Can Science and Technology Save China?

Susan Greenhalgh, Li Zhang

Published by Cornell University Press

Greenhalgh, Susan and Li Zhang.
Can Science and Technology Save China?
Cornell University Press, 2020.
Project MUSE.muse.jhu.edu/book/72636.

GOVERNING THROUGH SCIENCE

The Anthropology of Science and Technology in Contemporary China

Susan Greenhalgh

National Rejuvenation and Ascent through Modern Science: Political Promise, Political Mandate

Since its embrace of modernity a century ago, China has been animated by official dreams of national revival and global ascent. Central to every dream has been the promise of modern science. In the early twentieth century, Western-oriented Chinese intellectuals embraced modern science with fervor, seeing the promotion of "Mr. Science" (*sai xiansheng*) as a powerful means to critique China's traditional culture, whose scientific backwardness was seen as a root of China's poverty, and to set the nation on the path to modern civilization (Kwok 1965). Since that time, science has been associated with modernity and national salvation and imbued with almost omnipotent powers. One could perhaps say that *kexue jiuguo* and, more recently, *kexue xingguo*—popular adages conveying that China can and should be saved and rejuvenated by modern science—have been built into the cultural DNA of the Chinese nation.

In China, this vital project of defending and strengthening the nation with modern science has been conceived and carried out mostly by successive states. For over a century, science has been largely an instrument of state rule, introduced through top-down initiatives directed at strategic, state-defined ends (Elman 2005; Shen and Williams 2005). And so, far from withering under the Communists, the belief in the promise and power of science persisted into the early People's Republic. Under Mao Zedong (paramount leader 1949–1976), science was assigned

a highly progressive role in Marxist philosophy (Kwok 1965). In the 1950s, following the lead of the Soviet Union, the leaders of the young People's Republic consolidated state control over science and created Soviet-style research institutions. During the chaotic years of the Cultural Revolution (1966–1976), Mao notoriously turned on the scientists, wreaking havoc on the nation's science and social science establishments.

In a striking historic reversal, in the years since Mao's death, modern science and technology (below, simply S&T) have secured a political prominence perhaps unmatched in the world. After decades of often disastrous ideological decision-making culminating in the Cultural Revolution, modern science appeared as the way out, a deus ex machina that would guide China into the modern world. Deng Xiaoping, Mao's successor as paramount leader (1978–1989), designated science and technology the first of the "four modernizations" (*sihua*) and China's primary route to modernity and global power. (Chinese political discourse joins "science" and "technology" [*keji*] into a term of central importance in the post-Mao era. My discussion of the political significance of these domains follows Chinese usage and yokes the terms, except where the emphasis is clearly on either science or technology.) Starting in the late 1970s, the new reform leadership under Deng began to invest in S&T as a national strategy, rebuilding the science infrastructure and introducing a series of policies to promote the rapid development of modern science and technology. "Scientific policymaking" (*kexue juece*) became politically obligatory, and science—that is, the claim to be a scientific modernizer—joined the now-exhausted Marxism-Leninism–Mao Zedong Thought as a legitimating ideology of the Deng regime.

In the twenty-first century, science and the party-state remain deeply intertwined. Following Deng, successive leaders have adjusted the political meanings and uses of the term *science* to meet new goals, yet science has maintained its importance. Hu Jintao (top leader 2002–2012) made the "scientific concept of development" (*kexue fazhan guan*) a signature theme, to be incorporated into all policy arenas (Fewsmith 2008; Wang 2009). During the 1980s, 1990s, and early 2000s, as the country's leadership filled with scientists and engineers, China became a virtual technocracy run largely by engineer-politicians (Li 2016; also Andreas 2009). Since the late 2000s and early 2010s, technocratic dominance of the party-state has waned. Although the majority of the nation's top leaders are now trained in economics, law, politics, and the humanities, the regime continues to place immense faith in the powers of S&T (Li 2016, chap. 5).[1]

Today China aspires to be one of the most technologically innovative nations by 2020 and a global S&T powerhouse by midcentury, and it is investing heavily to realize those goals (Cao and Suttmeier 2017; Chinese Academy of Sciences [CAS] 2016). These widely promoted aspirations of the leadership have given

rise to a global narrative of China as an increasingly formidable global power in science and, even more so, technology. In the Western media, high-tech success is the dominant story about China's scientific and technological development. And there is much that is impressive. A global leader in a few fields, China is now home to more researchers than any other country, and it is second only to the United States in the number of scientific publications (Yu, Zhang, and Lai 2014). Top leader Xi Jinping (from late 2012; likely to remain in power well beyond the usual ten years) has energetically supported this agenda, pouring vast sums into advanced technology projects such as Made in China 2025 and Internet+, which are aimed at spreading robotics, networking, and artificial intelligence among existing industrial sectors (Naughton 2018).[2] Addressing a major S&T conference in 2016, he stressed the role of science and technology as bedrocks on which China relies for its power, enterprises rely for their success, and ordinary people rely for a better life (CAS 2016). Xi has advocated strengthening basic research, yet he has also asked for translatable results that will help solve enduring economic and industrial problems ("The Future of Chinese Research," 2016). Reflecting the leadership's view that technological development is the essential key to making China globally competitive and addressing the nation's confounding domestic problems, the latest five-year development plan (the thirteenth, covering 2016–2020) prioritizes innovation in S&T (Cyranoski 2016; Five-Year Plan 2016; Yu, Zhang, and Lai 2014). Forty years after Deng elevated science and technology to the top of the list of domains to be modernized, the official narrative of S&T as China's domestic savior and global uplifter is stronger than ever.

