

Preface

China's one-child-per-couple policy was animated by a beautiful dream. It was a dream of a once powerful but now downtrodden nation, just emerging from the horrors of Maoism, seeking to create a new generation of healthy, wealthy, smart, and savvy young people to lead the nation's rise to global prominence. I can still remember the frisson of delight that swept through me when, back in 1982, on my first trip to China, I encountered on the streets of Zhangzhou a troupe of Chinese children, decked out in colorful outfits, parading around in a circle singing:

One child is the very very best; One child is the very very best!

Yige haizi zui zui hao; Yige haizi zui zui hao!

For some—primarily city residents—this appealing dream came true, if at great cost to parents. For most Chinese—those living in the tens of thousands of villages that dot China's vast countryside—it did not. Never did I imagine, as I watched that sweet performance, that I would spend some twenty years of my life bearing witness to the dark underside of that dream. Initially as policy analyst for the New York-based Population Council and later as anthropologist at the University of California, during the 1980s and 1990s I traveled frequently to China to talk with the people who made the policy, carried it out, and endured its restrictions. As a village fieldworker I came to know in a very immediate way how the effort to hold couples to one child tore families and communities apart. As population specialist I came to see that the policy's effect

on fertility was uncertain, but its effects on society were only too clear: accelerated aging and a growing gap between the sexes. As time went by, the one-child policy came to inhabit me. I was gripped by one question: Why? Why did China's leaders adopt a population policy that was certain to fail in reaching its demographic goals while producing so much harm in the attempt? Where did the one-child policy come from?

In the conventional distribution of scholarly labor, the policy question has belonged to political science and the newer interdisciplinary field of policy studies. In an effort to create a true science of politics, historically these fields have sought to understand public policy by constructing ideal models of the policy process. In these frameworks, that process is represented as an orderly set of procedures that move linearly from agenda setting to policy formulation, implementation, effects, and evaluation. Although such stage models of the policy process have heuristic value, real-world policymaking rarely if ever conforms to their specifications, as students of policy in these fields now understand well. Far from following a regular sequence, the policy process is characteristically messy and disorderly: policies often skip stages, loop back around to previous stages, or disappear from view before being implemented. Newer institutional approaches escape some of these difficulties but face other problems, especially in capturing human agency and incorporating the role of ideas and ideologies. A recent overview of policy research portrays an intellectually vibrant field with a wealth of approaches, including new postpositivist ones, but lingering dissatisfaction with its ability to resolve certain persistent problems (Peters and Pierre 2006). Those include a state-centrism despite the importance of nonstate actors; the assumption of rationality in the face of haphazard processes and irrational actors; and difficulty assessing the often diffuse effects of policy. My own very superficial reading of the political science literature has uncovered other assumptions that will probably seem unproblematic to colleagues in political science but perhaps a bit worrying to anthropologists. That literature assumes that policies are formed of elements belonging to "the political system," when nonpolitical things often go into policymaking. More broadly, it presumes that generic features of political structure and/or process are more important determinants of policy outcomes than are ad hoc, contingent features of the local context. Are policies in fact generalizable? I am doubtful; to me it seems that the more closely one examines the social life of particular policies, the farther one gets from a general model of the policy process.

Might anthropology have fresh ways to think about and study public policy? Nearly thirty-five years ago, Laura Nader issued her famous manifesto urging anthropologists to abandon their preoccupation with the marginal and powerless of the world to study elites and how they exercise power in contemporary society (Nader 1974). In the past few decades, anthropologists have increasingly answered the call. The field has seen an explosion of interest in topics such as bureaucracies, networks, documents, and the elites—economic, cultural, and scientific—that manage the complex processes of globalization (Ong and Collier 2005; Ong 2006; Riles 2001, 2006; Rabinow and Dan-Cohen 2005; and many, many more). To study this new landscape of power, anthropologists have devised novel methods for defining “the field” and for ethnographically exploring the rapidly changing dynamics of a globalizing world in which the comfortable distinctions of the past (local/global, ethnographer/informant, and so on) have collapsed (e.g., Gupta and Ferguson 1997; Marcus 1998). Despite this expanding interest in modern power and its elite makers, until very recently one domain—the creation of public policy by political and intellectual elites—has escaped the ethnographic gaze. Although applied anthropologists have worked *for policy makers*, and public-minded anthropologists have promoted their findings *to policy makers*, historically academic anthropologists have exhibited little interest in the ethnographic study *of policymaking*.

In the last few years, however, a small but growing number of anthropologists has begun to explore the making, working, and effects of public policy as problems of modern governance. A study of public policy, these scholars have suggested, is crucial to the discipline’s understanding of issues such as the operations of modern power, the localization of global processes, and the formation of modern subjects (Shore and Wright 1997; Wedel et al. 2005). With its critical theories, ethical concerns, and ethnographic eye for the ad hoc and the contingent, anthropology would seem especially well equipped to develop a new, more politically and ethically engaged approach that aspires not to be a generalizable science, but to illuminate the characteristic complexity, messiness, and specificity of policy processes. The most humanistic of the social sciences, anthropology is also well placed to bring out the human dimensions of public policy that tend to be neglected by political science. Judging from the enthusiastic response to the new Interest Group on the Anthropology of Public Policy formed within the American Anthropological Association in 2004, interest in policy is strong. The anthropology

of policy is incipient, however; what the field can contribute and how is just now being worked out.

The small body of work published so far has focused primarily on how policy is carried out and produces its social effects. How policy gets made is a theoretically and methodologically more challenging question. Today anthropologists are keenly aware of the tight link between knowledge and power, expertise and policy. So far, however, the insights of science and technology studies (STS), the field devoted to understanding how expert knowledge is created and politically advanced, have not been applied to the anthropological study of policy. In this book I seek to empirically expand and theoretically enrich the anthropology of policy by examining the making of public policy and by rethinking the field of policy study through the intellectually productive lens of science studies.

