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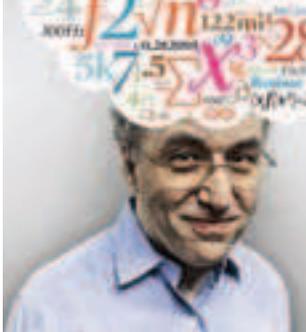


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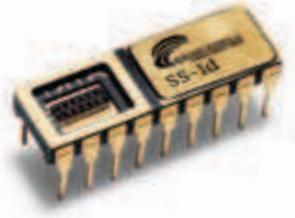
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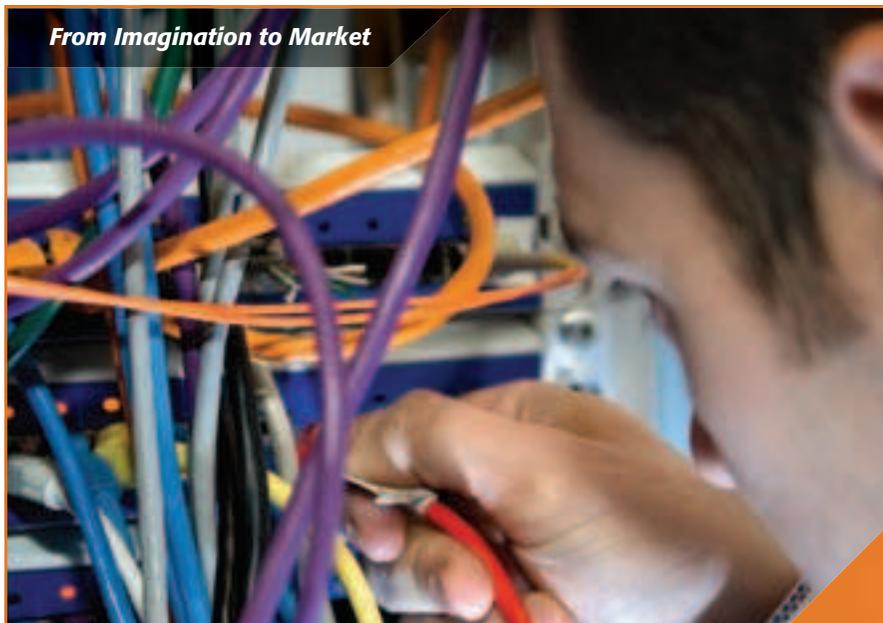
The Great Depression occasioned a battle over federal funding of science.