The official narrative, however, tells only part of the story. The post-Mao years have brought the rapid development not only of science, but also of *scientism*, the belief in science as a panacea for all the nation's ills. Indeed, scientism and its twin, *technicism*, which values instrumental reasoning and technical efficiency above all, emerged as virtual official ideologies of the party-state (Greenhalgh 2008; Hua 1995; Suttmeier 1989). In the West, the years following World War II saw the emergence of widespread critiques of the adverse effects of powerful technologies and the dominance of technological rationality in modern society. In China, in sharp contrast, modern science and technology have been surrounded by a halo of official optimism and largely immune to social critique (Shen and Williams 2005). Post-Mao China has been home to a veritable state-sponsored religion of S&T marked by a widespread faith in the power of modern science and technology to solve the problems that other approaches have failed to solve. Since the early 1980s, the vision of mobilizing science to remake China has deeply penetrated Chinese society, reshaping the mindset of ordinary people. In the late twentieth century, the official scientism and technicism of China's leaders increasingly became a mass culture of S&T, in which modern science, statistics, and

technology were at times treated with almost magical or mystical reverence, their products accepted, with few questions, as ideal solutions to China's problems. In the twenty-first century, despite widespread complaints about the vexing problems of daily life—contaminated food and toxic air, for example—there has been great pride in the nation's high-tech achievements and little apparent discussion of the potential dangers of a state-S&T-driven modernization project in which society has no independent voice. Only in the last decade or so has that begun to change, as some high-tech fixes to the nation's environmental crises have failed to work, and popular discontent has become hard to ignore (Economy 2018, 152–185). Patient attacks on physicians, which have grown violent in recent years, represent an assault on scientific as well as clinical authority and evidence of the limits of technological solutions to the problems plaguing China's healthcare system (Nie et al. 2018).

Today, under Xi Jinping, the party's promise of a brighter future takes the form of the China Dream (*zhongguo meng*). Introduced by Xi in late 2012, the phrase is now widely used in official statements and has become one of the guiding ideological principles of the leadership under Xi. A combination ideological campaign and nation-building project to transform China into a global economic and military power, the China Dream aims to connect the party to the people through a common vision by addressing social inequalities, restoring Confucian values, and fostering a sense of personal well-being (Carlson 2015; a darker view is presented in Economy 2018). Xi's signature slogan is presented as the people's dream; indeed, cities, towns, and villages across the nation have sprouted "dream walls" plastered with images of happy Chinese extolling the virtues of socialism and their leader's ambitious plans.

On-the-Ground Realities: The Rise of an Anthropology of Chinese Science and Technology

Meantime, as if in mockery of Xi's China Dream, the on-the-ground reality of life in China today poses manifold threats to human flourishing. A large body of science and social science research makes clear that the party-state's forty-year pursuit of economic-development-at-any-cost has eroded human health and undermined the ecological balance that is necessary to sustain life. Even as infectious diseases continue to erupt unpredictably, the chronic diseases of modernity (cardiovascular and respiratory diseases, cancers, diabetes, and more) are taking an enormous toll on human vitality. Mental distress and mental illness plague untold numbers of rural and urban residents. In much of the country, severe soil,

water, and air pollution poses dire threats to human well-being. After countless scandals, the safety of the food and medicine in China's markets seems always to be in question, spawning widespread feelings of vulnerability, fear, and "bio-insecurity" about the adequacy of resources for human survival (Chen 2014). In light of these troubling realities, the China Dream seems best described as an instance of what Lauren Berlant (2011) calls "cruel optimism," in which the promised hope serves to stifle dissent, discourage change, and render aspirations unattainable.

With individual, collective, and environmental health all now in crisis, the restorative powers of modern science and technology are being sought after with increased urgency. In the 2010s, however, modern sciences and technologies are being summoned to rescue China not from the depredations of an imperial West or from the blunders of Mao's collectivism, but from the fallout of post-1978 party policies that have prioritized economic growth above all else. Given that the party that produced those policies is still in power, this project at times takes on a kind of mission-impossible character. Tasked with finding solutions, Chinese experts have been adapting a wide range of international sciences to the China context, laboring to create scientific knowledge in a context in which science is always already highly politicized and in which the mantra of "economy first" can scarcely be challenged. For their part, China's people, facing threats to their psychological, physical, socioeconomic, and even moral well-being (Zhang, Kleinman, and Tu 2011), have been responding by latching onto the promise of science to restore life, embracing solutions that they believe are based on the latest sciences and technologies. The proliferation of these science projects, at both expert and mass-society levels, raises a host of questions. In the contemporary Chinese context, in which the meaning of science has been unmoored from specific knowledge-producing activities and attached to political dreams articulated by the party-state, what counts as "modern science" to China's people?[3] What hopes are being invested in it? Who is making "science" and how? Are these scientific and technological solutions having their promised effects, or are they producing other effects that may be neither anticipated nor wanted?

Given the political centrality of science and technology in contemporary China (here, meaning the reform era that began in the late 1970s), one would expect to find a large body of social science scholarship on their making, workings, and effects. In the early reform years, the 1980s and 1990s, these domains of Chinese life received remarkably little attention. Since the mid-2000s, though, scholarly interest has grown quickly.[4] Political scientists (and a few political sociologists) have taken the lead, tracing the development of the nation's post-1978 S&T policies and exploring the political roots, organization, and applications of Chinese science (major works include Baum 1980; Miller 1996; Saich 1989; Simon and

Goldman 1989; Suttmeier 1980; Wang 1993; on science-party-state relations, Hamrin and Cheek 1986; Goldman 1987, 1994; Goldman and MacFarquhar 1999; critical science-policy updates include Cao et al. 2013; Cao and Suttmeier 2017). More recent political science and sociology work has focused on technology policy and innovation, China's S&T elite and talent pool, and the role of government-sponsored think tanks in supplying social science expertise for policymaking (Cao 2004; Li 2001; Li 2017; Sigurdson 2006; Simon and Cao 2009; Suttmeier, Cao, and Simon 2006; Suttmeier and Yao 2004; see also Sleeboom-Faulkner 2007).