As the authoritative knowledge in the modern era, science is fundamental to modern governance and its policy instruments. This book brings together two powerful fields of thought—governmentality studies, which explores governance “beyond the state,” and STS, which examines science in social context—to study the making of public policy by political and scientific elites. Although neither field has systematically addressed the question of policy, together they provide a formidable toolkit of concepts for illuminating the critical role of scientific logics, techniques, cultures, and politics in policymaking today. By greatly expanding the domain of the political, these domains of inquiry allow us to ask important new questions about how the policies that structure our everyday worlds come into being.

This book takes readers to the People’s Republic of China, surely one of the world’s politically most fascinating, complicated, dynamic, and significant nations, to explore policymaking in the highly secretive arena of the party and state Center. Despite growing anthropological interest in the state, recent work has focused on processes unfolding along its peripheries (e.g., Das and Poole 2004; Gupta and Sharma 2006). To study the making of public policy, we need to observe political elites operating at the center of the state apparatus. Despite very real limits on ethnographic access, by creatively tapping into personal networks or working with international organizations engaged in policy and program work, anthropologists are finding ways to gain entrée to political elites. It was through employment with such an organization that I got to know some key makers of China’s one-child policy.

I develop an *epistemic*, or *knowledge-centered*, approach to policymaking that gives analytic pride of place to policy constructs and the

knowledges, discourses, rhetorics, and visual representations with which they are created and contested. In studying the making of those policy constructs, I extend the insights of STS, which are based largely on observation of laboratory science, to the office science of population studies. Because policy constructs are institutionally crafted, and institutions shape the constructs that are made, the approach gives due weight to institutions, formal and informal, and the individual actors who populate them. Yet it goes beyond conventional interest in what institutions do to examine more contemporary questions of organizational sense making: how institutions think (Douglas 1986), how states see (Scott 1998), and how laws know (Jasanoff 1995). My central concern here is how regimes reason. To guide the analysis of the making of the one-child policy, I introduce a cluster of three interrelated concepts: policy problematization, policy assemblage, and the micropolitics of science making and policymaking. I hope scholars working on other policies in other settings find these notions helpful as well.

I also advance arguments about ethnographic method and ethnographic knowledge. The one-child policy is one of the most sensitive policies of the PRC regime. How it was made is a closed and politically dangerous question. I came to learn the answer through a combination of serendipity and dogged persistence fueled by intellectual curiosity and moral outrage. Institutional good fortune also played a role. My research was crucially enabled by my employment as a policy analyst for the Population Council in the early years of the policy's existence. As I returned to China again and again to pursue various research projects, I gradually innovated a set of methods for accessing Chinese elites and opening closed subjects without endangering informants. What I know was decisively influenced by how I came to know it. Because the how is an important part of the story, in telling it here I occasionally insert methodological asides on the politics or techniques of fieldwork. Beyond this analytical point, the research methods I improvised on the ground may also hold lessons for ethnographers interested in studying hard-to-access policy elites and dynamics in other settings.

The study of public policy opens windows on many domains of modern life, inspiring fresh questions about the role of policy in modernity's making. In this book I seek answers to four sets of questions: First, what are the origins and broad effects of the one-child policy? What can we conclude about its likely future? Second, what are the implications of the novel process of "scientific policymaking" that produced the one-child policy for China's politics writ large? How did that

new mode of decision making rearrange the relations among state, science, technology, and society? How has this reordering shaped the rise of China and the character of modern China now emerging on the world stage? Third, this close study of “scientific policymaking” in the PRC also raises some larger questions of interest to students of modernity generally. Among the most provocative are these: What culture is Chinese science? After the political ascent of science and technology, what now counts as Chinese politics? What practices count as problematic policy science in China and why does it matter? What gives population its vital significance as a field of politics today? Fourth and finally, what is the anthropology of policy? What theoretical, methodological, and ethical resources can anthropology contribute to the understanding of modern policy, governance, and power?

Though trained in anthropology and China studies, my work has always been broadly interdisciplinary, engaging with ideas of colleagues in population studies, women’s studies, and, more recently, STS. Perhaps foolishly, in this book I seek to reach researchers in all these fields, as well as political scientists intrigued by the notion of an anthropology of policy. I would also like to reach natural scientists curious about how one of their kind happened to become involved in shaping Chinese social policy and, more generally, how science gets made in the PRC. Writing for scholars in fields as different as, say, anthropology and demography (to say nothing of anthropology and natural science) is challenging. Colleagues in different disciplines make different assumptions about how the world works, value different theoretical perspectives, and even speak in different disciplinary tongues. Despite these barriers to communication, by defining my terms clearly and writing in accessible language, I hope to reach some if not all readers interested in my subject.

This book is a close relative of another text, *Governing China’s Population: From Leninist to Neoliberal Biopolitics*, which I coauthored with the political scientist Edwin A. Winckler (Greenhalgh and Winckler 2005). Empirically, that book (*GCP* for short) traces the emergence and transformations of China’s population policies over the half century 1949 to 2004 and their broad effects on China’s society, politics, and international standing. This book treats one subset of policy issues (the origins of the core policy) during one small slice of time (1978–1980). Theoretically, the two projects share the same broad framework, Foucault’s notion of governmentality, but emphasize different constructs. *GCP* centers on the concept of governmentalization—the historical process by which population comes within the purview of rationalized

control—and the attending rise of a “biopolitics,” or politics of life. This book focuses on concepts relevant to the making of a single policy—problematization and assemblage—and it adds the insights of STS that are limned but not theoretically elaborated in *GCP*. Substantively, this book confirms the arguments about the origins of the one-child policy developed in *GCP* but goes beyond them to develop a more in-depth explanation of what happened, when, how, and why in those crucial first years of Deng Xiaoping’s rule. Part 1 of *GCP*, on the making of policy from within institutions of the political Center, is based on the research and analysis of Winckler. Emphasizing a convergence of elite interests, he argues that the one-child policy was adopted because most senior members of Deng’s coalition agreed that drastic limitation of population growth was necessary to achieve core regime goals. This more fine-grained study fully affirms that argument while adding the epistemic dimensions of policy and the policy work of actors beyond the state that in my view are essential to understanding how and why top Communist Party leaders agreed on the necessity of a one-child policy. I argue that the one-child policy was a product of a new kind of scientific sense making within the regime that emerged in a historical context in which the embrace of science was politically essential to the regime’s survival. I also build on some other, smaller-scale arguments from part 1 of *GCP*. In particular, chapter 2 on the Mao era draws on *GCP*’s arguments about institutionalization, legitimation, and policymaking in the 1970s, interweaving them with new arguments about the destruction of population science and its impact on policymaking. Finally, my overview of the social and demographic effects of the one-child policy, offered in chapter 1, finds full elaboration in part 2 of *GCP*, which I wrote.

