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IMAGING

SIGNALS IN A STORM

A new computer imaging technique shows researchers how brain cells communicate—one molecule at a time

By Carl Schoonover

IF YOU COULD PAUSE TIME FOR AN INSTANT AND MAKE yourself small enough to discern individual molecules, the far right of this image is what you might see when one brain cell communicates with another across a synapse—the point of contact between two nerve cells. How the brain senses, thinks, learns and emotes depends on how all its nerve cells, or neurons, communicate with one another. And as a result, many laboratories are working feverishly to understand how synapses function—and how psychiatric drugs, which target them, improve patients' lives.

Yet neuroscientists are hobbled by the fact that synapses are extremely complex, vanishingly small and extraordinarily fast. Thanks to the coordinated efforts of over 1,400 types of molecules, one neuron communicates with another by spitting out chemical neurotransmitters that carry its message across a thin gap to a receptive surface on its partner. The only way to provide a full account of what goes on at the synapse is to build a computer model that is as realistic as possible. The hope is that running a moment-by-moment, molecule-by-molecule simulation will yield novel insights that could then be tested experimentally.

The computer-generated image here, created by Tom Bartol of the Salk Institute for Biological Studies and his colleagues, is a start. It represents a small portion of a three-dimensional reconstruction, four years in the making, of a minuscule cube of nervous tissue in a rat brain. Aside from showing structure, it captures a single dispatch, at the right, from one neuron to another. Individual molecules of the chemical neurotransmitter (*yellow*) explode out of the synapse formed at the point of contact between an axon (*gray*) extending from the signaling cell and a dendrite (*blue*) on the receiver. (The blue-green structure is a nonneuronal cell that aids neurons in their normal function.)

One important observation made possible by Bartol's simulation is that fully one fifth of the volume in this region of the brain is nothing but the space between neighboring cells—space through which neurotransmitters can apparently spread fairly widely. This broad diffusion contradicts the standard picture of the synapse as a site of communication between only two neurons and could potentially alter our understanding of how information spreads through the brain. SA

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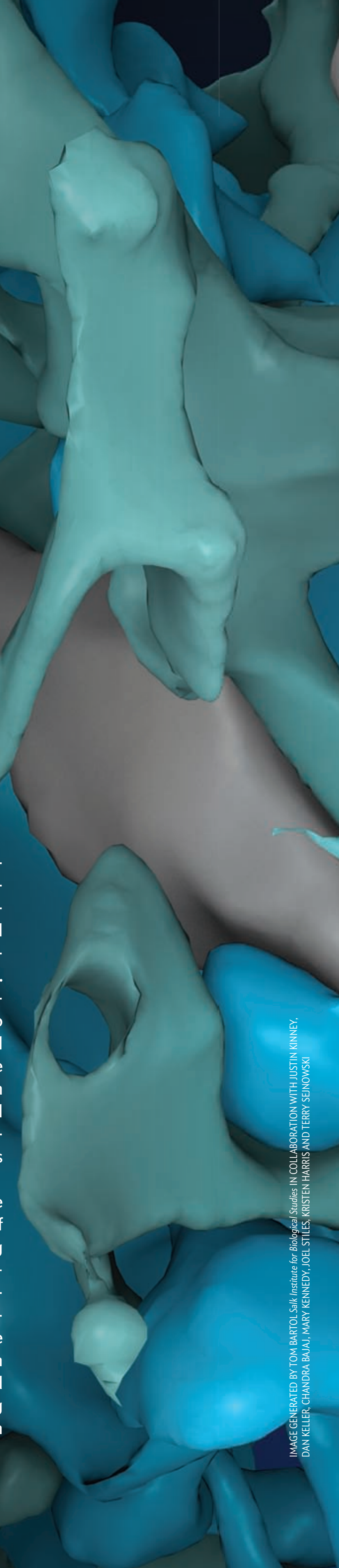

IMAGE GENERATED BY TOM BARTOL, *Salk Institute for Biological Studies* IN COLLABORATION WITH JUSTIN KINNEY, DAN KELLER, CHANDRA BAJAJ, MARY KENNEDY, JOEL STILES, KRISTEN HARRIS AND TERRY SEJNOWSKI