In the last decade, as the government has focused its energies on transforming China into an "innovation nation" and its thinking on innovation has broadened beyond science and research and development to consider the larger ecosystem (of market forces, entrepreneurship, and the financial and legal set-up, as well as state policy), the scholarship on Chinese technology has grown rapidly in scale and diversity. Today, scholars in economics and management, geography, and urban and regional studies are tracing China's push to become a global innovation hub, analyzing technology development by industrial sector, the roles of the party-state and global market in those dynamics, and the complex state-university-business relationships that support (and hinder) the deepening of the country's innovation capacity (recent illustrative works include Chen and Naughton 2016; Fuller 2016; Lewin, Kenney, and Murmann 2016; Naughton 2019; Yip and McKern 2016; Zhou, Lazonick, and Sun 2016).

This burgeoning scholarship tells important parts of the story of Chinese scientific and technological advance. Yet by centering the party-state and focusing on institutions, existing work leaves vital questions unexplored. Virtually the entire domain of science and society remains untouched. So too does the cognitive core of science—the hypotheses, methods, data, and so on that form the stuff of science. How do Chinese experts create scientific knowledge and technical innovations in the unusual context of the People's Republic? How do non-state institutions (corporations or nonprofits, for example) mobilize science in pursuit of their agendas? How do members of society at large take up, negotiate, and/or contest the sciences and technologies offered as solutions to their problems? Why and to what extent do they matter in ordinary people's lives? The study of Chinese science remains underdeveloped not only in contemporary Chinese studies, but also in the interdisciplinary field of science and technology studies (STS), which, though becoming broader in scope, continues to prioritize the experiences of Euro-America.[5] Even as China moves ever closer to its goal of becoming a global S&T power, the nation's distinctive approaches to developing and applying science are largely missing from the field of STS. This limited attention to Chinese science means missed opportunities for China scholars and science studies scholars alike.

In the last decade or so, anthropologists of contemporary China, some influenced by STS, have begun to explore precisely these questions. Ethnographic research on the sciences of psychiatry (Chen 2003; Lee 2011; Yang 2015; Zhang 2014), disability (Kohrman 2005), population/reproduction (Gottschang 2018; Greenhalgh 2008; Greenhalgh and Winckler 2005; Wahlberg 2018), traditional Chinese medicine (Palmer 2007; Zhan 2009; see also Farquhar 1996 on medical expertise), sexuality (Farquhar 2002; Zhang 2015), public health (Hyde 2007; Mason 2016), cancer epidemiology (Lora-Wainwright 2013), the environment (Hathaway 2013; Tilt 2014), genome sequencing (Ong 2016, 197–222), and regenerative medicine (Song 2017) has shown how science has profoundly restructured social, cultural, and political life in the post-Mao era, but not necessarily in the ways intended.[6] The party-state remains a key actor in engineering dreams of personal and national rejuvenation through science and technology, yet the dreams acquire social lives of their own as they get taken up and put into practice by diverse social forces. While the number of scholars with such interests is growing rapidly, anthropological research on science and society in China has not been cumulative, in the sense of creating shared conversations across domains of science or living.

In April 2016 I invited Li Zhang, the coeditor of this book, to join in convening a workshop-style conference at Harvard University to explore these questions and, in the process, create a subfield of scholars with shared concerns. Taking advantage of the growing interest in questions of environmental sustainability among younger China anthropologists, we sought to bring together researchers working in medical and environmental anthropology, subfields that until recently have developed relatively independently (newer works exploring the intersections of pollution and health include Bunkenborg 2014; Lamoreaux 2016; Wahlberg 2018). We asked participants to write about Chinese dreams of modern S&T rejuvenating the nation. Most wrote not about hopes and dreams, but about fears, nightmares, and struggles to achieve the promised good life and good society through scientific and technological means. Overall, the presentations conveyed a bleak picture of contemporary Chinese life in which the mental, bodily, and environmental costs of China's rapid growth seemed ever more intractable, hope was in increasingly short supply, and the prospects for human and national flourishing were growing dim.[7] The contrast between the upbeat, utopian rhetoric of a science-obsessed leadership and the reality of life for scientists, engineers, and ordinary people on the ground was striking.

This volume presents the results of our discussions. Based on research conducted between 2006 and 2018, the chapters explore the makings, workings, and effects of various sciences and technologies.[8] Our focus is on an array of applied health and environmental knowledges and innovations being developed to solve

some of the gravest problems of human and ecological health facing China today. The kinds of cutting-edge basic sciences that are being energetically promoted by the state and private entrepreneurs remain a subject for future anthropological research (but see Ong 2016, 197–222). The approach here is ethnographic in being based on fieldwork in China (as well as documentary, visual, and other modes of research), and in seeking to capture and reflect the actors' own points of view. Our informants include both experts (scientists, technicians, surgeons, therapists) and ordinary Chinese (pollution sufferers, patients, and other categories of citizens).