A Sinified Cybernetics of Population

Throughout the mid- and late 1970s, the emerging field of Chinese population studies was a social science committed to formulating China's population problem and its solution in terms of China's own intellectual tradition of Marxian economics. Indeed, since the 1950s Marxian social science had provided the only publicly available framework for thinking about the governance of population in the PRC.¹ Yet the social sciences' grip on population was about to be challenged.

In mid-1978, a group of three natural scientists—cum—systems engineers from the defense world began quietly applying their skills to the population question. Their field was cybernetics, the science of control and communications in complex machine systems. Their specialty was control theory, an engineering approach to controlling the behavior of machines—not humans (Wiener 1948). Although the researchers had no experience in population research, they had developed a keen personal interest in China's population affairs (IF,11/16/99,BJa). The group's leader and prime mover was Song Jian, a top control theorist at the Seventh Ministry of Machine Building—in charge of missiles.

Song and his colleagues occupied a politically protected and intellectually privileged place on the elite cultural map of the PRC. As military researchers, they were denizens of the relatively independent land of “defense science and technology.” Unlike their social science colleagues, who as subjects of the kingdom of “party politics” remained burdened by the tortuous history of PRC population politics, the defense scientists

were outside “ideology/politics” and thus free to develop the science of population in fresh directions. Although defense researchers such as Song were required to serve the regime and to respect its ideological fundamentals, they had their own highly authoritative and newly elevated body of thought—the reasoning of modern science and mathematics—to use as their guide. In contrast to the social scientists, who were constrained to practice a follow-the-leaders demography, the scientists and engineers were able to develop an independent body of population thought based on modern science and technology that pushed the leaders’ views in new directions. Moreover, as beneficiaries of decades of top-level support for strategic defense science, the defense researchers possessed an extraordinary wealth of intellectual, political, and cultural resources with which to create a new and more “scientific” approach to population policy.

In 1978–1979 this team of researchers created a novel natural science of population that reflected their training in defense mathematics and systems engineering, an institutional location affording privileged access to international science, and their histories of relative freedom from political attack. Drawing techniques and logics from two sources—the population alarmist writings of the Club of Rome, an international network of scientists and engineers based at the Massachusetts Institute of Technology, and Chinese strategic defense science—the Song group created a distinctive set of scientific ideas and practices that I gloss as a sinified cybernetics of population. The resulting policy construct recast China’s population problem as a population-environment-economy crisis whose solution could only be a policy of one child for all to be implemented immediately, regardless of the social and political costs. Whereas the Marxian statisticians had merely numericized population, making the leaders’ narrative of population-induced economic backwardness appear more empirically “true,” the defense scientists had *scientized* the leaders’ narrative—and changed the story.

This chapter tells this remarkable story. It begins with Song’s rise during the Mao years and the personal attributes, intellectual training, and political connections that propelled it. The next two sections trace the practices by which Song and his colleagues radically redefined the population problem and its ideal solution in scientific terms. Their crisis-crackdown story did not replace the economic story, but rather subsumed it in a more urgent account of the disaster facing the Chinese nation. By taking apart the procedures by which their scientific policy construct was created, these sections show how consequential political

assumptions got embedded in it and then got veiled in powerful language of international scientific truth.

FROM MISSILE SCIENCE TO POPULATION SCIENCE

As we have seen, in the revolutionary turmoil of Mao's China, most of the social sciences were abolished and the natural sciences decimated. Yet because of Mao's military view of the world and the very real threats of attack from the United States and, after 1960, the Soviet Union, military science became an advantaged site of knowledge and technology production. Most favored of all was the strategic weapons community of scientists and engineers charged with building the atomic bomb and the missile systems to deliver the payload. While the rest of the science community suffered, the strategic defense community was largely protected from political violence and supported with exceptional state largesse. During the Maoist decades, students of China's military have shown, Chinese science was virtually all military science (Lewis and Xue 1988, 1994; Feigenbaum 2003). As a result, at the beginning of the Deng era, China's strategic weaponeers were the only fully functioning scientists capable of responding rapidly and effectively to the call to apply modern science and technology to the challenge of rapid economic modernization (Feigenbaum 2003: 71–72). In using their skills to solve China's social and economic problems, they both built on the advantages of strategic defense science and—more consequentially—built some of the logics and techniques of their field into the new sciences they created.² At the forefront of that movement to convert military to civilian science was Song Jian.

An innovative scientist, talented technician, and savvy politician, Song Jian was a major figure in China's defense science establishment, playing key roles first in building China's military-industrial complex and later in converting it to civilian uses. In the 1960s and 1970s, Song pioneered the development of Chinese cybernetics and its application to missile guidance systems, becoming one of the nation's leading missile experts. Because of the enormous secrecy surrounding China's defense research, for the past twenty-five years Song has kept his military science and engineering background out of sight in his population writings, leaving the military foundations of his population research obscure even to Chinese who have devoted their professional lives to population work. Yet by mining the literature on China's defense research and development (R&D), and by tracking the development of Song's work in the scientific literature, we can tease out the strategies by which he

took advantage of that favored background to create an entirely new natural (and physical) science of population.

Song Jian: Control Theorist with Talent, Ambition, and Luck

In the mid- to late 1970s, when our story of population begins, Song Jian inhabited the highest echelons of the elite world of strategic defense science. His rise had begun early. In 1946, at the age of fourteen, Song left his home village in Shandong's Rongcheng County and joined the Eighth Route Army.³ With this move he essentially joined the Chinese Communist movement, apparently securing the party credentials that were crucial to all who wished to rise in China's soon to be party-led society. In 1953, he passed a crucial exam and, on the recommendation of top leader Liu Shaoqi, was sent to the Soviet Union, where he trained in cybernetics and military science. An outstanding student, Song studied with the world-famous control theorist A. A. Feldbaum, received an associate PhD degree from Moscow University, and published seven papers in Russian on the theory of optimal control, later earning the acclaim of Soviet and American scientists.

