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Editor's Journal

Unknown Knowns

In 2002, Donald Rumsfeld, defense secretary to President George W. Bush, famously said of uncertainties around whether Iraq had weapons of mass destruction: “There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns—the ones we don’t know we don’t know.”

The statement has been ridiculed for its obscurity and admired for its rigor, but it is perhaps most notable for its incompleteness. The late Steve Rayner, a social scientist who studied the intersections of science, policy, and culture (with a particular focus on climate change), observed that Rumsfeld missed what is certainly the most interesting category of uncertainty: the “unknown knowns,” the things we don’t admit that we know, what he termed “uncomfortable knowledge.”

Today, the science and technology community must face its own uncomfortable knowledge. We find ourselves in a crisis of cognitive dissonance: though the nation remains the world’s leader in science and technology by almost any measure, the widely shared benefits that such leadership was supposed to deliver to society seem to be drifting farther from reach. That the crown jewel of America’s scientific preeminence—biomedical science—has failed so spectacularly to protect society as a whole, and vulnerable populations in particular, from the COVID-19 virus has brought these contradictions into excruciating visibility.

For decades, inequities in American education, income, health, and opportunity have deepened—

and they now motivate politics across the left and right. These trends, of course, have many causes. But as John Alic argues in his essay about the history of American industrial policy, one important cause is the substitution of science and technology policy for meaningful policies to help foster the creation of jobs and industries in the United States, policies that are common in other industrialized countries. The national allergy to pursuing open and coherent industrial policy—dating back to the country’s founding—has meant that the private sector has tended to dictate the terms of growth through informal political means. One consequence has been the continuing disenfranchisement of workers from the benefits of science-and-innovation-led prosperity.

More uncomfortable knowledge: Scientists have on the whole been beneficiaries of this arrangement. In March 2016, well before the election of Donald Trump, the UK science journalist Colin Macilwain pointed to this disconnect in a scathing column in *Nature*: “It is the scientists who have chosen a career that allows them to pursue relatively simple problems (such as building a machine to detect gravitational waves) rather than genuinely difficult ones (such as running a social-care programme in a small town).” This might all seem a bit unfair if it weren’t for the fact that the tens of billions of taxpayer dollars invested in science are uniformly justified in terms of the benefits they will deliver to the public. As Roger Pielke Jr. explains in his consideration of the social responsibilities of science, Vannevar Bush’s powerful metaphor of the “endless frontier,” which decoupled scientific exploration from social impacts, has exempted scientists from having to

think about their responsibilities to society.

In the concatenation of crises that COVID-19 has triggered, Alic and Pielke expose the political expedience at the heart of science and technology policy: throwing money at research and the endless frontier, and justifying it as a contribution to the public good, has been an easy case to make since the end of World War II. This approach to governance remains almost unique in its bipartisan support, and why wouldn't it? Boosting, say, biomedical research budgets requires none of the exhausting political work necessary to reform a health care system that pretty much everyone agrees is broken. Ditto for policies that would both stimulate innovative industries *and* assure decent livelihoods for people whose prospects are undermined by the constant creative destruction of a dynamic economy. Of course more money for science has led to extraordinary advances, but the long-term consequences of this political expediency can be seen in the anger and suffering of those left behind.

As a former director of the Defense Advanced Research Projects Agency and the National Institutes of Standards and Technology, Arati Prabhakar is confident that science and innovation can be engines of societal betterment. Here, she explains her new venture—an agenda so ambitious it's almost outlandish—for science and innovation to solve challenges threatening the nation's ability to thrive. Prabhakar has identified transformative opportunities on the horizon where a convergence of technological capabilities can be mobilized to directly improve social mobility, population health, privacy, and environmental protection.

The cumulative vision showcased in these pages for helping to resolve the contradictions between scientific achievement and national failure is not without its own tensions. Alic emphasizes a policy pathway “that reduces the influence of business interests and the wealthy relative to that of the great mass of US residents.” The politics involved would be daunting. And achieving Prabhakar's vision makes demands on science and technology that today seem barely feasible.

The tension between political and technological pathways, each fraught with obstacles, is mirrored at a smaller scale. How can the nation assure quality jobs for tomorrow's workers? Steve Viscelli, focusing on the great American occupation of long-haul trucking, sees a policy opportunity to steer self-driving trucks

on a road toward better jobs, away from today's exploitative labor market. John Paschkewitz and Dan Patt are conducting shop-floor experiments to create an AI-mediated symbiosis between robots and human workers that respects and reinforces the unique capabilities of each. Different pathways, each really difficult, but both demonstrate how we might realign the nation's approach to science and innovation policy.

Because the world is far too rich and complex for full comprehension by anyone, unknown knowns are a necessary cognitive strategy for allowing each of us to maintain a view of things coherent enough to allow us to act in the world. In his 1902 essay “What Pragmatism Means,” William James observed that people cannot easily absorb every idea that challenges the coherence of their existing view, or else they would exist in a continual state of mental chaos: “By far the most usual way of handling phenomena so novel that they would make for a serious rearrangement of our preconceptions is to ignore them altogether.” These are the unknown knowns.

But at times, James acknowledges, events do “oblige a rearrangement,” where one must “graft” a new idea upon one's existing “stock of ideas,” although always “with a minimum of disturbance of the latter.” From this perspective, the in-your-face evidence of the COVID-19 disaster, and the way it undermines assumptions of how science leads to shared progress, may be obliging a rearrangement of some fundamental ideas about the way we develop and pursue science and innovation policies. Charles Holliday, the subject of our *Issues* interview, is chair of the board of Royal Dutch Shell (and before that, chief executive of Dupont). He starts with a refreshingly open confession of ignorance about the multiple crises triggered by COVID-19: “We don't know what this is yet. This is a very tough combination of things, it's very difficult. It could even turn out to be good for us in the long-term. We might develop healthier habits as individuals. We might think about the connectedness of the world in a totally different way than we had before.” This might include, for example, different ways to think about the connectedness between how we organize science, and what it takes to assure society-wide inclusion in the prosperity that science helps to create. Some of these different ways of thinking appear in the pages to follow. If we're doing our job, you'll soon come face to face with some uncomfortable knowledge of your own.