Governing China through Science: New Understandings of the 2000s and 2010s

Since the turn of the century, the anthropological study of China has been profoundly transformed by analyses of governance and governmentality. (Briefly, governance can be understood as efforts to shape conduct by agents within and beyond the state; governmentality is the modern regime of government that takes the optimization of the population as its primary end.) Focusing on logics, discourses, subjectivity, and other analytically key features of modern power, these studies have revealed how the market has joined the party-state to become arguably the central forces involved in governing Chinese society and creating human subjects (see for example, Li and Ong 2008). In this book, we make two major intellectual interventions. First, under the rubric "governing through science," we extend the governance/governmentality approach to the study of Chinese science and technology. Second, we deepen the analysis by adding the insights of science and technology studies. These analytic moves have important implications for both China studies and science studies. They greatly complicate the study of contemporary China by adding science to the cluster of governing agents, and placing the hugely complex but little-understood nexus of state-market-science/technology at the very center of the governance of social life. By focusing on an array of problems of government, we also push STS beyond its current preoccupations with such issues as actor network theory and ontology to consider problems of life-and-death importance in countries of the Global South (the erosion of human and environmental health, for example). Although this is not the place for a detailed discussion of the governance/governmentality and STS perspectives, a few basic ideas and orienting terms should help guide readers who may be unfamiliar with these bodies of thought, while situating our project in relation to a larger theoretical literature. These constructs were originally developed to understand

Western liberal societies but, with some modification, have proven fruitful in understanding China as well.

Science and Technology as Instruments of Governance

Understanding *governance* broadly as the "conduct of conduct," work on modern governance focuses on governmental projects—that is, more or less rationalized schemes undertaken by multiple authorities (state bureaucrats, professional experts, self-governing citizens), employing a variety of knowledge forms, that seek to influence conduct according to specific norms in order to achieve certain ends, with diverse and mostly unpredicted effects (foundational theoretical texts include Burchell, Gordon, and Miller 1991; Dean 1999; Foucault 1991; Rose 1999). We will encounter many such rationalized and consequential schemes below, from the Ministry of Health's program to build a community-level mental-health infrastructure (Ma, chapter 1), to a surgeon's game plan for making China a center of experimental stem-cell transplantation (Song, chapter 3), to an independent scientist's efforts to promote the black soldier fly as the solution to problems of urban waste management (Amy Zhang, chapter 7). The brief analytic sketch above provides a way to think about these projects: how they are structured, who counts as a "governor," what they do, and so on.

A modern governance perspective emphasizes the importance of rationalities of government, especially knowledge- or science-based ones. As the core logic in modern systems of governance, science shapes governing in countless ways. Science and its language of numbers often supply the rationale behind governmental projects and the authoritative norms those projects promote. Because of their status as authoritative knowledge producers, scientists, both human and natural, are often active participants in the political and policy process. In an authoritarian system such as China, where scientists are subject to party-state controls, they are expected to serve the party and government by lending their expertise to the making of official policies and plans (Cao and Suttmeier 2017). Indeed, as noted earlier, scientific policymaking is mandatory, making experts and expertise essential parts of the policy process. And there is more, for science is the ultimate arbiter of truth in modern societies; when science speaks in the name of nature, it depoliticizes objects of inquiry that may be profoundly political and thereby removes them from the field of contestation. These political capacities of science are especially pronounced in China, whose state has always treated S&T as tools of state power and whose ruling party has staked its legitimacy on its claim to be a scientific and technological modernizer capable of engineering the use of S&T to achieve national wealth, power, and global status. For China's party—and of

course its people—the stakes in the making, claiming, and applying of science and technology could not be greater.

Science as Politics by Another Name: New Layers of Meaning

The interdisciplinary field of STS highlights the political nature of knowledge-making and the permeable line separating science from politics. In the early days of the field, these observations were captured in the pithy phrases of Donna Haraway and Bruno Latour, who famously declared: "Science is politics by other means" (Haraway 1984; Latour 1983, 1988). Over the years, STS scholars working in Western liberal societies have imbued the notion of science-as-politics with a multiplicity of meanings. Science-as-politics has come to refer to the contestation among ideas, for example, or the embedding of differences along lines of race/class/gender/sexuality in scientific thought. After thirty-some years in circulation, the notion has become something of a truism in the field.

In authoritarian China, the notion of science as politics takes on still more layers of meaning, for science and the party-state are intimately connected. As Cong Cao and Richard Suttmeier explain, in the West, a high degree of autonomy from political pressure is seen as necessary for the responsible exercise of scientific expertise expected by society. In China, by contrast, since the founding of the People's Republic in 1949, "professional autonomy has been circumscribed and viewed as antithetical to the political formula of the CCP [Chinese Communist Party]" (Cao and Suttmeier 2017, 1021). This additional meaning of science-as-politics—the subordination of science to governing authorities and their agendas—deserves our closest attention, especially because the relationship between science and the party-state is not stable or static, but rather always shifting. Indeed, in the Xi era, when S&T have been assigned vital roles in national rejuvenation, party control over the scientific and technical communities appears in some ways to be growing (Cao and Suttmeier 2017). The political urgency surrounding the promotion of S&T is rooted in the reality that the party's number one priority is remaining in power; its primary strategy for doing that is maintaining high economic growth rates; and the key to that, party leaders believe, is advanced S&T. Thus China's sciences and technologies serve a political master with an overriding interest in delivering the economic goods that will keep the people rich and content. Put another way, in the making of Chinese sciences and technologies, both the political and the economic demands of the party-state loom large. The subordination to the party-state is evident in many ways. Many if not most scientists and engineers work in state-run (and party-overseen) organizations, and the party-state possesses countless means, formal and informal, material and ideo-

logical, by which it can influence what counts as truth and how truth is made and promoted, even among those in private-sector positions (see, for example, Cao 2014; Hong and Zhao 2016; Tenzin 2017). How and under what circumstances these mechanisms operate are poorly understood, making in-depth ethnographic research on science-making vitally important.

