



Kill the myth of the miracle machine

Unchallenged assumptions about how science works threaten its support and decrease its ability to contribute to society, says **Daniel Sarewitz**.

At the end of June, the Republican-led US Congress put forth budget plans that ignored many of President Trump's proposed cuts to science agencies. Why is this? Aren't these the same Republicans who, according to many scientists, science advocates and Democratic politicians, have long been waging a war on science?

The reason is that free-market Republicans and academic scientists share a common belief: that unfettered, curiosity-driven basic research is the foundation for technological innovation and economic growth. Republicans who control the House Committee on Science, Space and Technology wrote in their March annual position statement that "basic research in the physical sciences" is the area "with the greatest potential for scientific breakthroughs that will benefit new industries and US jobs." Mirroring this sentiment, Maria Zuber, chair of the US National Science Board, called such research the "bedrock" of the "technology ecosystem". The problem with this shared belief is not just that it is misleading, but that by continuing to use it, scientists put the research enterprise itself in jeopardy.

Decades of scholarship suggest that fundamental science is most effective in contributing to social goals when it is pursued in the context of practical problem solving. Almost 25 years ago, the economists Nathan Rosenberg and Richard R. Nelson wrote that the widely accepted definition of basic research that focuses on the absence of a concern with practical applications is "unfortunate, indeed bizarre".

Yet, when my research assistant and I examined more than 100 articles that mentioned 'basic science' or 'basic research' in *The Washington Post* and *The New York Times* over the past 12 months, we did not find one that challenged the view that basic science, intentionally disconnected from considerations of use, is the source of technological advance. Indeed, writing in *The Washington Post* in May, president of the Broad Institute of MIT and Harvard Eric Lander and the chairman of Google's parent company Alphabet Eric Schmidt describe investment in basic science as a "Miracle Machine" that drives the economy.

Of course, serendipity and curiosity play a part in science, as in all aspects of innovation. Whether Thomas Hunt Morgan studying fruit-fly genes or Osamu Shimomura isolating green fluorescent protein from jellyfish, the accounts of miracles coming from the imagination of great scientists are seductive. But the history of modern innovations such as vaccines, aircraft or the Internet mostly shows something very different: that important contributions of basic science are grounded in 'use-inspired' research, not in leaving scientists to their own devices.

After 20 years of trying to promote this idea, I am no longer surprised that scientists are reluctant to accept it. In advancing beliefs that support their political interests, scientists are simply acting like a special interest

group, no different from dairy farmers or chief executives.

But the myth of the miracle machine harms science and society because it shields scientists from accountability, governance and being responsive to human needs. A major reason that pervasive problems such as poor quality publications, hyper-competition and hype have been allowed to fester is the miracle-machine ideology: give us money, leave us alone and we'll solve the world's problems.

Scientists may justifiably complain that these problems result, at least in part, from funders' push for translatable ideas — not the pursuit of their own creativity. After all, from the US National Institutes of Health's translational science centre to the UK's Research Excellence Framework, scientists are being pushed to demonstrate the impacts of their research. But the idea of a push towards translation reflects the problem: the false belief that innovation starts with isolated basic science.

Academic scientists might be relieved that Republican lawmakers believe in a miracle machine enough to protect its funding. But, as the summer continues, I expect that Republicans will carry out some of Trump's proposed cuts to mission-oriented programmes at agencies such as the National Oceanic and Atmospheric Administration and the National Institute of Standards and Technology (NIST), including several that are non-partisan. Some targeted programmes, such as NIST's Manufacturing USA, are aimed at precisely the sort of integration across research and application development that fuels innovation.

The academic community could stand back and acquiesce to such harmful cuts as part of the price of maintaining its miracle machine. Politicians, meanwhile, could say that in difficult budgetary times they are simply following scientists' advice and giving precedence to basic science. Instead, scientists should be working with policymakers to reform how research is prioritized and organized. Vast improvements in the scientific system could be had if science agencies strengthened the ties that link research agendas to societal needs, and counteract the perverse incentives that commit scientists to careers measured by publications and grant dollars rather than the creation of socially valuable knowledge.

Exceptional science is produced not by a miracle machine, but by institutions that tie scientific curiosity to problem solving. Universities and science organizations should come together to develop a plan to deliver better social value at no additional cost to taxpayers. Congress might just listen. Science and the world would benefit. ■

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MIRACLE MACHINE
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