

lem, not the solution.

But Danto is determined to celebrate the here and now. His satisfaction with the present moment comes through most clearly toward the end of the book (which brings together the 1995 A. W. Mellon Lectures). He extols a work featured in a 1993 Chicago exhibition of “community-based art” called *Culture in Action*. The piece that caught his eye—or rather, his sweet tooth—was “a candy bar called ‘We Got It!’ produced by the Bakery, Confectionery, and Tobacco Workers’ International Union of Amer-

ica, Local No. 552, and described . . . as “The Candy of their Dreams.” So much for the philosopher as art critic. The medieval debate over the number of angels who can dance on the head of a pin has given way, it seems, to a more pressing, contemporary, and no doubt “post-historical” controversy: how many works of art can melt in the mouth of Arthur Danto?

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Mind Matters

THE EMOTIONAL BRAIN:

The Mysterious Underpinnings of Emotional Life.

By Joseph LeDoux. Simon & Schuster. 384 pp. \$25

GOODBYE, DESCARTES:

The End of Logic and the Search for a New Cosmology of the Mind.

By Keith Devlin. Wiley. 320 pp. \$27.95

by Paul R. Gross

Science books for the general reader, on substance rather than exploits and personalities, have never been abundant. Books on frontier science have been even rarer—with reason. Scientists in the forefront of research are too busy keeping track of the work of others to toil at writing trade books, which win few scientific honors, and professional science writers tend (sensibly) to avoid areas where the only possible conclusion is “This looks right, but it may be wrong.” Yet in recent years, perhaps due to the aura of celebrity and commerce associated with such best-sellers as Stephen Hawking’s *Brief History of Time*, every biblio-supermarket now has, near the espresso bar and the CD-ROMs, a rack of new volumes of contemporary science made comprehensible. Amid the gloom of semiliteracy and the postmodern denial of special truth-value to science, this is a bright spot.

An outstanding specimen of the accessible science book is *The Emotional Brain* by Joseph LeDoux. A neuroscientist at

New York University, LeDoux writes about new understandings of emotion—especially of fear, the object of his own researches. The account is unabashedly biological: “The proper level of analysis of a psychological function is the level at which that function is represented in the brain.” It is also unapologetically evolutionary: “Brain systems that generate emotional behaviors are highly conserved through many levels of evolutionary history. . . . And within the animal groups that have a backbone and a brain . . . the neural organization of particular emotional behavioral systems—like the systems underlying fearful, sexual, or feeding behaviors—is pretty similar across species.”

This fact, and it is a fact, drives LeDoux’s history of research on emotion, which he insists has come to proper focus in neurobiology. Technical material that would obscure the argument for lay readers is omitted. But the history is accurate and fair, an estimable achievement in light of the key roles played by neuroanatomy,

the molecular biology of neurotransmission, and neural pathway tracing.

So LeDoux explains, and traces the origins of, the discovery that a small region of the brain, the amygdala, is the “hub of the wheel of fear.” He avoids anatomy lessons in describing this ancient (in evolutionary terms) structure lying beneath the cortex in the temporal lobe. And he avoids the detail of controls and statistics in clarifying what behavioral experiments on rats reveal about the trains of electrical impulses that connect the sensed features of the external world, and memories and contexts thereof, to physiological actions of the whole animal. There is no watering down. Technical evidence, indispensable to practitioners, is left out. But the conclusions, even some of their uncertainties, are there to be understood.

What about consciousness? Do these pathways and signal processings, well defined in neuroscience, explain the awareness, the *feeling* of emotion? Do snakes feel fear as we do? LeDoux’s answer is firm: “Consciousness is something that happened after the [cerebral] cortex expanded in mammals. It requires the capacity to relate several things at once. . . . To the extent that other animals have the capacity to hold and manipulate information in a generalized mental workspace, they probably also have the potential capacity to be conscious. However, in humans, the presence of natural language alters the brain significantly. . . . Whatever consciousness exists outside of humans is likely to be very different from the kind of consciousness that we have.”