In this volume, the micropolitics of science-making receives particular attention, as our contributors dissect the social dynamics by which their expert-informants gather data, fashion concepts, deploy measures, and promote their findings. Beyond the more quotidian discussions of data sources, quality, presentation, and the like, we show that in China scientists and engineers often find themselves negotiating the nuts and bolts of science-making and science-advancing with public officials. Environmental scientists are constrained to work out the parameters of their research with local cadres (see Lord, chapter 5); public health researchers must massage politically correct data supplied by their leaders into something resembling the truth (Mason, chapter 4); and scientists developing low-tech, traditional Chinese approaches to waste management must frame their projects as high-tech, modern, and commercially viable to make their ideas comprehensible in the scientistic and economistic discourse of the regime (Amy Zhang, chapter 7). Indeed, the research presented below suggests that negotiations with officials of the party-state may be simply a routine part of science- and technology-making in China. More broadly, our work shows that the relationships between the scientific community and agents of the party-state, far from simple subordination, are nuanced and negotiated in ways that need to be better understood.

Science Is Contextual: Politics and Economics in Command

For students of STS, science is no one thing; instead, it is humanly made in such a way that it bears the fingerprints of its makers and of the context in which it is made. And indeed, we will see in the chapters that follow that Chinese science is distinctly Chinese, bearing the imprint of unique historical and cultural forces at local and national levels and of the nation's place in global scientific and political-economic hierarchies.[9] Two key features of the wider context stand out in the chapters. The first is the prominence of market logics, which is a result of the decline in state funding for research and the state's push to commercialize academic knowledge, as well as the predominance of economic goals in Chinese politics generally. In one case, an environmental scientist called on to "innovate through commercialization" had to set aside his basic research to focus on developing marketable products and raising capital to scale up production (Amy

Zhang, chapter 7). In China, where state regulation of business is weak, the power of market forces can at times be virtually unchecked, putting great pressure on experts who are trying to fashion scientific and technological solutions to the nation's problems. In the most extreme cases presented in this book, environmental and public health researchers had to submit to market logics simply to survive. In one case, researchers were subject to the economic growth imperative of local-level leaders (Lord, chapter 5); in another, Chinese scientists had to subordinate their work to the profit imperative of foreign firms (Greenhalgh, chapter 6). In such cases, science itself could be said to be marketized.

The second is China's still very subordinate position in the global hierarchy of science. Though deeply rooted power imbalances constrain the development of Chinese science in a myriad ways, the chapters in this volume focus on how Chinese science is perceived by Chinese and foreign observers—almost invariably (though this has begun to change) as backward relative to that of the West—and how Chinese researchers and citizens attempt to right the global order of things. In several chapters, Western (as well as Japanese) sciences and technologies, considered superior by definition, are ardently embraced by Chinese experts and citizens searching for solutions to urgent social problems (Li Zhang, chapter 2; Mason, chapter 4; Greenhalgh, chapter 6; Kohrman, chapter 8). In some cases Western knowledges are praised even though they may not be well understood (Mason, chapter 4). The experts who are embracing and reworking foreign sciences are driven not only by a need for scientific solutions but also by a deep desire to catch up with the advanced nations and to show off the prowess of Chinese S&T so that Chinese experts will be accepted as equal members of the global scientific community. In yet another chapter, foreigners' criticisms of Chinese research and practice as ineffective, fraudulent, and even unethical provoke Chinese practitioners to defend their work by developing novel assessment tools and ethical formulations that fit the Chinese context (Song, chapter 3). In virtually every domain of science and technology examined, Chinese experts struggle mightily to be accepted as full members of their worldwide community of practitioners. Yet the going is tough, and they never quite succeed.

The Extraordinary Productivity of Science and Technology in China

If science carries the stamp of its context, that context also bears the stamp of science. Another fundamental tenet of STS is that modern sciences and technologies are highly consequential, or productive, shaping how life is lived and society is organized. In the language of the field, science and society (or science and politics) are *co-constituted*, produced in the same moment and in relation to one

another (Jasanoff 2004). The co-production notion is especially illuminating in China, where science has the backing of a still-powerful party-state that, despite the rise of the internet and social media, largely dominates public discourse. As we will see, the result is that state-supported sciences and technologies have enormous force to shape not only the plans and policies of the party-state, but also the worldviews and personal identities of the people. This insight was a major contribution of the earliest work in the anthropology of Chinese S&T, which sought to put science and statistics on the intellectual map of the field. Korhman's (2003, 2005) genealogy of disability statistics illuminated how a massive 1987 survey, which for the first time enumerated the disabled population, served both to secure the biologized identities of disabled officials and to build a bio-bureaucracy with the legitimacy and ability to meet their needs. In my account of the historically first major instance of the newly mandated scientific policymaking (Greenhalgh 2003, 2008), I revealed that the inner party struggles over the one-child policy that erupted in 1979–1980 were at root contests over which science of population would shape party policy. Through its impact on the one-child policy—the policy's crisis rationale, tight targets, and blindness to gender and other social consequences—the winning science of population cybernetics profoundly reordered Chinese society and politics, creating jagged distortions in the social structure that planners are still struggling to correct.

