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Science Policy Up Close


Mark Schaefer

Science Policy Up Close traces the high points of John Marburger’s career from president of Stony Brook University to director of Brookhaven National Laboratory, and later, science advisor to President George W. Bush. The book, focused, as Marburger put it, on “policy in action,” is part retrospective on science policy and part memoir laced with biographical information and speeches. It is inconsistent in structure and content, by necessity, due to his death in 2011 after completing the first two chapters. At Marburger’s request, his longtime colleague Robert Crease, professor of philosophy at Stony Brook University, completed the book by ably editing materials from Marburger’s speeches, writings, and interviews, and providing context and commentary through introductions to the material in the remaining four chapters.

The book is indeed about policy in action—the challenges of dealing with complex and controversial issues, with various advocates pursuing diverse, often strongly held, positions and outcomes. In that respect, the book provides a glimpse of science policy making, administration of science and technology programs, and conflict resolution at the highest levels. But for those looking for insights into thought processes, perspectives on interpersonal interactions, or glimpses of internal White House advice and deliberations, Science Policy Up Close will seem somewhat distant. However, through the course of his career, John Marburger was an up-close participant and influenced major science and technology policy decisions involving everything from the decommissioning of the Shoreham nuclear power plant to funding for the proposed Superconducting Super Collider particle accelerator, to the future of Brookhaven National Laboratory, and more broadly, to the distribution of funding for the federal research and development (R&D) enterprise. The book portrays the diverse experiences of an accomplished physicist, administrator of complex scientific and engineering programs and institutions, and manager of people—and there is much to glean from Marburger’s personal accounts and Crease’s compilations and insightful commentary.

In the preface, Marburger points to his “ability to deal with people in an objective and productive way,” and his skill at resolving conflicts involving science and technology programs and projects. In the book’s initial chapters, he underscores the value he places in working to understand diverse perspectives and identifying a path forward. For example, in the first chapter, he describes his efforts to resolve the dispute over the future of the Shoreham nuclear power plant on Long Island as head of the commission established by New York Governor Mario Cuomo. He proved to be an effective mediator, in part due to his respect for others, patient listening skills, and belief that the range of views on an issue should be given a full hearing.

In the second chapter, Marburger provides a detailed accounting of the factors leading to the demise of the Superconducting Super Collider from his vantage as chair of the board of trustees of the University Research Association, the group managing the project. He points to what he calls the Principle of Assurance—the need to ensure public accountability on large scientific facilities and projects through transparency on costs, scheduling, and performance—as a general objective that he pursued in later high-level positions.

The third chapter continues with the theme of conflict resolution and consensus building as Marburger, the new director of Brookhaven National Laboratory, responds to public uproar over a leak of radioactive water from a reactor at the laboratory. As in other controversies he dealt with throughout his career, Marburger’s strategy for resolution began with developing a narrative in which all sides could see themselves. Then he worked to craft a resolution that reflected elements of multiple perspectives. Chapters four and five are dedicated to his activities as science advisor to President George W. Bush and as director of the White House Office of Science and Technology Policy (OSTP) in each of the president’s two terms.

Early in his tenure, Marburger made organizational changes at OSTP in an effort to focus the office on a smaller number of policy issues. Critics viewed his streamlining of objectives skeptically, believing this would limit the influence of the office. Indeed, he did focus on a more limited policy agenda. He argued that such controversial issues as climate change and embryonic stem research were not primarily science policy matters and therefore were not OSTP priorities. He believed climate change policy was largely driven by economic considerations that were not an area of analytical strength in OSTP. Similarly, he argued that the debate over embryonic stem cell research involved ethical matters beyond the purview of his office.

