# Innovation's Hidden Scaffolds

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Call it the *Vannevar Index*: The greater the pressure on the scientific enterprise, the more one hears about Franklin Delano Roosevelt's science advisor. The *New York Times* has mentioned Vannevar Bush 16 times since 2015—and nine of those were in the last six months. Recent titles: "US Scientists Warn That Trump's Cuts Will Set Off a Brain Drain," "White House Tech Bros Are Killing What Made Them (and America) Wealthy," and "The End of the University as We Know It." In these articles, Bush's 1945 report to *Truman, Science, The Endless Frontier*, is nearly always described as "landmark" or a "blueprint" or sometimes "a landmark blueprint" for American science.

In his speech on "Reinvigorating America's Scientific Enterprise" at the National Academy of Sciences in May, White House Office of Science and Technology Policy director Michael Kratsios also invoked the "blueprint" as the usual static legend. But Kratsios went further by conjuring its inspirational power. Bush, he said, "planted a banner in the national imagination that in less than 25 years would become an American flag on the surface of the moon."

In this time of political, economic, and technological upheaval, what does it mean that so many advocates for science are pointing to an 80-year-old report that references a frontier declared closed in 1880, using a metaphor (the blueprint) that was replaced by other technology long ago? Rhetorically, it places Bush's emphasis on curiosity-driven basic research within the realm of myth, rather than policy—which does a disservice to Bush's considerable political acumen. And by citing the blueprint as a national creation myth, scientists appear to wax nostalgic for infallible expertise, appointing themselves the keepers of that flame rather than acknowledging the hurly-burly of economic and political forces that have shaped the enterprise. Telling and retelling the blueprint's story crowds out other narratives that might give the public a more central role in the creation of the country's highly productive science enterprise—and our collective future.

Finally, as a metaphor, the blueprint is a flat, monochrome representation of the vast, multidimensional, technicolor innovation ecosystem that we have built since the end of World War II. Think of a coral reef that has colonized a shipwreck: Successive layers of accretions now host underwater microhabitats filled with swirling masses of lampreys, clownfish, and wrasse. The twenty-first-century clownfish knows and builds upon the newer conglomerations of its coral environment, and the ship that lies below is irrelevant.

Likewise, today's science occurs amid layers of deliberate scaffolding that make the US innovation ecosystem outstanding. This hidden armature of policy has been assembled by thousands of people with differing political aims. It reflects the work of multiple government agencies—in particular, the Department of Defense—public and private universities, federal labs, congressionally mandated programs for small business, and state enterprise zones, to name a few. There are also tax breaks to encourage

research and venture capital, rules to make banking and investment reliable, and so on.

This summer, *Issues* authors document how federal spending during World War II built the modern chemical industry, and how the National Institutes of Health's relatively small investments in intramural research yielded technologies that have contributed to $133 billion in US sales over the last 40 years. As much as it is the work of scientists, the remarkable productivity of the American innovation ecosystem is also the work of bureaucrats, politicians, a creative industrial sector, and sophisticated consumers.

The very concept of the innovator, now baked into every story of Silicon Valley success, started as a government project in the 1960s. In 1972, President Richard Nixon seized upon the idea as a practical antidote to the elitism of scientists. Historian of science Matt Wisnioski explains in this issue that Nixon argued that "the mere act of scientific discovery alone is not enough" in a speech celebrating those who mix "the genius of invention with the skills of entrepreneurship, management, marketing, and finance." To put innovators on par with Nobel Prize winners, Nixon established a National Prize for Innovation. But in its first year the prize got caught up in the politics of Watergate, never to be resuscitated.

Innovation, as much as it seems like a neutral objective, is an inherently political concept. Wisnioski writes, "Americans have called upon innovation as a path forward to better futures that overcome political divisions and broaden participation in a technological society." In other words, since Nixon's time, the concept's lack of a fixed meaning has made it useful for people with competing ideologies who want to bridge their differences. It is a type of political glue that has helped strengthen this dynamic system.

This publication has devoted much space to contemplating the risks of politicizing science, scientizing politics, and the pressures of politics on scientific integrity. But ignoring how politics shapes the scientific enterprise carries its own risks. Just as the innovation ecosystem is inhabited by many different players beyond scientists, the American public has a prismatic view containing many stories, values, and mindsets. Appreciating these differences—as well as similarities—could be key to continuing public support. To that end, two articles in this issue recommend the use of more sophisticated polling to understand how the public sees the scientific enterprise, and how they'd like to shape it.

The enterprise could also learn by watching how political leaders generate support for emerging technologies by building new scaffolding to buttress research and translation to market. In this issue, Senator Todd Young, a Republican from Indiana, explains why the emerging bioeconomy should be understood as an urgent opportunity as well as a potential military and security vulnerability. As chair of the National Security Commission on the Emerging Bioeconomy, Young is optimistic that both parties are willing to foster the bioindustries of the future, including a White House coordination office, a streamlined regulatory regime, and a "demand signal" enabling government entities to buy new bio-derived products in bulk. These three elements align with the ways American decisionmakers have structured opportunities and incentives to enable previous technological leaps.

But Young also describes the bioeconomy as requiring a cultural change—in this case, an always-on societal readiness: "a future in which Americans engage with biotechnology the same way they do with cell phones and computers, leading to a more informed, empowered, and resilient society capable of leveraging science and technology to solve a wide range of global challenges."

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It is much easier to imagine a suite of useful bio-derived molecules than to imagine such a social transformation. Cultural change at this scale and speed is far beyond the scope of Bush's blueprint, which concerned itself mostly with scientists and the linear model. But there are other protagonists, and other models. As another group of authors points out in this issue, in the 1890s industrialist Andrew Carnegie's donation of 1,600 libraries to American towns was intended to establish libraries as a "democratizing institution.… [where] all were free and equal." Creating this technologically empowered society will require tapping into many historic stories, myths, and models outside of science.

The first six months of 2025 suggest that science will be under increasing pressure for years, perhaps decades. Now that postwar norms around science funding and science institutions have been broken, they are unlikely to be reconstituted. As the science enterprise starts the work of building deep bipartisan support and investment, looking beyond Bush's beloved 80-year-old blueprint can help it find a new political language.