The chapters in this volume make clear that, despite the major administrative and governmental shifts that have occurred in China since the early post-Mao era dissected in the above works, the impact of science is equally pronounced today. The effects are particularly visible in the field of mental health, which in recent years has been the target of sustained efforts at multiple levels to find scientific solutions to soaring rates of psychological distress and untreated mental disorder. At the central government level, the administrative creation of a huge new network of numbers has worked to construct communities as objects of governance, create populations of sufferers, distribute those populations in marked territories, and enable mental-health specialists to monitor and serve them in their communities (Ma, chapter 1). After this intervention, the practice of mental health in China will never be the same. The transformative nature of psychological science is also evident at the popular level, where therapists—the new experts in human emotions and relationships—are gaining the authority to define the good life and the good family for their middle-class clients (Li Zhang, chapter 2). These chapters reveal what is at stake in our study of S&T today. Taken together, the chapters in this book suggest too that in the China case, the co-production idiom may be necessary but not sufficient to capture the mutual productivities of two domains of reality ("politics" and "science") that are not only deeply interdependent but also hierarchically ordered.

New knowledges and technologies not only create novel forms of sociality (populations of the mentally ill, notions of normative personhood), but also interact with existing social realities, altering them in the process. The chapters that follow highlight intersections with entrenched social divides (rural/urban, male/female, rich/poor), showing how new knowledges and gadgets may reproduce and even worsen old inequalities. Environmental research, which is supposed to ease the glaring ruralization of pollution, ends up reinforcing the ecological burden imposed on China's villages (Lord, chapter 5). Technologies of air pollution, which once gave women power over their smoking husbands, are now stirring up feminist anger as husbands light up inside air-purified homes (Kohrman, chapter 8). Costly new therapies for mental and physical health are privileging middle-class over working-class and foreign over Chinese patients, offering succor to some while denying it to those who may need it most (Li Zhang, chapter 2; Song, chapter 3). What these ethnographic cases suggest is that the much-celebrated modern S&T may be making an already unequal nation even more so. Science and technology are important parts of the story behind China's gaping socioeconomic divides.

Focusing on individual, public, and environmental health, this volume explores three sets of questions. First, how do these dreams and schemes for better health and lives through S&T circulate through Chinese society? Which dreams are still alive and which are dying? Second, how are the sciences of physical, mental, and environmental health made and made to fit to Chinese realities? How does the official elevation of modern S&T shape how science and technology are constructed and applied to resolve pressing problems of the day? Third and finally, are the party's and people's dreams of personal and national salvation coming true? What effects—intended and otherwise—are those practices having on China's politics, society, human and environmental health, and personhood in a time of rapid and profound societal transformations?

By placing the science question at the center of the study of contemporary Chinese society, this book aims to discover how different China might look when science and technology are given their due and in the process make science and society more central to the intellectual map of late twentieth- and early twenty-first-century China. By providing ethnographic insight into the making, workings, and effects of various sciences and technologies, we also aim to provide scholars in science and technology studies with up-close accounts and analytic frameworks for understanding Chinese S&T based on in-depth knowledge of the country's distinctive history, socioculture, and political economy. As a rising global superpower, one with multiplying connections to and effects on science communities the world over, China is a critical case for the field. A close study of China can also contribute to the development of a transnational field of science studies

by illuminating both the workings of science in a non-Western and nondemocratic society and the connections among sciences in different parts of a rapidly changing world.

Are Modern Science and Technology Saving China? A Look Ahead

The chapters below are arranged in four pairs. Each pair supplies a different part of the answer to our overarching question of whether science and technology, as currently configured, are capable of "saving" China from the human and ecological fallout of four decades of growth at any cost. In the first pair of chapters, two scholars explore the great faith that government planners and ordinary people alike place in the promise of modern science to alleviate the many crises plaguing the country. Both chapters focus on the mounting crisis of mental distress. Zhiying Ma investigates a Ministry of Health program launched in 2004 to deliver basic mental-health care to communities nationwide. Focusing on the program designers and psychiatrists, she uncovers the supple if invisible role of numbers in the creation of a mental-health infrastructure. Yet the numbers deliver more than anyone expected. Ma shows how the planners' dream—of perfect, grid-like numerical governance capable of surveilling and serving all—not only becomes a nightmare of plan-targets and social control at the grassroots but also, by excluding common disease categories, fails to meet the needs of large swaths of the population.

Shifting to the popular level, Li Zhang charts how, since around 2000, happiness and psychological well-being more generally have emerged as key components of "the good life" (*meihao shenghuo*) and how the Western sciences of psychology and psychotherapy are seen as the key instruments for achieving these desired states. But in this fuzzy area of human science, the meaning and efficacy of science are anything but clear cut. Zhang presents a series of ethnographic encounters between counselors and patients, showing how therapists take advantage of the popular faith in science to frame their sometimes unproven approaches as scientific; how contests over efficacy are routine parts of the therapeutic encounter; and how discouraged patients respond when the promise of happiness is not fulfilled. Can science help solve the growing problems of mental disease and distress in China today? These two chapters suggest that the hope remains very much alive, but whether science helps depends on who gets to define the meanings and uses of "science" and where one stands in relation to the science project. In these cases, the benefits of mental health science accrue not to the

sufferers, but to the planners and counselors in charge of delivering the science to the people.