But many in the scientific community believed Marburger was not actively pursuing these issues and not using his position to ensure that an ideological
White House was making decisions informed by objective science. He responded to critics by emphasizing his role as an advisor and not an advocate, and pointing to the need to work in a manner that maintained the trust and confidence of the president and his other senior advisors. Marburger focused on budget priorities and R&D funding, communications technologies, bioterrorism, and the many technical issues that OSTP is called on to address. Unlike his predecessors, he was not given the title of Special Assistant to the President, which fueled the perception that he was not fully engaged in White House policy-making processes.

A controversy that dogged Marburger’s tenure at OSTP moved into the public spotlight in 2004, when more than 60 prominent scientists, including 20 Nobel laureates, signed a statement charging that the Bush administration was “suppressing, distorting, or manipulating the work done by scientists at federal agencies.” The statement, organized by the Union of Concerned Scientists, called for restoring scientific integrity and cited examples of alleged manipulation of science to further political objectives and the appointment of individuals to science advisory panels based on views favoring administration policy objectives. Marburger argued that the claims lacked a basis in fact and that the statement was counterproductive. He steadfastly defended the Bush administration’s record related to science, pointing to sustained support of R&D, including substantial funding increases for basic research.

Marburger was a determined leader and administrator who focused on priorities, acted deliberately, and cultivated an image of evenhanded propriety. As Crease points out in his introduction to the book, Marburger “learned to keep his image under his own control,” quoting him as saying that in order to maintain credibility and authority, an administrator involved in controversy should be “as bland as possible.” Marburger was a complex, highly accomplished individual who behind the scenes played piano, meticulously maintained an MGB sports car, and early in his career spent his spare time over three years building a harpsichord. He was chair of physics at the University of Southern California at the age of 32, dean at 35, and president of Stony Brook University at 39.

Marburger learned from his early accomplishments and attempted to apply his skills and experiences as science advisor to the president. But he, like other science advisors, found the complex and chaotic nature of political processes to be perplexing, and science policy making at the highest levels to be challenging. He was, as Crease put it, “a lightning rod for attack,” in part because prominent scientists believed the Bush administration was misusing science. Yet Marburger believed his job was to put politics and opinions aside and provide the president independent scientific advice.

What actually goes on in the White House policy-making deliberations often remains a mystery because advisors generally adhere to the principle that conversations with and advice to the president are private matters. In addition, many of the issues involve classified information and considerations that do not allow for the degree of transparency required for objective evaluations of the roles and actions of individuals. Marburger’s book is not an exception to this general rule.

But autobiographies and memoirs such as Science Policy Up Close are useful in providing a perspective on history from the standpoint of those who participated in historical events. In essence they provide a public figure an opportunity to present his or her actions in the context of events as he or she perceived them—or would like others to perceive them. One may argue that a more balanced assessment can be provided by those who are in a position to critically evaluate events from multiple perspectives, and are not defending or advocating for the actions of an individual—or oneself—actively engaged in those events. Science Policy Up Close provides an important, albeit somewhat opaque, glimpse of the inner workings of OSTP under particularly challenging political circumstances. It presents a clearer accounting of the complexities of operating major scientific facilities; the challenges of securing and maintaining support for large science and technology enterprises; and the difficulty of not just crafting, but effectively implementing, policy positions.

For those interested in national science policy, particularly those who might choose to participate in and guide the policy-making process as public servants, Science Policy Up Close is a valuable resource. Whether or not a reader agrees with the opinions and actions described in memoir or biography, there is much to learn from the way an individual assesses and responds to the issues with which he or she is confronted.

In an essay excerpted in the book’s final chapter, Marburger states that “science must continually justify itself, explain itself, and proselytize through its charismatic practitioners to gain influence on social events.” Readers of Science Policy Up Close and observers of actions and events during the presidency of George W. Bush will debate the degree to which Marburger accomplished this goal. Regardless of one’s perspective, the book provides a thoughtful accounting of the challenges associated with science policy making at the highest level, and of
an accomplished individual's persistence and dedication to science and public service under difficult circumstances.