This sounds like an evasion but isn’t: LeDoux is stating what we know about the biology of emotion, distinguishing

between what we can be sure of and what we must still guess about. He is not explaining consciousness; he is separating the essential, neurophysiological substratum of what is meant by “emotion” from what humans feel when that substratum of processes is operative. The re-definition of emotion in terms of neural pathways does away with older (and unjustified) psychological and philosophical distinctions, such as that between “perception” and “emotion.” These are not distinguishable conceptually because they are not distinguishable in neurophysiology. To perceive certain stimuli is to activate the machinery of emotion, whether or not conscious awareness follows. It is not that “hardwiring” is everything, but rather that some circuits function universally in giving rise to what we recognize as fear, sexual arousal, anger. This knowledge has significance beyond experiments on rats.

At the very least, it offers insight into various emotional disorders—which consist, after all, of intense feelings in the absence of any appropriate stimuli.

Conveying all this is a challenge that LeDoux meets with honor. Of course, the outcome is not perfect. Because technical detail has been excluded—for example, the full evidence that specific neural pathways exist and work

in the brain—LeDoux’s summary can seem more ad hoc and speculative than it is. What is truly speculative can appear more certain than it should. Crucial terms and acronyms (such as “NMDA” for n-methyl D-aspartate) are not spelled out. Still, I have not seen a more readable and compelling account of ongoing brain science and its implications for what it means to be human. The emotions that



mean so much to us are connected to an ancient machinery, up and running when dinosaurs bestrode the earth. To be human is to be different from all other animals, but it is also to be similar.

Scientists being human (a fact that tends to get rediscovered every few academic years), LeDoux cannot resist hinting that, however clever his predecessors, they were often misled. Neither can Keith Devlin, a Stanford mathematician-linguist of the band who have moved energetically, via cognitive science, into what used to be called “philosophy of mind.” In his new book, *Goodbye, Descartes*, Devlin is even more prone than LeDoux to suggest that those who have gone before—Aristotle to Descartes, George Boole to Alan Turing, Noam Chomsky to Marvin Minsky—approached mysteries only now being illuminated. For a book that does not go beyond reporting research-in-progress, this is quite a build-up.

If LeDoux is biological and reductionist, then Devlin is aggressively nonbiological and holistic. The best part of *Goodbye, Descartes* is its superb historical analysis of how “mind” and natural language came to be understood as products of a logic machine. It is a rare volume of this length and purpose that can deal soundly—as Devlin’s does—with the Eleatic philosophers, Descartes, Chomsky, and the post-World War II flowering of “artificial intelligence.”

Less impressive is the support Devlin musters for the book’s real claim: that two and a half millennia of logic, formal and otherwise, have yielded little of consequence in explaining how we communicate through language and, more broadly, how we think. Announcing the failure of artificial intelligence, Devlin judges the whole effort misconceived: “Of course, it could be that people have simply not tried long or hard enough. . . . But there is another explanation: that the original goal of machine [logic-based] intelligence is not possible, at least in terms of a program running on a digital computer, because human intelligence involves *knowing how*, and *knowing how* cannot be reduced to *knowing that*.” Readers will applaud or deride this

proposition, depending upon their enthusiasms. But Devlin does not prove it. Instead, he offers some striking observations, especially on conversation and the extent to which it can and cannot be captured in rules of logic.

The problem, as Devlin and his companions in argument explain, is that the abstractions of logic, adequate though they may be to syntax (grammatical rules), do not come to grips with meaning (semantics). It is fine to recognize the existence of a brain-centered Universal Grammar and a “language of thought” common to us all, whatever words and syllables happen to comprise the local language. But the logic of that grammar does not, Devlin insists, represent meaning: “There is considerable evidence to suggest that logical form, or any variation of logical form, provides at best a very poor picture of mental activity, and at worst is both misleading and a completely inappropriate way to think about mental and linguistic activity.”

On this point Devlin is more certain than most experts, who are divided. He insists that there is no algebra of conversation and (more to the point) no conceivable method of devising one. Therefore, he would substitute a sort of ethnomethodological catalogue of conversational structures, in which mathematical logic is used as a tool but not given pride of place. Yet it is a long stretch from showing that existing formulas for communication are too simple to concluding that the entire analytic tradition of language and reasoning is a failure. It’s not that easy to bid Descartes goodbye.

Never mind: this is frontier science, conveyed by a practitioner who cares about and knows how to enliven the relevant history—which happens to include the work of some of humanity’s commanding intellects. Like LeDoux, Devlin avoids technicalities without Disneyfying the issues. If these two books foreshadow more of their kind, then those who despair of the public understanding of science can take heart.

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