In the next pair of chapters, two contributors shed light on the struggles of Chinese scientists and clinicians to produce "objective," internationally credible scientific results in the challenging context of postsocialist China. In her study of a pioneering but controversial fetal stem-cell-transplant practice aimed at helping patients with ALS (Lou Gehrig's disease) and others facing rapid neuromuscular decline, Priscilla Song shows how the surgeon in charge sought to rebut Western accusations of lack of scientific rigor, poor ethics, and even quackery by developing alternative standards of proof, measures of efficacy, and ethical stances. Though he aspired to live up to ideal scientific and ethical principles, his efforts were undermined by the realities of a society in perpetual social and communicational flux.

Turning to public health science, Katherine Mason unearths the multiple forms of scientific truth created in a local Chinese Center for Disease Control and Prevention (CDC). She shows how a younger generation of scientists trained abroad, who initially hoped to contribute to the production of (what they considered) pure, untainted, internationally accepted scientific truth, discover to their frustration that they are trapped in a system dominated by their less educated elders in which the production of data is deeply shaped by social networks and clientelist political obligations.[10] Hoping to do "real science" that could save China both by preventing another severe acute respiratory syndrome (SARS) epidemic and by boosting the global reputation of the nation's public health community, they find themselves able to produce only "good-enough truths" that remain inferior or even false.[11] In both chapters, ambitious researchers seeking to do good science that solves problems and enhances China's reputation find themselves stymied by a social, political, and cultural context inimical to those lofty ends.

The third pair of chapters exposes some of the hidden dangers of China's highly commercialized sciences. These two chapters show how the widespread marketization of science—both the mandate to create economically useful science and the need to rely on non-state, including corporate, funding—leads to science that is fragmentary at best and practically ineffective or even harmful at worst. In her account of environmental science-making, Elizabeth Lord shows how the prioritization of economic over environmental goals that has long dominated the political process is reproduced in the science-making process. Constrained to fit environmental studies into a profit logic, researchers find themselves subject to rural cadres' demands to prioritize economic growth, prevented from gathering data from the most polluted villages, and dependent on political connections to do any research. The result is a distorted body of knowledge that excludes concerns with environmental justice, fails to address rural pollution control, and ends

up reproducing the very gap between urban and rural that environmental science and policy are supposed to address.

In my analysis of the making of obesity science and interventions (Greenhalgh, chapter 6) I reveal how scientists' dependence on multinational soda companies for funding leads to the inadvertent adoption of scientific ideas and policies that may have protected soda profits but did little to arrest the rapid increase in obesity and related chronic diseases. The danger here is compounded by a lax environment around scientific ethics, in which the lead researchers are able to frame their embrace of corporate-funded projects as fully compliant with Chinese research ethics because the state's ethical bar is so low and its support for global capital is so strong. These chapters suggest that when science becomes subordinate to economic demands and the state underfunds science while placing few ethical or other limits on corporate intervention, real solutions to urgent problems such as ecological degradation, rural decay, and soaring rates of chronic disease become nearly impossible. In any case, the sort of marketized science that is widespread in China today contains few answers to the vexing problems that trouble the nation.

In the fourth and final pair of chapters, two scholars trace what happens when the state's promises of a better life through modern S&T palpably fail to deliver, and public faith in state solutions ebbs. One response has been the creation and often difficult promotion of indigenous technological solutions. China is drowning in its urban waste and much of it is organic matter. In her chapter on waste management, Amy Zhang charts the public's (and experts') growing distrust of the imported large-scale infrastructural solutions favored by the state, all of which have proven unviable or even toxic. In the 2010s some researchers have been reaching back to an older tradition of Chinese entomological science that saw insects not as public health threats to be eradicated, but as potential resources for human betterment. Zhang's chapter tells the story of an independent scientist who is developing a low-tech solution that relies on adult flies to devour organic waste, while marketing the larvae as protein-rich animal feed. Early evidence for its effectiveness is promising, and some state support can be found in official discourses on "indigenous innovation," which are part of China's drive for national autonomy. Yet whether the insect solution can be scaled up and succeed in the political context of Xi's China remains highly uncertain, for state discourses on science include the imperative of commercialization, which forces scientists to become business-minded entrepreneurs. In principle, indigenous innovation sounds promising, but in the political context of contemporary China it is likely to offer a partial way out at the very best.

A second response is closer to despair. The specter of slow death by airborne particulate matter—the dreaded PM2.5, whose levels have far exceeded safe

levels for years—has led to an air filtration craze among urban middle-class households desperate to filter out the pollution that is quietly eroding their health. In his rumination on the historical and emotional links between two technologies of filtration—the filter-tipped cigarette introduced in the 1980s and the air purifier of today—Matthew Kohrman excavates the gendered politics of action and affect these technologies have spurred. He shows how the urban home, once a battleground over smoking, has become a war zone over air purification, as men embrace the purifying machines as promising high-tech solutions, while women despise and distrust them, expressing a tangle of fear, endangerment, desperation, and hopelessness over being held captive in their homes like "caged birds." Kohrman's chapter is a sobering reminder of the social and emotional costs imposed on China's people by the failure of the state's vaunted "modern S&T" to alleviate the severe environmental pollution that its policies on economic growth created.

In an afterword, Mei Zhan reflects on the book as a whole, highlighting the specificities of the sciences and technologies in China and the ethnographic and conceptual contributions China anthropology can make to transforming STS into a more truly global field.