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Gamers Abroad

Video Games Around the World

Harry Brammer

Defining video games involves a bit of fuzzy science these days. Arcades of the 1980s or home consoles such as the Nintendo Wii and Sony PlayStation may immediately spring to mind, but games on smartphones, social networks, and (soon) a new wave of virtual reality devices are constantly evolving the medium and expanding the player population to just about everyone you know. There is no one element that makes a video game a video game, but Pac-Man creator Toru Iwatani attempts to capture the medium's essence: “Video games differ from other manufactured goods in that they are the rare product to simultaneously be electrical, mechanical, and works of art; they aggregate a range of ideas from the fields of engineering to literature to art to psychology, and they provide society with a necessary cultural tool of 'play.'”

As the possibilities of those fields change and flourish, so grow video games, and so grow the world and economy around them. Video Games Around the World, a new collection of essays edited by Mark J. P. Wolf of Concordia University, arrives at an ideal time for surveying the remarkably dynamic—and, importantly, global—landscape of digital gaming.

The Internet has dominated video game discourse with so-called “new games journalism,” a term coined by writer Kieron Gillen (derived from Tom Wolfe's essay collection The New Journalism) to describe the non-academic, very personal style of journalism where game-playing experiences are described and embraced almost entirely through the first person. Recent book-length examples include Extra Lives by Tom Bissell and Gamelife: A Memoir by Michael Clune. This kind of writing about video games is perfectly entertaining, often informative, and nostalgic, befitting a medium that spread across the monoculture of suburban American life over the past four decades.

As good as this new games journalism often is, its omnipresence tempts fatigue, with similar themes and memes appearing again and again, and all of this shared individualism ultimately raising the question: What about everyone and everywhere else? Although video games have managed to find a home most places on the planet, the English-speaking continents of the Internet inevitably remember and recount only their own limited experiences. Video Games Around the World provides a glimpse beyond this bubble by commissioning writers from Africa to Asia to South America to offer an objective retelling of their homeland's gaming past. To provide a comprehensive picture, the usual suspects such as Japan and the United States are included as well, but the allure of this book is the experience of less-traveled digital landscapes.

Both the pitfalls and the value of this impersonal investigation are evident in the first chapter and its singular attempt to cover the entirety of Africa. Popular regional games whose names have never before been uttered by Mario Bros.-filled mouths here get a chance to at least present themselves as existing. It is difficult to understand a game purely in words—especially when those words are directed toward the volume's more overarching archival aims—but it is almost enough to know that they are out there. The gaming community often complains that developers overread the same battlegrounds—World War II being a particularly popular setting—yet there already exist virtual worlds with fresh environments, if not always fresh ideas. Do you want to relive the early Islamic conquests of North Africa or the 1814 Peruvian Rebellion in Cusco? These games have already been created on the periphery and could perhaps succeed in English-speaking markets with the slogan, “It's still war, but different!”

Many games documented in the book do offer truly different experiences that extend beyond warfare, in part simply due to their having been created outside dominant markets. It may not always be possible to play them due to technical or bureaucratic barriers, but we're nearing a world in which such unavailability is anachronistic. Although a lack of industry access is a factor in countries less versed in traditional consumer delivery methods, the PC and smartphone ecosystems are developing to a point where established games publishers hold significantly less influence. A game put on a smartphone app store by a guy in Vietnam can make tens of thousands of dollars per day, as with the Flappy Bird phenomenon, which is revolutionary regardless of your opinion on the merits of Flappy Bird. It remains to be seen whether a new dynasty of publishing conglomerates capitalizes on this situation, but for now these peripheral video game markets are a dynamic “Wild West” of game development and distribution.
That said, there are still significant gaps in the global accessibility of game development. This is a technical field that requires up-to-date training. Even when skilled outsiders do overcome the odds to create a deliverable product, marketing skills are required to navigate the “all-access” environment. Perhaps the greatest accomplishment of Wolf’s book is the compiling into a single source the various support pipelines available to aspiring game makers. Many countries subsidize game development, and many more feature trade organizations akin to medieval guilds and conferences purposed toward professional progress. The transitioning landscape makes this a confusing time, to be sure, but the book’s individual authors typically conclude their chapters optimistic of this “Gilded Age.”

