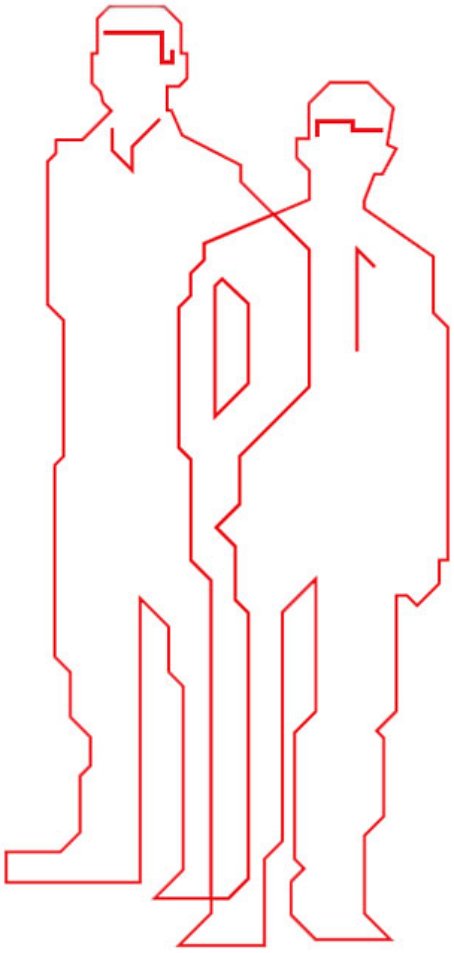
WHO ARE THE SCIENTISTS OF TODAY? WHERE DO THEY WORK? WHAT MOTIVATES THEM? AS SCIENCE INCREASINGLY SHAPES OUR CULTURAL MOMENT, THE IDENTITY OF ITS PRACTITIONERS IS ALSO EVOLVING.

The Scientist in 2008

BY **STEVEN SHAPIN** | POSTED NOVEMBER 20, 2008

SCIENTISTS, PERHAPS TO A GREATER DEGREE than any other sector of society, get to define what the world is like. They may not always be the most highly rewarded people in our communities, but they are among the most influential: When reality speaks, it speaks through them, and what we know about the world, we know because we have found grounds to recognize their competence and to trust them or the institutions they represent.



GENDER GAP: On average, women represent slightly more than one-quarter of scientists world-wide. But there is considerable disparity across regions: In Latin America and the Caribbean, for example, 46 percent of researchers are women, while in Asia women constitute only 15 percent of the scientific workforce.

Our understanding of who these men and women are is central to the authority of modern science, and if, as seems to be the case, there are emerging problems with that authority, then a clarification of the scientist's identity is in order. It's not so easy, however, to know exactly *who* the scientist is. Public perception of the scientist probably owes much to the idea of mastering something known as the "scientific method" (even though there is no consensus on what exactly this consists of), but we also define scientists through some notion of integrity — an independent voice speaking truth to power. So any perceived problems concerning scientists' moral makeup are of great consequence: Scientists without credibility are culturally impotent, and science without credibility is a meaningless enterprise.

In recent times, and especially over the past quarter century, scientific integrity has become a live issue in public culture — think of the drumbeat of reports on commercially and politically induced bias and violations of research independence. Medical-journal editors despair of finding reviewers without financial ties to Big Pharma. *The New York Times* and the Associated Press now routinely inform readers not just about what scientists claim but also about their sources of commercial research funding and whether or not they act as consultants to, or accept speaking fees from, industry. It's become a truism — a point of pride for some, of anxiety for others — that academia and industry as scientific work environments have converged in all sorts of ways. At the same time, these ties and convergences have elicited diverse reactions from within the scientific community: Just as there are scientists wholly comfortable doing their work in industry or with industrial support, there are others who take the responsibility of defending scientific integrity and who seek to foreground commercial bias or government interference as public issues. Some scientists speak for reality from within the big oil companies; others claim that to do such a thing with integrity is impossible and speak up for the environment from an advertised position of institutional independence.

We are on the verge of a new administration, and major universities are holding public symposia on the likely fate of science in the next presidency — whether there will be more or fewer dollars for research

Seed's inaugural edition of the State of Science explores the current scientific landscape and its emergent hotspots—along with the motivations and ambitions of the individuals charting its future.