By Matt Mahoney



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From Imagination to Market



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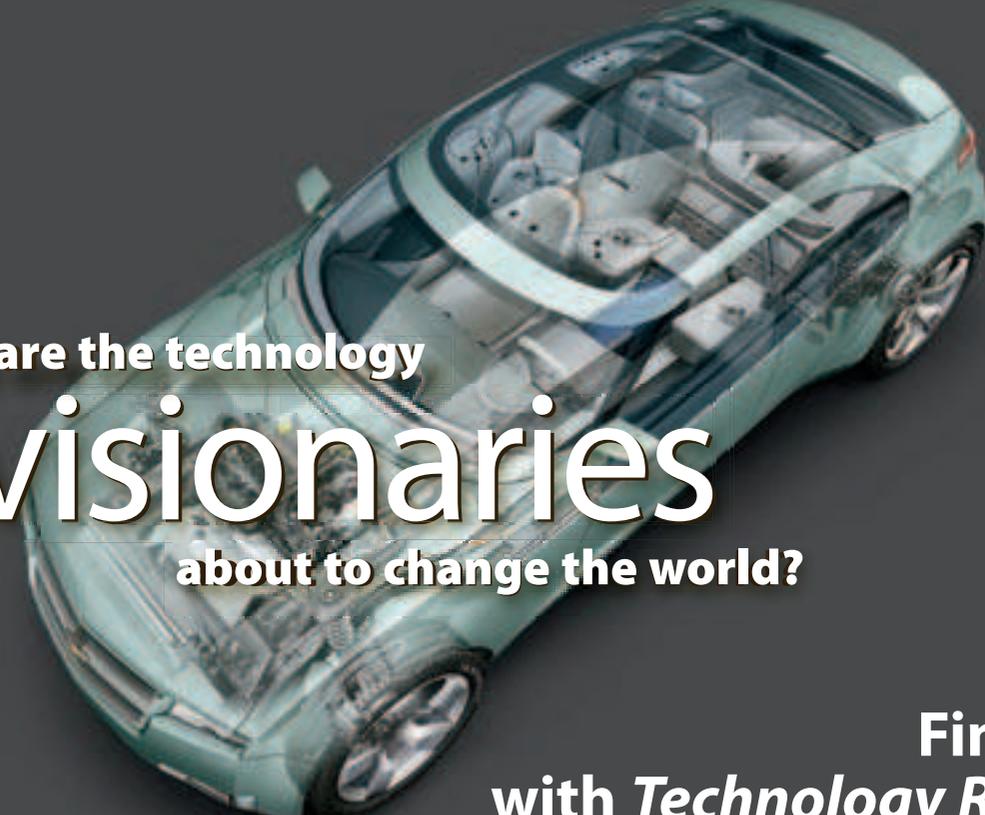
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SIMSON GARFINKEL wrote this issue's essay, on privacy in the age of Facebook ("*Privacy Requires Security, Not Abstinence*," p. 64). He argues that in a time when people are simultaneously scared out of their wits about data theft and alarmingly cavalier about the exposure of their innermost secrets, we need to rethink what it means to maintain a private self while participating in a public life. "We need strong security for keeping our secrets safe from hackers and strong identification systems to make sure that we ourselves aren't locked out," he says. Garfinkel wrote his first article for *Technology Review* in 1989 and has been a regular contributor ever since. He published *Database Nation: The Death of Privacy in the 21st Century* in 2000. In 2003, as a PhD candidate at MIT, he spent a summer as a contractor working on the Defense Advanced Research Projects Agency's Total Information Awareness

project. Garfinkel spent two years at Harvard as a postdoctoral fellow at the Center for Research on Computation and Society before becoming an associate professor at the Naval Postgraduate School in Monterey, CA, where he does research on computer forensics and data fusion.



PETER FAIRLEY reviews the European Union's effort to reduce carbon emissions through the market-based approach known as "cap-and-trade" ("*Carbon Trading on the Cheap*," p. 72). "Putting a price on carbon has become a mantra for how to go about stopping and reversing climate change. And it is a necessary step. But it is not sufficient," says Fairley. "The price has to be high enough to stimulate the long-term investments—like building nuclear reactors and carbon-capture plants—that will slash carbon emissions. Europe's experience shows that politicians are unwilling to set the cap tight enough to drive prices

up." He adds, "When push comes to shove, politicians continue to err on the side of ensuring that the price doesn't get too high and hurt industry." A freelancer who regularly covers energy for *Technology Review's* website, Fairley is now living in Paris. He writes for a number of magazines, including *Discover* and *IEEE Spectrum*.

ANDY KESSLER examines the likely impact of the economic stimulus bill's \$19 billion in incentives for the advancement of health-care IT, electronic health records in particular ("*A Pound of Cure*," p. 75). Kessler, who worked on Wall Street for 20 years investing in Silicon Valley, suggests that for financial reasons, the medical industry is reluctant to use this technology to



improve preventive care and increase accountability. "Everyone's first reaction to technology's effect on health care is always about medical records. But that should be easy—it's something even the airline indus-

try has already done," he says. "Instead, I think the real breakthrough will come from keeping all of us from getting sick in the first place." Kessler is a former hedge fund manager who has written for the *Wall Street Journal*, the *New York Times*, *Wired*, *Forbes*, and the *Los Angeles Times*. His books include *Running Money*, *Wall Street Meat*, and *The End of Medicine*.



Photographer JASON MADARA shot this issue's photo essay, which examines the launch of the National Ignition Facility in Livermore, CA ("*Igniting Fusion*," p. 24). Scientists at Lawrence Livermore National Lab will attempt to create self-sustaining nuclear fusion using lasers; if they are successful, fusion could one day become a viable source of energy. "I was awed by the complexity and size of the construction," says Madara. His work has appeared in the *New York Times Magazine*, *Entertainment Weekly*, and elsewhere.