The chapters of Video Games Around the World are arranged alphabetically, which is appropriate, benign, and concedes the fact that this is ultimately an encyclopedia in form and function. This leads to flow issues for those seeking to read the work cover to cover, but the arbitrariness serves complex issues such as piracy well. There are few moral conclusions offered (as perhaps none exist), so the piracy discussion takes a disjointed path through international history. Corporations will be happy with cases such as Mexico, where longtime video game fans fostered during eras of piracy are now likely to spend money on their favorite franchises via legitimate pathways. However, traditional pay structures are being undermined by online subscriptions and microtransactions in any case, so piracy itself is morphing into shapes this tome cannot and does not seek to predict.

The individual authors are both the strengths and weaknesses of this book. Excellent introductions by the editor and the above-quoted Iwatani aside, the writing consists of (mostly) local voices describing local game history. Yet how many different voices can a reader entertain before intrigue becomes exhaustion? All authors were given the same assignment by the editor (to describe the past, present, and future of video games in their countries, with added focus on local game companies and academic endeavors), and although there is some stylistic variety to the response, the book as a whole feels a bit rote. All of the authors are qualified and knowledgeable, and all certainly care about and are personally invested in the topic at hand, but writing skill is sometimes lacking or has been lost in translation.

The chapters with personality inevitably become the most memorable. Hungarian contributor Tamás Beregi provides a couple of interesting anecdotes, one involving Yegor Ligachev, an official of the former Soviet Union who requested underground Commodore 64 software for his grandson, and another describing a hungover gonzo journalist in a bomber jacket wandering the halls of Hungary’s Ministry of Education, demanding permission to publish a game magazine. Thomas Apperley does an excellent job giving life to the Venezuela chapter as well, but here we have the case of a non-native ethnographer telling the national tale. The book never promises exclusively local authors, and it would be naïve to study a single nonfiction essay with the expectation of understanding the entire history of a country’s gaming past, so credentials providing the author’s bona fides should satisfy. However, these credentials are aggregated in the back of the book rather than alongside the numerous other appendices contained within the chapters—a legitimate formatting choice, but one that makes the reader work harder to discover the qualifications of their local tour guides.

Is it wrong to ask for more personality in a work like this? The opposite complaint might be leveled against new games journalism and all its self-centered style, so studiously avoided by the experts of Video Games Around the World. The truth is, though, that traveling the world is tiring without a good companion. The breadth of coverage amassed by Wolf is impressive, but the format makes a murderers’ row of virtuoso writers unlikely. Too often the games are presented in facts and lists rather than an engaging discussion of the tangible, vibrant, important entertainment video games offer. The book accomplishes its mission of delivering history. However, in so doing, it surrenders readability for completionism, transmuting along the way into a repetitive experience akin to playing too many first-person shooters, and making it unlikely many readers will see the mission through.

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Nobody Knows Anything

The Cunning of Uncertainty


Jack Stilgoe

In a memoir, the screenwriter William Goldman reflected on his moviemaking career, wondering why some films caught the public imagination and soared, while others flopped. His depressing conclusion was that “nobody knows anything.” Although Hollywood projects an image of brash self-confidence, behind the scenes the actors, producers, and writers are in perpetual panic over the uncertain future—blockbuster or bomb?—of their fragile experiments.

Strictly speaking, some people do know some things. Experience, expertise, and data can, of course, help us when faced with difficult decisions. But it’s important to remember that uncertainty remains our default state and that it drives the scientific enterprise. The search for scientific certainty resembles the trial of the Danaids of Greek myth, whose fate in the Underworld was to spend eternity pouring water into an unfilled
vessel. If we believe we have found an inviolable scientific certainty, or demand such certainty before acting, we are only kidding ourselves.

