have a basis in brain function.

The author describes three unifying insights that correlate mind matters with brain activity. First, even distant neurons will establish meaningful connections (circuits) if their firing patterns are synchronized: "Neurons that fire together wire together." Second, experience can either strengthen or weaken synapses (neuronal connections). Edelman uses the analogy of a police officer stationed at a synapse who either facilitates or reduces the traf-

### SECOND NATURE:

Brain Science  
and Human  
Knowledge.

By Gerald M. Edelman.  
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fic from one neuron to another. The result of these first two phenomena is that some neural circuits end up being favored over others.

Finally, there is reentry, the continued signaling from one brain region to another and back again along massively parallel nerve fibers. Since reentry isn't an easy concept to grasp, Edelman again resorts to analogy, with particular adeptness: "Consider a hypothetical string quartet made up of willful musicians. Each plays his or her own tune with different rhythm. Now connect the bodies of all the players with very fine threads (many of them to all body parts). As each player moves, he or she will unconsciously send waves of movement to the others. In a short time, the rhythm and to some extent the melodies will become more coherent. The dynamics will continue, leading to new coherent output. Something like this also occurs in jazz improvisation, of course without the threads!" Reentry allows for distant nerve cells to influence one another: "Memory, imaging, and thought itself all depend on the brain 'speaking to itself.'"

Edelman concedes that neurological explanations for consciousness and other aspects of mind are not currently available, but he is confident that they will be soon. Meanwhile, he is comfortable going out on a limb: "All of our mental life . . . is based on the structure and dynamics of our brain." Despite this cheeky optimism about the explana-

tory powers of neuroscience, Edelman acknowledges the pitfalls in attempting to explain all aspects of mind in neurological terms. Indeed, culture—not biology—is the primary determinant of the brain's evolution, and has been since the emergence of language, he notes.

In light of Edelman's enthusiasm for a brain-based epistemology, I was surprised to learn that he considers Sigmund Freud "the key expositor of the effects of unconscious processes on behavior." Such adulation ignores how slightly Freud's conception of the unconscious, with its emphasis on sexuality and aggression, resembles the cognitive unconscious studied by neuroscientists. More important, as Edelman concedes, Freud's grasp of biology was poor, and he perhaps made too much of certain brain activities, such as dreams. Dreams may simply result from the state of consciousness that occurs during rapid eye movement sleep.

Despite these minor quibbles, *Second Nature* is well worth reading. It serves as a bridge between the traditionally separate camps of "hard" science and the humanities. Readers without at least some familiarity with brain science will likely find the going difficult at certain points. Nonetheless, Edelman has achieved his goal of producing a provocative exploration of "how we come to know the world and ourselves."

—Richard Restak

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