Song returned to China after the Sino-Soviet split in 1960. From his position in the second subacademy of the fifth academy of the Ministry of National Defense, Song became the nation's leading control theorist and a foremost expert on missile guidance and control systems.⁴ (The fifth academy was in charge of missiles and space. In 1965, it became a separate ministry, the Seventh Machine Building Ministry [Qijibu]. The second subacademy [after 1965, second academy] was in charge of control systems.) Song was the first in China to apply optimal control theory to missile guidance and control.

Early on, Song was singled out for patronage by Qian Xuesen (1911–), the brilliant and politically shrewd MIT-educated father of China's aerospace and missile defense programs. In the late 1940s and early 1950s, Qian was the Goddard Professor of Jet Propulsion at the California Institute of Technology and the director of the Jet Propulsion Laboratory in Pasadena before coming under suspicion during the McCarthy era. He was permitted to return to China in 1955. There, as the top military science advisor to Mao and Zhou, Qian quickly became the most powerful scientist in the country.⁵ Patron-client ties are a fundamental feature of Chinese politics, enabling the rise of many a junior politician. Qian's patronage seems to have been a powerful asset, for many informants stressed the fundamental role it played in Song's ascent (IF, 12/22/03, BJ;

12/24/03,BJb). And, indeed, the written record shows that that eminent scientist-politician showered the young Song with praise and favored opportunities for scientific advance. With great fanfare Qian announced that Song, not he, was the country's leading control theory scientist. At Qian's behest, Song was invited to head a new Control Theory Research Office in the Mathematics Institute of the Chinese Academy of Sciences. Song was chosen to coauthor the revised edition of Qian's two-volume *Engineering Cybernetics*, a bible for generations of Chinese defense scientists and engineers (Qian and Song 1981).

With his stellar list of scientific and political accomplishments, Qian undoubtedly facilitated Song's rise—or prevented his fall—in other ways as well. From Qian's political biography we learn of his leadership of countless scientific societies. He was a member of the Executive Council of the International Federation of Automatic Control (1957); president of the (Chinese) Dynamics Society (1957), the Automation Society (1961), the Society of Mechanics and Automation (1978), and the Mechanics Society (1980); vice president of the Association for Science and Technology (1980); advisor to the Society for the Study of the Future (1979); and honorary president of several other associations. Academically, Qian was the founding director of the Chinese Academy of Science's Institute of Mechanics (1956), a member of the Academy's Department of Mathematics, Physics, and Chemistry (1957, 1979), and the director of the Department of Mechanics at the Chinese University of Science and Technology (1959). Qian was influential in scientific publishing as well, serving on the editorial board of *Zhongguo kexue (Scientica Sinica)* (1961) and the editorial staff of *Kexue tongbao (Science Bulletin)* (1956). In the political arena, Qian was a member of the Chinese People's Political Consultative Committee (1956), a member of the presidium of the National People's Congress (1964, 1980), and a People's Liberation Army deputy to the National People's Congress (1978). A party member from 1958, Qian was appointed alternate member of the CCP's Central Committee in 1969 and member and vice chairman of the Science and Technology Commission for National Defense (1975, 1978) (Bartke and Schier 1985: 168–170). With this extraordinary résumé, Qian must have had dense and powerful networks throughout party, government, military, and science circles. In any of these capacities he could have greased Song's career.

Song's abundant talent, technical accomplishments, and political patronage and savoir faire combined to propel him into the ranks of the foremost defense scientists and engineers. During the Cultural Revolution,

after Song's house was ransacked by the Red Guards, Zhou Enlai placed him on his list of roughly fifty scientists who, because of their indispensability to the nation's defense, would enjoy special protection by the state. Perhaps Qian prevailed on Zhou to save Song from the Red Guards. Qian himself not only survived the Cultural Revolution without coming under attack, he was seen participating in numerous official occasions at the time (Bartke and Schier 1985: 169). Song was sent to the Jiuquan missile base in the Gobi Desert, where he spent more than a year broadening his scientific knowledge by reading in astronomy, nuclear physics, and other fields. In 1969, he returned to Beijing, where he continued his work on missile control and guidance systems, attracting the attention of Zhou for his work on antimissile missiles (*fan daodan dandan*). In 1978, Song was awarded the post of deputy director of the missile ministry's second academy.

By 1978, Song had become more than a military scientist. He had joined a small class of elite scientists, strategic defense experts whose native brilliance, signal contributions to national defense, and list of accolades from top scientists and politicians led them to see themselves, and others to see them, as almost superscientists who could speak with originality and authority on any subject and command attention. In China the most prominent elite scientists, Qian Xuesen and the nuclear physicist Qian Sanqiang, gained extraordinary prestige and influence among political leaders (Lewis and Xue 1988, 1994; Feigenbaum 2003).⁶ The boldness and self-assurance with which Song would tackle the new project on population and promote his plan to China's leaders can be traced in part to this special status.

In 1977–1978, Deng Xiaoping was reducing investment in military R&D and urging defense scientists to turn their attention to the nation's many economic problems. One of China's most serious problems was its huge and still swiftly growing population. As we have seen, after Mao's death a strong consensus had emerged at the highest levels of the party and government that the rapid growth of a largely rural population was a major obstacle to the achievement of the Four Modernizations. The sorry history of population studies and population control in Mao's China was only too well known in Chinese intellectual circles. Song tells how deeply "unsettled" he felt by the case of Ma Yinchu, who had suffered great persecution for his views even though they were correct (IF, 12/24/03, BJa). The cuts in defense spending and encouragement to turn from defense to development issues may well have whetted Song's interest in Ma and the population question.