Science, Helga Nowotny tells us, "thrives on the cusp of uncertainty," using what is known to probe what is not. Her brilliant new book, The Cunning of Uncertainty, argues that we should not just understand what it means to be uncertain, we—scientists, society, politicians, and all—should learn to embrace uncertainty. Nowotny provides dispatches from the frontiers of current research, taking in psychology, history of science, digital humanities, genomics, planetary science, and much more. She resists the temptation to report the latest surprising finding or pop fact; her aim is, instead, to map the social graph it became the social vessel. If we believe we have found an inviolable scientific certainty, or demand such certainty before acting, we are only kidding ourselves.

In the 1990s, Nowotny was part of a group of scholars in Science and Technology Studies (STS) who influentially described the changing relationship between science and society. "Mode 1" science, as they described it, was characterized by a social contract in which society gave science autonomy and funding in exchange for its downstream social benefits, whatever those might end up being. These STS scholars idealized contemporary science as "Mode 2," in which the social contract is in flux; science is no longer done for its own sake; scientists are expected to imagine new economic possibilities, work with colleagues in other disciplines, and deal with public scrutiny. Nowotny and her colleagues made an argument that was at once descriptive and prescriptive: Mode 2 is the way science is going and the way it should go.

It is ironic, therefore, that Nowotny ended up running the European Research Council, a resolutely Mode 1 organization, a bulwark against the "impact" agenda that is creeping through other science funders. The sole criterion for funding research is "excellence," which is code for scientists deciding what counts as worthwhile science. Nowotny cites education reformer Abraham Flexner's 1930s call for an appreciation of the "usefulness of useless knowledge." Her case for excellence is far more coherent and robust than most of what passes for contemporary science policy. But, in reading her book, I kept wanting to know whether its Mode 1-oriented conclusions had emerged from a lifetime of scholarship or a sequence of compromises. Is this Nowotny the STS scholar or Nowotny the policy maker?

She is certainly critical of some recent and powerful trends in science. For example, she draws attention to the tendency, through the collusion of policy makers and researchers, to hype the impact of research. As a funder, she knows all too well that "grant applications tend to be replete with over-promising rhetoric."

One of the fields steeped in this kind of rhetoric is the emerging science of big data. Nowotny describes well, without resorting to algorithm alarmism, how the quest for big data leads to unintended consequences. "Data," she points out, is the great misnomer. Despite the term's Latin roots, data is (or are, if you insist) made, not given, and we should keep track of its (okay, their) social roots. Nowotny describes big data's potential for moving from a science that is driven by "why" to one driven by "what," in which surprising findings are allowed to emerge from data. But she would be as critical as anyone of overblown talk such as appeared on the cover of Wired magazine, which declared the "end of theory" in 2008. Excitement about "what" must not be allowed to occlude the discussion of "what for."

Big data is one of many areas where research is intimately implicated in the creation of future worlds. The world of big data is not just a world as understood by big data, but a world created from big data. As Nowotny puts it, "when Google sought to gauge what people were thinking, it became what people were thinking. When Facebook sought to map the social graph it became the social..."
graph.” Knowledge cannot be so neatly split from action.

In 2002, Donald Rumsfeld (then US Secretary of Defense) was much mocked for an obfuscatory attempt to justify an invasion of Iraq despite the lack of evidence that the country possessed weapons of mass destructions. He said: “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.” (Nowotny uses the neatened-up version that appeared in Rumsfeld’s memoir, which he titled *Known and Unknown*). Those of us who are interested in the interplay of knowledge and politics were embarrassed to admit that he was right. When imagining uncertain futures, it is comfortable to think in terms of calculable risks. But there are areas of uncertainty or ignorance in which we cannot calculate probabilities and we cannot predict consequences.