Through deep dives into the micropolitics of knowledge and innovation, these chapters expose to daylight a yawning gap between the promises delivered by the party and the frustrations of ordinary people trying to live a good—or even just decent—life in China today. Although faith in science and technology has remained strong in most of the communities studied, expert and lay alike, in case after case we found that the promises attached to them have not been realized: Policies were ineffective or even harmful; programs furthered state control instead of popular health; treatments were rife with ethical and efficacy problems; initiatives reproduced existing inequalities; and the promised good life seemed forever postponed. This is not to say that none of the scientific and technological innovations developed to address China's problems has worked; certainly, many have, even if in unexpected ways. Still, in all the cases we subjected to an anthropological gaze, the gains were invariably shadowed by losses, the truths ruptured by paradoxes. Utopian dreams too often were followed by dystopian realities. Our analysis of the wider contexts shows that the failures of science to fix the targeted problems can be traced to the imprinting of party histories and politics, profit motives, and existing social inequalities on the science that was made. Science is, in short, too subservient to overarching economic and political agendas of the party that conflicted with the goals set for science. And that subservience, captured in the analytic of the state-market-science/technology nexus, appears to be intensifying under the ambitious, authoritarian leadership of Xi Jinping.

Our work on the ground in the People's Republic raises critical questions for future research. If Chinese science and technology are, in the end, mostly by and for the party-state and its agents, under what conditions can they also improve the lives of China's people? Which people in which places are most likely to benefit? Short of a drastic change in leadership, what changes in political-economic arrangements or sociocultural norms might precipitate a shift toward greater political independence for China's researchers and technicians? Can the impetus for change come from outside, or must it originate within China itself? To what extent do our conclusions, which are based on our study of practical sciences and technologies, apply to the more cutting-edge fields of S&T energetically supported by the state? These are just a few of the questions that we hope might provoke other researchers to make the sciences and technologies more central parts of their study of contemporary China.

NOTES

The author thanks Arthur Kleinman, Elizabeth Lord, Amy Zhang, Li Zhang, and two reviewers for the press for their insightful comments on earlier drafts of this introduction. The author is grateful to Wei Hong for many illuminating discussions of STS in China, and to Victor Seow for sharing his perspectives on the work of historians of science and technology in late twentieth-century China. His thoughts are reflected in note 4.

1. Xi Jinping holds an undergraduate degree in chemical engineering but advanced degrees in law and politics. Li Keqiang, Premier of the State Council and head of government, has a graduate degree in economics (Li 2016).

2. In March 2018, the Thirteenth National People's Congress amended the constitution to eliminate term limits on Xi's post as president, opening the way to his remaining in power for a great many years.

3. Some practices deviate so significantly from conventional notions of scientific activity that some observers may deem them unscientific or even anti-scientific. We avoid such language here. Rather than imposing an outsider's view of what is scientific and what is not, we examine what trained scientists in China present as "science," delving into how it is crafted and what work it performs.

4. Science and technology are growing areas of interest among historians of modern China, including those working in the early and mid-twentieth century (see, for example, Rogaski 2004; Lam 2011). In the last fifteen years, a few historians have begun to take up the Maoist era (1949–1976) as history. Their central concern has been to write against the narrative that "all Maoist science was bad science" (see especially Schmalzer 2008; Schmalzer 2016; Wei and Brock 2013). By showing ways in which certain scientific practices and projects worked, they have been considering whether there is something distinct that can be called "socialist science."

5. In addition to the work of STS-influenced anthropologists discussed in this book, in-depth scholarship on China within STS includes writings on regulatory and ethical governance of stem-cell research (Sleeboom-Faulkner 2015; Sleeboom-Faulkner and Sui 2015; Zhang 2012). Much of this STS work concerns China's life sciences. Unfortunately, institutional and other constraints have greatly slowed the development of STS scholarship in China itself. The assessment of Liu Bing (2011) remains relevant today.

6. This is not intended as a comprehensive list of anthropological writings on science and technology in China. The publications just cited include the major book-length studies and, for scholars whose work on science (and technology) has appeared so far only in article or chapter form, a key article.

7. Such a bleak outlook may have dominated our discussions because the papers dealt with the difficulties science and technology have encountered in solving social and environmental problems. China's achievements in high-tech engineering (visible in major infrastructural developments, for example) and the frontier sciences have spurred great national pride.

8. Scholars in STS often use the term "technoscience" to signal that science and technology are not readily differentiated (with one engaging in basic research, the other in applied practice) and should be understood not as separate fields but as co-constructed and hybrid forms of knowledge and practice (Latour 1987). This term has not yet caught on in the study of Chinese knowledge practices. Though the term may be suitable for the analysis of China's cutting-edge sciences and innovations, in this volume we deal mostly with simpler, applied sciences and technologies in which the connections between knowledge and application are a small part of our accounts. For that reason we follow conventional practice in China studies and refer to "science and technology."

As this book goes to press in early 2019, China's great leap into artificial intelligence, which took off in the mid-2010s, appears to be rapidly accelerating the societal relevance of technoscientific logics and practices. Today automated machine processes using algorithms created through machine learning from massive amounts of personal data scraped from networked smartphones, surveillance cameras, and other devices are shaping individual behavior in ever more domains of Chinese life (Lee 2018). I discuss these developments elsewhere.

9. China of course is not alone in this; since all science formations reflect their wider context, all national science systems can be described as unique to the host nations. Whether there is a universal science with shared values (such as truth-seeking and freedom of inquiry) is a different question, one that has garnered considerable interest in the China context, where such values are not much in evidence (e.g., Cao 2013, 155).

10. An especially illuminating case study of the multiple levels of hierarchy and subordination in the field of geosciences is Hong (2008).

11. The 2002–2003 SARS outbreak in southern China led to eight thousand cases and over seven hundred deaths worldwide, with the majority in China. The hostility met by the government's initially poor handling of the epidemic led to major changes in how China handles infectious-disease threats to public health (Mason 2016 and chapter 4 of this volume).

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