These were the historical currents prevailing in mid-1978 when Song traveled to Helsinki to attend the Seventh Triennial World Congress of the International Federation of Automatic Control (IFAC). There Song met two Dutch control theorists, G. J. Olsder and Huibert Kwakernaak, who had developed a new cybernetic-based natural science of population control that was tied to the well-known work of the Club of Rome (Song 1986: 2–3). Song immediately saw the promise of the systems science approach. As he put it in an interview, the encounter provided a “tremendous stimulus,” enabling him to “suddenly see” that the precise quantitative techniques of control theory could also be applied to population, a qualitative field long mired in ideological controversy. “Anyone could have quantified population,” Song said, speaking of his own central contribution, “but no one had” (IF,12/24/03,BJa). Moreover, developing such an approach would both utilize and showcase Song’s peerless cybernetic skills, while giving him an exceptional opportunity to respond to the call for defense conversion by helping to solve one of the country’s most urgent problems. The appeal, evidently, was irresistible.

Part of that appeal may well have lain in the opportunity population provided for Song to mobilize his talents as an elite scientist, one who could quickly master new fields and find brilliant solutions that lesser minds had missed. Song’s population writings provide ample evidence that he saw himself in these terms. Unusually for population work, Song’s writings would occasionally draw on fields as diverse as astronomy, geography, and environmental science. After 1980, his articles would sometimes note the praise his work had earned from China’s leaders and famous foreign specialists. Song would also write with supreme self-confidence that his techniques and policy proposals were not only right but also the very best available. It was as though everything he wrote was by definition correct and compelling. These unconventional features of his work make sense when one sees Song as he apparently saw himself: as an elite scientist who stood head and shoulders above the rest.

Even as he was developing the new science of population, Song continued work in missile and aerospace science. Indeed, Song reports that he did the population work in the wee hours of the night (from 10 P.M. to 2 A.M.), spending his days solving problems of satellite launching and the like (IF,12/24/03,BJa). In publications, Song would keep his two sciences separate, but they were very much intermeshed in his career and, one must imagine, in his thinking. In February 1980, the month he scored a key victory in the population battles (described in a later chapter), Song became the principal deputy chief designer of

China's submarine-launched ballistic missile. From this important post, he would move rapidly up the scientific-political hierarchy, a subject I return to in the book's final chapter.

*A Cybernetics of Population: Euro-American Origins
and Social Scientific Critiques*

In the late 1960s and early to mid-1970s, when China was in the throes of the Cultural Revolution, an influential body of neo-Malthusian thought was developing in the West that predicted mass starvation—a “race to oblivion”—as the inevitable result of rapid population growth (Ehrlich 1968: cover). Composed of natural scientists, engineers, and others who favored the application of scientific and engineering techniques (such as systems analysis, simulation, and decision theory) to the solution of human problems, the Club of Rome presented a global systems model in which population growth was exacerbating pollution and depleting the food supply and nonrenewable natural resources. According to this school of thought, population was now approaching the limit of the planet's ability to sustain it; without a significant change in orientation, population would exceed the planet's “limit to growth,” triggering calamitous environmental and social decline within the next hundred years. To avert catastrophe it was necessary to immediately institute strong, even drastic, population control. The best-known texts produced by this alarmist school of thought were Paul R. Ehrlich's enormously popular *The Population Bomb* (1968) and the more academic study *The Limits to Growth*, by a computer research team based at MIT (Meadows et al. 1972). In China, because of sharp limits on access to Western scholarship at the time, the term “Club of Rome” (*Luoma Julebu*) came to be used loosely to refer to any Western work in this alarmist vein. Here I follow the Chinese usage. It was this Club-type body of work, along with a more narrowly focused population cybernetics that specified a control theory solution to the problem of population control, that would capture the imagination of the Chinese scientists and engineers.⁷

Song's description of his encounters with the work of Olsder, Kwakernaak, and Edward Goldsmith et al. (1972), who had done similar work in Britain, brings out the excitement his discovery produced. This passage also provides a backward glimpse at the larger intellectual climate of the 1970s, when notions of explosions of population growth were prevalent around the world and applications of control theory to

abstract economies facing such situations were standard fare in Western population economics:

After more than ten years [of] isolation from the outside world, during a visit to Europe in 1978, I happened to learn about the application of systems analysis theory by European scientists to the study of population problems with a great success. For instance, in a "Blueprint for Survival" published in 1972, British scientists contended that Britain's population of 56 million had greatly exceeded the sustaining capacity of [the] ecosystem of the Kingdom. They argued [that] Britain's population should be gradually reduced to 30 million, namely, a reduction by nearly 50 percent; some Dutch scientists also believed that [the] Netherlands' population of 13.5 million had far gone beyond the limit of what the country's 40,000-square-kilometer territory could possibly bear and should therefore be reduced at least by a half. I was extremely excited about these documents and determined to try the method of demography. (Song 1986: 2-3)

Clearly, what enticed Song were the possibilities of applying the tools of systems analysis and control theory, which he had pioneered in missile design, to the new domain of population. By quantifying population and treating it as a biological entity free of social and political complications, a natural science of population held out the tantalizing promise of solving this major problem that had vexed China and its social scientists for decades.

In the West, the COR work had provoked an outcry from economists, demographers, and other social scientists concerned about its substantive limitations, methodological weaknesses, and ethical implications. So wide-ranging was the critique of World3, the best-known computer model, that in 1982, a decade after its publication, its creators acknowledged that it was "one of the most criticized models of all time" (Sanderson 1994: 47). The economic critique highlighted the neglect of continued technological progress and price and other adjustment mechanisms. Were such possibilities considered, the outcome might well be not global collapse but continued growth. Methodologically, economists complained, the relationships specified in the model were based largely on subjective plausibility; both the relationships and the variables in the model ignored theory and evidence in economics and demography. The global modeling was, in short, "measurement without data," resulting in the spurious appearance of precise knowledge of quantities and relationships that were in fact unknown, and in many cases unknowable (Nordhaus 1973). To many economists, the lack of necessary data and the ignorance of the underlying relationships

made the kind of modeling that would attract Song's attention virtually meaningless (Nordhaus 1973; also Cole et al. 1973; an excellent overview is O'Neill 2001).