The attempt to exert total control over uncertainty (Rumsfeld’s “unknown unknowns”) by domesticating it as risk (the “known unknowns”) may be part of the problem. One need only look at financial services and the crisis of 2007-8 to see how an industry that claims control over risk creates and fails to understand its own systemic risks, with the result that, when surprises hit, they are felt harder. Nowotny argues that “the vast majority of economists failed to foresee the 2008 financial crisis,” but this is to overlook the economic Cassandras who were ignored because it was in nobody’s interests to worry about the big uncertainties. More thoughtful economists are now realizing their mistakes. In *The End of Alchemy*, Mervin King’s recent book-length attack on financial chicaneery, the ex-governor of the Bank of England draws attention to what he calls “radical uncertainty,” by which he means uncertainty that can’t be put into numbers.

When Nowotny writes, regarding the financial crisis, that the “cunning of uncertainty transforms promises into probabilities,” we are left wondering who is claiming they have control over our futures—who is generating these probabilities? — and why. It is no accident that governments portray uncertainties in finance as under control while those from terrorism are presented as sufficiently troubling to justify our current security apparatus. Reading Nowotny’s book, I was left wondering where is the democracy in uncertainty? What would a genuinely radical approach to uncertainty look like?

The possibility of using under-scru
tinized uncertainties for particular ends has not gone unnoticed. If uncertainty has politics that affect decision making, the question, as Nowotny’s STS colleague Erik Millstone has posed it, is “who gets the benefit of the doubt?” Rumsfeld’s speech reminds us that uncertainty is not simply a certainty deficit. It can be defined, manufactured, ignored, or exaggerated for political or economic ends. Naomi Oreskes, whose work examines corporate attempts to inflate uncertainties in the sciences of climate change and public health, uses a term coined by the historian of science Robert Proctor to describe the study of culturally induced uncertainty: agnotology. Agnotologists seek answers to Millstone’s question.

In a lecture to the London School of Economics about this book, Nowotny asked “if science can thrive at the cusp of uncertainty, why can’t society?” Her rhetorical question doesn’t want a response, but, if we were to force one upon it, it would be that, as with earlier calls for an “experimental society,” we need to be extremely careful about who controls the experiment. Yes, we need to get used to trying and erring rather than planning and predicting; but we also need to connect our academics to the real world rather than trying to free them from it.

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### Surviving the Techstorm

**A Dangerous Master: How to Keep Technology from Slipping Beyond Our Control**


Eleonore Pauwels

In *A Dangerous Master*, Wendell Wallach, a scholar at Yale University’s Interdisciplinary Center for Bioethics, tells the story of modern society’s struggle to cope with technology’s complexity and uncertainty. In the course of telling this story, Wallach questions the terms of the social contract under which we as a society predict, weigh, and manage the potential harms and benefits that result from the adoption of emerging technologies. In urgent prose, he argues that we need different epistemic, cultural, and political approaches to adequately assess emerging technologies’ risks and their broader social impacts. Wallach promotes public deliberation as one of these approaches, which provides citizens and experts the opportunity to distinguish the technological hype from the hope, the speculation from reality, and in so doing shape their technological futures.

There is a whiff of science fiction in Wallach’s prose—maybe more fiction than science. He envisions a future where autonomous robots, designer babies, homemade pathogenic organisms, and mindclones confront our hopes, fears, and inner conflicts. An ethicist by training, Wallach uses these future scenarios to explore normative questions borne of the pervasive entanglements of technology and society. One of the principal questions at the heart of *A Dangerous Master* is whether we will find ourselves governed by transformative technologies whose ramifications we did not envision and whose development we did not examine. This question is one
that always emerges when we fail to anticipate or develop adequate controls for complex technological systems. To preemptively counter these questions, scientists and engineers usually reach for concepts and metaphors that portray their artifacts—physical and biological systems—as reliable and controllable.

