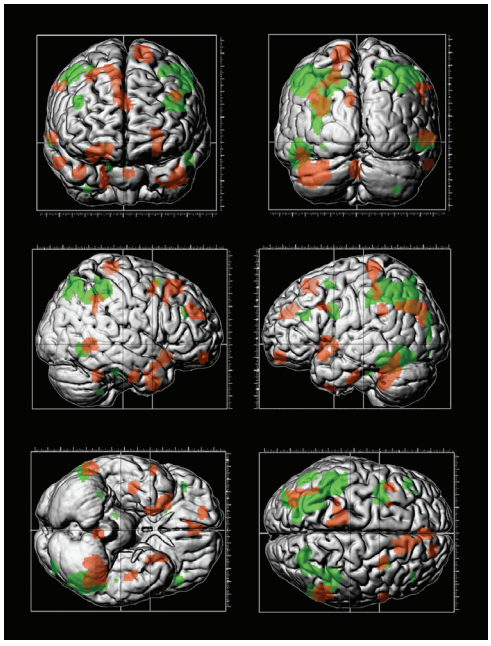
## About the Cover



### Mathematical exercises

April is Mathematics Awareness Month, and this year's theme is the connection between mathematics and the brain. The webpage is at `http://www.mathaware.org/mam/` and there ought to be some interesting short essays posted there. What those who chose this theme presumably had in mind was the sophisticated mathematics that has gone into the technology that analyzes brain functions. But also of interest is the possibility that analyis of brain activity can tell us something about how humans do mathematics. In his book on mathematical invention, the eminent French mathematician Jacques Hadamard asked, "Will it ever happen that mathematicians know enough of that subject of the physiology of the brain and that neurophysiologists know enough of mathematical discovery for efficient cooperation to be possible?" The answer seems now "Very likely".

Mauro Pesenti and colleagues have studied thoroughly the brain activity of a calculating prodigy named Rüdiger Gamm, and it is his brain displayed on the cover of this month's issue. The sorts of things he does remarkably well in his head include multi-digit multiplication, computation of sines, and calendrical calculations. The areas of the brain displayed in green are those used by both Gamm and nonexpert control subjects while doing mental arithmetic, and those in red are those used only by Gamm. What is interesting is that the areas used only by Gamm are generally those associated to episodic long-term memory, whereas nonexperts use only short-term memory. Episodic memory is used to store memory of our own life's events, and is one of several types of long-term memory recognized by neuroscientists. As Pesenti writes in a survey article in the *Handbook of Mathematical Cognition*, the work supports the suggestion "that high-level expertise is not only accounted for by an acceleration of existing processes and by local modulation of activations, but" …"also involves new processes involving new brain areas." Of course mental arithmetic is not the same as higher mathematics, but sometime in the not too distant future it should be possible to analyze what is involved in discovering and proving theorems!

The important role of long-term memory should make us wary of referring disparagingly to "mere memorization". But neither should it make us pessimistic about the value of attempting to teach our students how to reason. In a brief note by Brian Butterworth about this work (in the January 2001, issue of *nature neuroscience* at `http://neuroscience.nature.com`), Gamm is quoted as saying that at school he was "very bad at arithmetic" because the teachers never explained the concepts in a way he could understand. It was only later in life that he worked these things out for himself.

Pesenti's home page is at `http://www.nesc.ucl.ac.be/mp/pesentiHomepage.htm`.

*—Bill Casselman, Graphics Editor*
(`notices-covers@ams.org`)