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On Answers

FOUR KINDS OF SEARCH ENGINES

Search engines are knowledge systems that we ask, “What is known?” The answers we get reflect the questions the systems’ designers allow, which in turn reflect designers’ conceptions of what is knowable and useful to know.

The first search engines were not machines, and they didn’t satisfy their users. The most famous of them all, the Oracle of Apollo at Delphi on the slopes of Mount Parnassus, issued prophecies for more than a thousand years. We possess more than 500 of the results of queries put to the Pythia, the priestess who presided over the Oracle. With exceptions, her answers were not helpful.

King Croesus of Lydia once asked the Oracle if he should wage war on the Persians, whose empire was expanding westward after a successful revolt against their rulers, the Medes. According to the historian Herodotus, the Pythia answered that if he did, he would destroy a great empire. Cautious, Croesus sent a large fee to the Delphians, and refined his search terms. He pressed: Would his reign be a long one? The answer, according to my battered Penguin translation by A. R. Burn, came back:

“When comes the day that a mule shall sit on the Median throne, then, tender-footed Lydian, by pebbly Hermus run and abide not, nor think it shame to be a coward.”

Opaque—but Herodotus writes, “This reply gave Croesus more pleasure than anything he had yet heard; for he did not suppose that a mule was likely to become king of the Medes, and that meant that he and his line would remain in power forever.” Alert readers will have guessed the end. Croesus went to war; the empire he destroyed was his own. Cyrus, the king of the Persians, was half Persian and half Mede, and thus a kind of mule.

The answers of the Delphic Oracle abound in these sorts of tricky occlusions. Whoever designed the system at Delphi believed or pretended to believe that the future was known to the god Apollo, who chose (as a demonstration of the mutability of human affairs) to deliver through his priestesses prophecies that were obscure, but that retrospectively provided dramatic satisfaction. A rationalist will suspect that obscure answers had another function: they could apply equally well to different outcomes. In any case, the turbidity of the Oracle’s answers was its virtue.

In this month’s cover story (“*Search Me*,” p. 32), *Technology Review*’s chief correspondent, David Talbot, describes how the Web is usually searched: “Among all the leaders in Web search ... the core approach has remained the same. They create massive

indexes of the Web—that is, their software continually ‘crawls’ the Web, collecting phrases, keywords, titles, and links.” Talbot examines some of the technical limitations of this method. But the notion that a search should produce a list of links to Web pages represents a view of what is knowable and what is useful to know that is as specific as that which made the Delphic Oracle. Traditional search is chaotically democratic. It assumes that the consensus view is the best, while rewarding the wayward answer by exposing it to the curious. The truths of traditional search are provisional. Popularity is virtue.

Our story describes a new kind of search engine, Wolfram Alpha. In fact, its inventor, the physicist and entrepreneur Stephen Wolfram, dislikes the word *search*: he calls it a “computational knowledge engine.” Alpha, writes Talbot, is “meant to compute answers rather than list Web pages.” It consists of “three elements ... a constantly expanding collection of data sets, an elaborate calculator, and a natural-language interface for queries.”

Alpha, too, represents a particular point of view—that of its creator. Wolfram’s monumental book, *A New Kind of Science* (2002), explains how the complex world can be reduced to simple rules, and how those rules are computable. Alpha will be the first major application of his theories: an experiment to see how much of what is known can be expressed in straightforward answers.

About these fundamental questions, views differ. Ivan Herman of the World Wide Web Consortium tells Talbot, “Although I have graduated as a mathematician ... I am not sure you can handle all of the miseries of this world by mathematical formula and computation.” Another critic provides an example: “Imagine a question like ‘Who are the most dangerous terrorists?’ ... Is someone a terrorist? How do we assess danger? And danger to whom? It’s computationally very difficult to do that kind of reasoning.”

Perhaps, speculates Daniel Tunkelang, the cofounder of the search company Endeca, there is a better way to approach the problem of building a search engine (see “*To Search, Ask*,” p. 13). “What we need is human-computer information retrieval. ... Rather than guessing what users need, these tools provide users with opportunities to clarify and elaborate their intent. If the engine isn’t sure what users want, it just asks them.”

Now there’s an alternative that is somehow shocking: Ask the questioner. Write and tell me what you think at jason.pontin@technologyreview.com. —Jason Pontin