Wallach pulls a powerful yet simple interrogation from the sidelines of the global conversation on science policy: What is our purpose in developing a particular technology, and is that purpose one we ought to pursue? Wallach warns us that without adequate reflection, we risk being swept into an incessant storm of groundbreaking scientific discoveries and technological applications that outpace society’s capacity for control. What Wallach refers to as a “techstorm” is essentially a period of overzealous technological innovation that can have destructive consequences.

Wallach offers a useful historical analog for a techstorm in the tools and technologies that gave rise to the Industrial Revolution. Disruptive technologies, including steam power, the cotton gin, and more efficient iron production, radically transformed society, upending traditional hierarchies, reshaping economies, and even modifying relationships with the natural world. He reminds us that the benefits reaped from the new manufacturing era were preceded by a period that immiserated much of the workforce and included among its harms child labor and unsafe working conditions.

In the wake of the manufacturing era, came the rise of industrial capitalism, based on individual rights, private ownership, and free markets. Capitalism and the techstorm that enabled it brought with them growing disparities in wealth and opportunity, both among and within countries. In the current context of four decades of wage stagnation and wealth inequality approaching levels not seen since the early twentieth century, Wallach imagines what would happen if technology permanently replaced a great deal of human work, as many digital age observers have predicted, and suggests that rethinking capital distribution will become necessary if society wishes to avoid a crisis.

Wallach identifies another potential fissure in the social contract in the form of a genetically stratified future, where a select few are capable of further distancing themselves from the majority through the use of genetic enhancements. He also analyzes transhumanist philosophy, which idealizes a post-human future in which humans master their own evolution using technological enhancements: “The best of what it means to be a feeling, caring, and self-aware person will be fully expressed in technologically enhanced cyborgs and *techno sapiens*.” Wallach characterizes the critique of transhumanism as “buy[ing] into a representation of what it means to be human that is incomplete and mechanizes, biologizes, and pathologizes human nature.”

I think Wallach’s perspective on this debate is unduly Manichean, but I share the notion that we need to be vigilant of reductivist discourses. These conversations imperceptibly close rather than open the prospect for us to decide what we want to become and what we want our futures to be. Such discourses also obscure rather than illuminate the deepest sources of social ills, which shape the evolution of our genes, bodies, and identities. Our biological existences are profoundly influenced by where we live and how much money we have to better ourselves through education and access to care. Reductionist discourses that ignore social ills and contingencies will tend to crystallize our genetic and digital divides and, in turn, limit our opportunities to bridge them.

Techstorms are enabled by rhetoric that hypes immediate benefits while downplaying risks. This premise allows technology creators, such as those in the biomedical industry and the military-industrial complex, to evade scrutiny and quickly entrench themselves in society. Interestingly, Wallach’s emphasis on security and defense research as a driver of the techstorm is in line with what we see happening in cutting-edge biotech, as accelerated development and the glacial pace of regulatory agencies and courts outpace society’s ability to adequately evaluate the technologies’ effects. This paradigm of fast-paced innovation, driven by economic competition and security imperatives, incorporates little input from the public beyond consumers’ market preferences. Given that these technologies have the potential to disrupt many aspects of society, should we not look to uphold the much-espoused principle of democracy?

Wallach’s purpose in critiquing the techstorm is not to stifle innovation but to slow the speed of innovation to a “humanly manageable pace.” This pace is described as one that’s in line with informed decision making by individuals, institutions, governments, and humanity as a whole. As Richard Denison of the Environmental Defense Fund stated in his blog, “The real danger is continuation of a government oversight system that is too antiquated, resource-starved, legally shackled, and industry-stymied to provide to the public and the marketplace any assurance of the safety of these new materials as they flood into commerce.” A manageable pace that incorporates broad social values while ensuring human safety begins with the need to
The sheer speed of change will assuredly result not just in people who surrender their lives to gadgets and machines they may not want, but in vast disruptions that society cannot mitigate.

discover inflection points, which are historical junctures in technological innovation that are followed by either positive or negative consequences. Secondary inflection points can be thought of as rate adjustments in the technology’s research trajectory.

