# THIS WEEK

## EDITORIALS





# The benefits of brain mapping

*Two huge projects have the potential to revolutionize neuroscience, as long as they don't drain money from other work and are monitored to keep them on target.*

There are roughly as many neurons in the human brain as there are pages on the Internet, give or take a million or so. But brain wiring is orders of magnitude more complex than the web. "Think about it like this," says Konrad Kording, a neuroscientist at Northwestern University in Chicago, Illinois, who is interviewed in a News Feature on page 272 that describes the task ahead for two billion-dollar research programmes to understand the brain. "Whereas Internet pages only link to a couple of others in a linear way, each neuron links to thousands of others — and does so in a nonlinear way."

Neuroscientists know frighteningly little about the brain's complexity. They have sketched out the broad anatomy of the brain, and realize that individual functions — from deciding to lift a cup to feeling envy — are mediated by circuitry that crosses anatomical borders. They can examine the detailed electrical activity of small numbers of neurons. They can wield imaging technologies that show which brain areas are activated during defined tasks, such as viewing pleasant or unpleasant pictures. But those tiny (in brain terms) pieces of information have not led neuroscientists to the big picture: what we mean by human consciousness, what makes us our individual selves or why some people develop psychiatric disorders. Neuroscientists need to be able to join the dots — and there are a lot of dots.

Many scientists now believe that real progress on learning how the brain works can be made only through highly funded, interdisciplinary big science of the kind promised by US President Barack Obama's BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies) and the European Commission's Human Brain Project, both launched this year. The first steps will be to develop technologies to map the brain in unprecedented detail, in terms of activity and anatomy — and to develop theoretical neuroscience to make sense of it.

The approach is intimidating. Each of the big programmes is expected to absorb US$1 billion or more in the next decade (although not all of the money is yet in the bank). Some neuroscientists worry that pumping so much money into top-down programmes will reduce support for small, hypothesis-driven projects in individual labs. They are also concerned that the money could be wasted by pouring it into schemes that turn out to be unhelpful.

They are right to be nervous, and their concerns must be taken on board. The money pumped into the launch phases of the two big programmes is genuinely new — and the rest must be, too. As the programmes develop, they should not encroach on funding for research driven by individual investigators. And it is essential that the broad scientific community is involved in design and oversight of the big programmes, to ensure that the processes remain transparent, on track and based in the real world.

In some ways, the current tensions in the neuroscience community bear comparison to those surrounding the launch of the Human Genome Project in the early 1990s. New technologies had revolutionized molecular biology in the previous decade, but the outpouring of data from the project could not address the big picture of how genes fit together to keep us healthy or make us ill. The data needed to be referenced to detailed genome sequences. Many in the community bewailed the centralization and industrial scale of the work. Scientists prophesied the end of individual-investigator-driven research. But in the end, the results served to promote individual projects — and have revolutionized our understanding of many diseases. No molecular biologist now regrets the centralized investment in the Human Genome Project, even if — perhaps even because — it unexpectedly showed that we are only partly controlled by the sequences of our DNA. Researchers are now pinning down the mechanisms through which gene expression is altered by our changing environment.

***"Neuroscientists know frighteningly little about the brain's complexity."***

Similarly large gains are likely to emerge from the big brain projects, although they are not inevitable. The risk of failure is high, but the rewards of success will be great. In recent years, much of the pharmaceutical industry has pulled out of work on brain disorders, following many failures of candidate drugs in trials. There is an urgent need for new approaches to treating disorders that manifest in the young, such as schizophrenia or autism spectrum disorder, and those that begin in older age, such as Alzheimer's or Parkinson's disease. Reliable and detailed reference maps of the brain are likely to ground the research in reality, attracting industry back.

There is also a high-stakes cultural issue. As neuroscientists get a stronger grip on how the brain works, they will encroach ever deeper into the territory of philosophers. What does it mean to be human? The brain will contain the answer — and it won't be about surfing the Internet. ■

# Active protection

*Parents should vaccinate their children against human papillomavirus.*

Scientists at the US Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, announced good news last month. The prevalence of key strains of disease-causing human papillomavirus (HPV) fell by 56% in US girls aged 14–19 years in the years after 2006, when a vaccine was added to the routine US immunization schedule for girls (L. E. Markowitz *et al. J. Infect. Dis.* **208,** 385–393; 2013).

This is a clear-cut vaccine success story. The decline represents a drop from more than 1 in 10 girls in this age range carrying the



© 2013 Macmillan Publishers Limited. All rights reserved