Economic demographers were equally dismissive. In a trenchant critique of the economic-demographic models of the 1970s, Brian Arthur and Geoffrey McNicoll worried about the lack of validity, or relationship between model and reality. Despite their limited utility in policy evaluation, Arthur and McNicoll argued, such models have effects nonetheless, effects that are eminently political:

[Such] models, although apparently outside the political process, may be used to strengthen the hand of the planner. . . . Sometimes it appears that the larger and more complex the model (though actually it may be nothing more than a long list of variables), the more important the planner. Since he alone can interpret it, he may gain a kind of status from being its guardian. Finally, economic-demographic models see policies as emanating from a central supply house (the government) to its ultimate constituents, the individual citizens. A whole range of policy options involving decentralization of authority to local groups tends to be ignored. A central government "programmatic" approach results. (Arthur and McNicoll 1975: 262)

Sociologists worried about the application of the mechanistic models of cybernetics to the understanding and solution of human problems. Ignoring humans as thinking and purposefully adapting elements of dynamic systems, the cybernetic models neglected future social, political, and cultural changes that would surely prevent the arrival of that dark future. Equally if not more worrying were the potential consequences of applying the technicist solutions of cybernetics to real-world human problems (e.g., Lilienfeld 1975; Ludz 1975; Jahoda 1973). Critics of all stripes warned sharply of the dangers of computer fetishism—endowing computer models with a validity and independent power transcending the mental models that are their essential basis. Instead of overweening confidence in their results, the modelers should be humble about the limited ability of science to model the world and predict the future (Freeman 1973: 8). Though this earlier generation of critics lacked the language of contemporary science studies, they made one of that field's basic points when they argued that beneath the appearance of the detached neutrality of the computer model lay the subjective political values of the scientists, in particular the value of technocracy: the vision of a world run by scientists and engineers whose technical brilliance was matched by their sociological ignorance of the world they sought to reengineer.

By the late 1970s, when Song visited Europe, countless critiques of the Club-style work had appeared, many of them scathing and many by well-respected social scientists. Yet Song apparently did not encounter such perspectives in his travels. This is not surprising given the intellectual context in which Song discovered the Club of Rome ideas. The Helsinki world congress on automatic control was an impressive gathering that brought together more than 1,100 scientists from forty-five countries to give papers on highly technical and applied subjects. Those subjects ranged from nuclear power plant dynamics to thermal processes in metallurgical industries to computer control of pulp and paper plants. Judging from the conference volumes, the congress was infused with a spirit of scientific certainty, progress, and messianic fervor about the potential of control science to revolutionize the world. Participants were especially enthusiastic about the potential of control science to ameliorate problems of third-world development, a special topic of discussion (Kekkonen 1979; Apter 1979; Chestnut 1979). In his opening address to the congress, the president of the Republic of Finland put it this way: “We are just now experiencing the period of most vigorous development in this field. . . . [T]he technique of automation has already progressed beyond belief. . . . The development of this branch [of knowledge] is not only important to technology and industry: the extensive scope of the field and the far-reaching significance of its ideas mean a lot to the welfare and development of humanity as a whole” (Kekkonen 1979: xxviii). To the Chinese delegate encountering this work for the first time, the cybernetics of population that the Dutch scientists described must have seemed every bit as scientific and progressive as the other projects published in the IFAC’s four-volume 2,662-page conference proceedings (Niemi, Wahlstrom, and Virkkunen 1979). In any case, in his writings Song would treat the cybernetics of population with the same messianic fervor that dominated the IFAC conference volumes.

Other factors may also have prevented an encounter with the social science perspective on the cybernetics of population. The short duration of Song’s visit (roughly two weeks) precluded his gaining familiarity with the broader context of population studies in the West. And even if Song had encountered the sociological and economic critiques, his (and his Dutch hosts’) training and intellectual predilections would almost certainly have led them to reject those perspectives as irrelevant to the science they were pursuing. Social science review articles are absent from the reference lists of the Olsder and Kwakernaak papers that Song read and receive no note in any of Song’s own many publications (Olsder and

Strijbos 1976; Kwakernaak 1977). When he returned to China, Song brought back with him only the building blocks for the new natural science of population: the mathematical tools, the problematization of population as an environmental crisis, the engineering-type control solutions to that crisis, certain rhetorical devices, and a messianic fervor about it all.

Assembling a Research Team:

Two Defense Mathematicians and a Population Theorist

After the June 1978 IFAC meeting, Song spent a week with Olsder and Kwakernaak at their home base, the Department of Applied Mathematics at the Twentieth University of Technology in Enschede, the Netherlands. Soon after returning to China, he recruited two talented subordinates at the missile ministry—Yu Jingyuan, a control theorist and systems engineer in his own research institute, and Li Guangyuan, a mathematically trained computer expert based in another institute—to work with him. As is often the case in China (and, indeed, in many scientific communities), because the team's leader was busy with other things, there emerged a division of labor in which the subordinates would do virtually all the concrete work of model building (Yu Jingyuan) and computation (Li Guangyuan), while the leader would assume the role of entrepreneur, promoting the research to political leaders and the public, and taking credit for the group's achievements.⁸ Because their talents would be crucial to the success of the new approach, Yu's and Li's backgrounds are important to note.

A highly skilled mathematician, Yu Jingyuan (1937–), like Song, was a specialist in the application of control theory to problems of missile guidance and control. Yet Yu lacked the early political good fortune of his boss (IF, 12/21/03, BJ). After finishing high school in the mid-1950s, Yu was named to study in the USSR, but because of a “bad class background” (a landlord family) he was denied the opportunity. Instead he studied mathematics at the Harbin College of Military Industry and Changchun's Northeast Teacher's College and Northeast People's College, before moving to Beijing in 1960 to join the research staff of the missile ministry (at that time still the Ministry of National Defense's fifth academy). Song would become his “leader” in the early 1960s, when Song was named deputy head of the second subacademy. Sometime along the way, Yu worked under the direct guidance of Qian Xuesen on systems science and engineering. Yu names Qian as a major

intellectual influence and inspiration; Qian undoubtedly helped Yu in other ways as well (Population Awards 2003: 330–341).