Again, Wallach’s analysis is enlightening, as our global society currently grapples with the benefits and risks of genomic editing and artificial intelligence. When it comes to mastering the human genome, a first inflection point is our will to question who should own our genes and their secrets. The Supreme Court’s unanimous 2013 ruling barring the patenting of human genes was a wise and balanced decision that cleared a major barrier to innovation in biotechnology, drug development, and medical research. But as with any inflection point, the court’s decision was only a first step toward finding the right balance between protecting legitimate intellectual property and securing an open future for personalized medicine based on genomics.

By 2015, the scientific community was confronted with one of the most important disruptions in genomics research since the 1975 Asilomar Conference on Recombinant DNA. The advent of CRISPR technology, which allows gene editing at specific loci on the genome, drastically accelerates the potential for engineering human and non-human biology. I welcome Wallach’s critique of scientific boosterism and its tendency to simplistic empiricism, which saturates genomics research and policy discussions. For example, those who support gene editing often describe it as a pair of molecular scissors that cut out harmful DNA sequences on a chromosome, thus “editing out” disease. Images such as this make the gene-editing process seem easier and cleaner than it really is, and assume a control over our germline we do not yet have. They gloss over the potential for off-target edits, which can create unintended mutations in the genome. Another characteristic of the momentum around gene editing is the lack of clear understanding of the role citizens are invited to play. As Wallach might suggest, experts’ call for a moratorium on germline gene editing is no substitute for more inclusive public debates on the promises and risks of our biotech futures.

Inflection points such as those apparent with CRISPR are opportunities that allow society to exert a degree of control of the future we create. Once this window of opportunity passes, it becomes extremely difficult to overcome the ensuing technological lock-in. To avoid this fate, Wallach posits that it is necessary for oversight to comprise a combination of hard and soft regulations. In other words, effective oversight requires both nimble governance (industry standards, codes of conduct, statements of principle, and so on), and the authority of government to enforce appropriate research practices. To create this kind of oversight, Wallach advocates for the creation of governance coordinating committees (GCCs).

A GCC would act as a good-faith broker searching for gaps, overlaps, conflicts, inconsistencies, and synergistic opportunities among the various public and private entities already involved in shaping the course of an emerging field. Its primary task will be to forge a robust set of mechanisms that comprehensively address challenges arising from new innovations, while remaining flexible enough to adapt those mechanisms as an industry develops and changes.

The GCCs would be led by “accomplished elders” who have achieved wide respect (Wallach doesn’t specify their exact qualifications) and would work together with all interested stakeholders to monitor development and propose solutions to perceived problems.

Public engagement is another area Wallach addresses, highlighting the use of citizen panels as a way to involve a representative cross section of citizens to tap into their knowledge and provide input to lawmakers. Such a group would allow citizens to receive information and opinions that are different from those traditionally offered by politicians, experts, and interest groups. It would also provide a better way to generate informed attitudes that can be clearly expressed to decision makers.

Without proper citizen engagement and a means to contain the power of minority interests, technological development will proceed unhindered, for better or, quite possibly, worse. The sheer speed of change will assuredly result not just in people who surrender their lives to gadgets and machines they may not want, but in vast disruptions that society cannot mitigate. Although such a view may mark me as a Luddite, it’s appropriate to remember that the purpose of technology is to benefit our quality of life. Technological progress alone is not a means of transcending the human condition or a goal in itself; it is a tool for improving the human lot, and like any tool, it can cause serious harm with improper use. In the end, the most important message that Wallach shares—and I appreciate his effort to do so with elegance and perspicacity throughout the book—is that we need to harness the full force of our democracy to shape technological progress according to our values. Otherwise, we will end up controlled by technologies whose ramifications we did not foresee and whose path we neglected.

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