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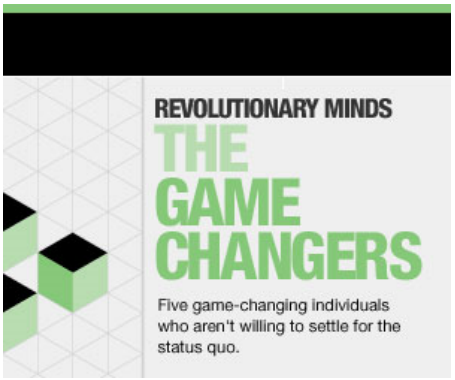
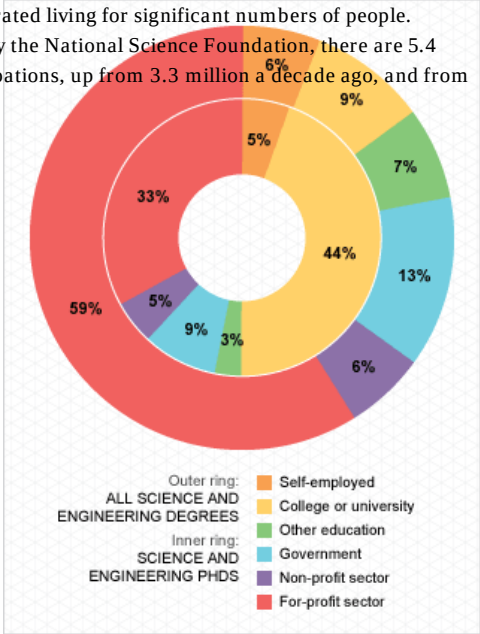


and education, how the status of research independence will unfold; whether government will once again view science as an ally rather than an enemy. At the cusp of 2009, it's imperative that we now take stock of what we know, and what we think we know, about the remarkable, and remarkably influential, group of people called scientists. What's been changing about scientists' identity over recent history? How do they define their jobs and roles? What's always been the case and what's new?

SCIENTIFIC RESEARCH IS A JOB, a decently remunerated living for significant numbers of people. According to the most recent statistics assembled by the National Science Foundation, there are 5.4 million Americans in science and engineering occupations, up from 3.3 million a decade ago, and from fewer than 200,000 in 1950. And a much larger number, 12.9 million, report that they need at least bachelor's-level science and engineering knowledge in their jobs. Figures for other developed countries vary, but the American trend is indicative — that's a lot of people with technical training, paid to deploy their scientific and engineering knowledge.



WHERE SCIENTISTS WORK: In the US, nearly two-thirds of all science and engineering degree-holders either work in the for-profit sector or are self-employed. When only PhDs are counted, the proportion of those employed in higher education increases (44 percent), but is still less than the combined number of those in industry, in government, and self-employed (48 percent). While the data for other nations vary, these numbers are indicative of major 21st century trends. Graph source: National Science Foundation, Scientists and Engineers Statistical Data System, 2003, Science and Engineering Indicators 2008.

It was not always this way. Well into the 19th century, and even into the 20th, doing science was typically more of an avocation than a job. In the 17th century, the great chemist Robert Boyle not only financed his science out of his own deep pockets but also shared a common view that doing science as a "trade" was demeaning. Anyone who accepted money to pursue knowledge would compromise their integrity — who paid the piper called the tune. Isaac Newton, as professor of mathematics at Cambridge University, was not paid to do physical or mathematical research but to teach. The 19th century's most famous scientist, Charles Darwin, was never paid to do science. And Einstein's three great papers of 1905 were not part of his job specifications: He was then a patent clerk in Switzerland. True, over the course of history, many scientific researchers were in academic employment, but with few exceptions, before the 20th century, the job of a science professor was not to produce new knowledge but to transmit and safeguard existing knowledge. Until quite recent times, the number of people in the world paid to do original scientific research "for its own sake" was infinitesimally small.

The transformation of science from a calling to a job happened largely during the course of the past century. Indeed, science is arguably the world's youngest profession: The routinization of the paid role is less than a hundred years old; the word "scientist," coined in 1840, was not in standard usage until the early 20th century. And though there are current concerns over commercial and military ties, practically no one now shares Boyle's worries that taking money to do science compromises its integrity or, indeed, that there is any conceivable alternative to government, industry, and, to a lesser extent, nonprofit foundations as sources of funding. Universities' own funds pay for only a small portion of scientific research, and while foundations have been a significant source of support for about a century, academic scientists without government funding are rare and usually handicapped in doing their work.

But this taken-for-granted state of affairs flowed from changing public perceptions of what scientific knowledge might be good for, indeed what science was. We should understand these changes and what brought them about, for they have enormous implications for the status, strength, and durability of present-day arrangements.

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