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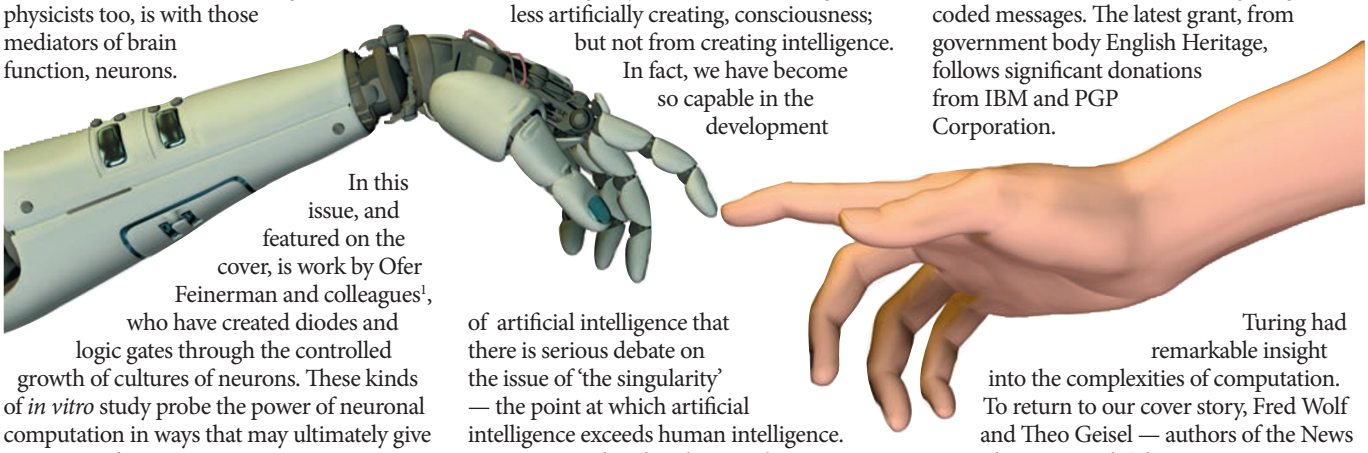
It makes you think

As we research the workings of the human brain, attempting to understand and even mimic its function, do we risk passing a point of no return?

Know then thyself, presume not God to scan;
The proper study of mankind is Man.

Most physicists, fascinated as they are by the workings of the physical Universe (or universes), wouldn't buy this line from the eighteenth-century poet Alexander Pope. But the study of man or, rather, of the human mind is proper indeed — how it works, what makes it conscious and how that consciousness evolved.

The place to start for biologists, and physicists too, is with those mediators of brain function, neurons.



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In this issue, and featured on the cover, is work by Ofer Feinerman and colleagues[1], who have created diodes and logic gates through the controlled growth of cultures of neurons. These kinds of *in vitro* study probe the power of neuronal computation in ways that may ultimately give *in vivo* insight.

It is, admittedly, a wild extrapolation from there to 'consciousness'. But this is a phenomenon that fascinates scientists and philosophers alike. "There is nothing we know more intimately than conscious experience, but there is nothing that is harder to explain", wrote[2] philosopher David Chalmers, of the Australian National University. Chalmers identifies experience as the "hard problem" of consciousness (although others, notably Daniel Dennett[3], disagree). The easy problems, such as the ability to discriminate or categorize, or to focus attention, are less of a challenge to mechanistic description, says Chalmers (even if they are not yet fully described).

But experience — of emotion, of a stream of conscious thought, or of visual sensation, such as the quality of 'redness' or dark and light — requires "an extra ingredient in the explanation".

What that ingredient might be, or what might underpin other approaches that don't recognize 'hard' and 'easy' problems, we don't know, although physical concepts such as chaos, nonlinear dynamics and quantum mechanics have all been brought into play. We are a long way from understanding, much less artificially creating, consciousness; but not from creating intelligence. In fact, we have become so capable in the development of artificial intelligence that there is serious debate on the issue of 'the singularity' — the point at which artificial intelligence exceeds human intelligence.

Some predict that the singularity is little more than 20 years away, others 40. But there are still others who deny it even as a possibility: John McCarthy, who coined the term 'artificial intelligence' in 1956, is notably not a fan. However, 500 people attended the latest Singularity Summit[4], co-founded by technologist Ray Kurzweil and held a few weeks ago in San Jose, California. Whether the singularity represents a point beyond which the creation of superhuman intelligence is of huge benefit to society or of lethal potential for the human species, this Pandora's-box of an issue certainly deserves thorough assessment and contemplation.

Meanwhile, the Turing test still stands as the benchmark of artificial intelligence. Proposed by Alan Turing in 1950, the test is whether a human judge can tell a fellow human from a machine by means of a text-based conversation. Turing is often considered the founder of modern computer science. The good news last month is that his legacy, in code-breaking if not computation, has been boosted with the announcement of further funding for the preservation at Bletchley Park[5] in the UK of the wartime premises that housed the Turing–Welchman Bombe machines for deciphering Enigma-coded messages. The latest grant, from government body English Heritage, follows significant donations from IBM and PGP Corporation.

Turing had remarkable insight into the complexities of computation. To return to our cover story, Fred Wolf and Theo Geisel — authors of the News and Views article[6] that accompanies the paper by Feinerman *et al.*[1] — point out that, as the neuronal patterns can be made to constitute a threshold element, an AND gate or a diode, these systems "contain all the elements needed to assemble a Turing-universal computer".

We are making such progress. But we are still so far from knowing even ourselves.

References

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4. www.singularitysummit.com
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6. Wolf, F. & Geisel, T. *Nature Phys.* **4,** 905–906 (2008).