During the Red Guard years (1966–1969), the Cultural Revolution disrupted work at the missile ministry, Yu reports, but it did not generate the kinds of political havoc it created for some other intellectuals.⁹ Unlike the social scientists, who were targeted for political attack, Yu managed to avoid the political crime of possessing “thought problems” (*sixiang wenti*) by participating in the incessant political study sessions of the day but keeping his opinions to himself. It was during this period, when ministry staff were pursuing research on their own, that Yu first came into close contact with Song Jian through their joint work on space vibrators and other techniques of missile control. In 1972–1973, Yu started to learn English from new English-language programs broadcast on Chinese television; Song may have picked up his English this way too. However it was acquired, this familiarity with the world’s dominant scientific language would help them access the international scientific texts that they would later mine in creating a mathematics of population. In the mid-1970s, when the research environment was largely normalized, Yu published his first article with Song, on a problem in the mathematics of missile and spacecraft control (Song and Yu 1975).

Li Guangyuan was in charge of the missile ministry’s computer facilities, a very major responsibility. A mathematician with a degree from the top-flight Chinese University of Science and Technology in Anhui, he had joined the ministry in 1965 (IF,12/21/03,BJ). Sometime in the early to mid-1980s, Li left China to go into business in the United States, allowing his ties to former colleagues to lapse. Because none of his former collaborators know his whereabouts, I have been unable to include Li’s perspective in this study.

From late 1978, this team, assisted by three computer experts working under Li, began to assemble the theoretical and methodological tools they would need for the new project.¹⁰ In his telling, Song studied up on population, reading Malthus and leading Western mathematical demographers to figure out how to adapt the control theory he had used for missile guidance to the problem of population (IF,12/24/03,BJa). Encouraged by the Birth Planning Leading Group (this important story is told in chapter 6), those involved in the concrete work used data provided by the Public Security Bureau and the computers of the missile ministry to project the growth of China’s population twenty, fifty, and one hundred years into the future. This was the first time any mathematically sophisticated researchers had done projections of China’s

demographic future. The results came as a shock to everyone. Throughout 1979, the scientists vetted their work among leading physical scientists and engineers. In March and October, they presented their findings to colleagues in the Institute of Mathematics at the Chinese Academy of Sciences, the Association of Systems Engineering, and the Expert Committee on Automation Theory (IF,12/21/03,BJ; Song, Yu, and Li 1999[1980]). By the end of the year, they had gained the support of key constituencies in China's powerful defense science and engineering establishment.

The natural scientists, however, had limited understanding of population dynamics. In the fall of 1979, Song, Yu, and Li paid a personal visit to Tian Xueyuan (1938–), an economist in the Institute of Economics at the Chinese Academy of Social Sciences, to recruit him to the effort. Tian, who had been a student at Beijing University in the 1950s when Ma Yinchu was its president, had long-standing interests in demography and a key publication on Ma to his name (Tian 1979). Tian had just moved to the newly opened Academy from the State Education Commission, where he had spent the previous fifteen years (IF,11/16/99,BJa; Population Awards 2003: 298–305). From Tian the military scientists hoped to get a better understanding of age-specific birth and death rates and demography more generally. The scientists had some riveting numbers, but little idea of what they meant. Tian was needed to add the “theory” that would make the numbers make sense. Tian was, in his own telling, eager to join the endeavor (IF,11/16/99,BJa).

In December 1979, Li Guangyuan presented the initial findings of the group's work for the first time to the population field, at the enlarged conference in Chengdu (Song and Li 1980[1979]). With encouragement from China's top population officials, Song immediately began promoting his ideas to those who would ultimately decide the nation's new population policy—China's political leaders. Over the next four months, he would introduce a gripping new construction of the population problem combined with a radical new solution. Because of the sensitivity of the policy and the process, Song would conduct his entrepreneurial activities in utmost secrecy, using open publications selectively and strategically while relying on internal reports within the government for the most important communications. Over the next few months, the pieces of the conceptual structure underlying Song's policy construct were gradually made available to leaders, midlevel officials, and eventually the broader public, with the most arresting scientific findings coming first and the most politically sensitive ideas emerging last. As a result of this piecemeal

politics, the full conceptual apparatus supporting the team's one-child-for-all policy became public only in late 1980—*after* the crucial decisions had been made and made public. Yet the evidence from interviews and other sources suggests that that conceptual apparatus was already virtually fully assembled by the time of the Chengdu conference.¹¹ To convey a sense of the intellectual coherence and power of the scientists' program, and of its contrasts with other policy packages in circulation at the time, in this chapter I pull the pieces together and present them as components of an ordered policy science framework. In part 2 of the book, I show how the various pieces were selectively shared with strategic audiences over the next few months, until eventually a decision in favor of the scientists' proposal was reached.

The Advantages of Strategic Defense Science

In developing this new science of population, the scientific resources, political capital, and cultural prestige Song enjoyed as a prominent defense scientist-engineer gave him enormous advantages. The missile ministry in which Song had spent virtually his entire career was part of a huge, powerful, and resource-rich military-industrial complex built up by Mao. During Mao's lifetime, the strategic defense community not only enjoyed protection from political violence, it also received a huge proportion of the nation's scarce developmental resources.¹² It absorbed the best-trained and most talented scientists, enjoyed use of the most modern equipment and facilities, and virtually monopolized the modern industrial sector. Scientists and engineers working on strategic weapons were a scientifically privileged and politically powerful group. Unlike other specialists, they had access to foreign literature, to data, and to computers with which to analyze them. The institutions in which they worked encouraged the construction of personal networks that gave them access to the highest levels of the government and involved some in important national policy decisions. Defense scientists and engineers worked in an environment with an entrepreneurial, risk-taking culture that encouraged bold initiatives and rewarded technical accomplishment with political influence and cultural prestige. Moreover, after years of active participation in national political debates on spending and policy priorities—debates that gave them a say in decisions on broad development policy—by the mid-1970s leading defense scientists had acquired the self-assurance, risk-taking attitude, and political protection needed to safely undertake new ventures in fields in which they had

no training (Feigenbaum 2003). This is the larger context in which Song was able to create and promote a new science and policy on population.

From their position in the missile ministry, Song and his colleagues enjoyed access to many scientific resources that population specialists in less well endowed institutions lacked. In an environment in which all statistics were treated as state secrets, the missile ministry scientists were able to use personal connections to officials in other government agencies to gain early access to crucial population data. It was through a personal tie to a contact at the Public Security Bureau (who must go unnamed) that the scientists were able to acquire the sample survey data of 1975 and 1978 that formed the basis for their population projections (IF,11/16/99,BJa; 12/21/03,BJ). Although these data had serious limitations, they were the only national population data available. Other groups would obtain these data as well, but the personal relationship appears to have given the Song group earlier access to them. The military scientists also had better access to the resources of the international scientific community. After the announcement that China would open up to the outside world, natural scientists were among the first to travel abroad. Song recounts how, after the thaw, Chinese cybernetics was quickly able to catch up with developments in international cybernetics (Song 1986: 2). The contrast with the situation of social scientists, whose access to their peers abroad was restricted by politics and ideology, was striking.

The Song group also benefited enormously from the availability of the missile ministry's large computers. As in many countries, in China computers had been developed by the military for weapons applications (Reichers 1972). According to a key staff member at the Birth Planning Leading Group, in the late 1970s the missile ministry had one of the biggest and most sophisticated computers in China (IF,12/24/03,BJb). The ability to process large quantities of data rapidly and accurately enabled Song and his colleagues to perform modeling tasks the social scientists could scarcely imagine. Song tells how it took but five minutes of borrowed time on the ministry's computer to run all the population computations (IF,12/24/03,BJa). Moreover, unlike the social scientists, who possessed only basic statistical skills, the natural scientists were highly trained mathematicians who had used sophisticated mathematics in working on some of the most complex tasks of advanced weapons development. These skills enabled them to develop models that were both different from, and much more sophisticated than, any demographic

models available in China—or almost anywhere—at the time. Such complex models were not necessary to understand population dynamics, but they were original and, with their esoteric equations, would impress many who could not understand them.

As natural scientists based in a leading military science research institute, the Song group were able to publish their work in prestigious sites not open to the social scientists. In the late 1970s and early 1980s, Song and his team would frequently publish in top science journals such as *Nature Magazine* (*Ziran zazhi*), *Chinese Science* (*Zhongguo kexue*, officially translated as *Scientia Sinica*), and *Science Bulletin* (*Kexue tongbao*). (As noted earlier, Qian Xuesen had ties to editorial staff at the latter two.) Like the Liu group, they also had the political connections needed to get their work printed in leading national newspapers such as the *People's Daily* and *Guangming Daily*. Later, the scientists' books would be published by top presses, including the People's Press (Song et al. 1982) and Science Press (Song and Yu 1985). Publishing in such venues would lend scientific (and political) authority to their population work and enable them to reach a large and influential audience for their ideas.

The missile ministry team also possessed exceptional political and cultural resources. During their years in the defense science field, Song and his colleagues had developed ties to influential military science figures who could press their case with the nation's political leadership. Song's greatest asset, his patron Qian Xuesen, was only the most prominent. In their years in the weapons development community, the physical scientists and engineers had also imbibed that community's culture of bold experimentation and risk-taking. Whereas the social scientists were encumbered by an ingrained caution and fear born of years of political persecution, the military scientists possessed the self-assurance to enter an entirely new field, borrow a set of foreign techniques they had encountered only briefly, modify them in significant ways, and then employ those techniques to quickly develop and press for a radically new solution to social problems that had vexed the nation for decades.¹³ Of course, such maneuvers posed dangers to China's leaders and people, but those would emerge only later.

Finally, in China in the late 1970s, natural scientists generally and military scientists specifically enjoyed tremendous cultural prestige. That high esteem was based not only on their record of past accomplishments in building bombs and missiles, but also on the unchallenged prestige of science at a time when ideology was moribund. Unlike the

social scientists, who by political definition belonged to an inward-looking ideological past, the natural scientists by definition belonged to an internationally oriented scientific and technological future. In his National Science Conference speech in March 1978, no less a figure than Deng Xiaoping had extolled the virtues of science, and especially cybernetics and computers, as the keys to transforming China into a powerful modern nation (see chapter 3). Song and his team would greatly benefit from this wider culture of scientism that Deng's speech reflected and, in turn, intensified.

The advantages of the missile ministry team emerge with particular clarity when one considers the history of a similar intellectual enterprise—one that failed to reach China's leaders. In a case of independent invention, in the late 1970s a group of systems scientists at Xi'an Jiaotong University under Wang Huanchen was also applying systems techniques to find a solution to the nation's population problems (IF,12/16/03,BJc; 3/30/02,LB). The group included Jiang Zhenghua, who later became a leading economic demographer and vice minister of the State Birth Planning Commission. According to Jiang, Xi'an Jiaotong, a leading center of scientific and technological research, had developed its own computer by 1961 or 1962. Although the machine was slow and cumbersome, it was able to process large-scale data. The Xi'an group conducted military research for a couple of years, but their major emphasis was on economic development. In the mid-1960s, the group encountered the idea of applying systems engineering techniques to social and economic development in the international literature. The work was disrupted by the Cultural Revolution, when many faculty were sent to the countryside, but it resumed in 1976–1977. In the late 1970s, in an effort to demonstrate the applicability of systems engineering to a wide range of human problems (and thus garner more state funding for it), the group tried their hand at population research, a subject they found much easier than industrial production, their staple. Although the Beijing and Xi'an groups both used equations from missile control research, the Song group developed partial differential equations while the Wang group used difference equations.¹⁴ The two groups were in close contact; indeed, in a collegial move, Yu Jingyuan shared the Public Security Bureau data with the Xi'an researchers. The results reached by the two groups were strikingly similar. Yet the work of the Xi'an group would disappear from sight, while that of the Beijing team would enjoy a long political life. Jiang's explanation—that Song was “more political”—can serve as shorthand for the many advantages listed here.

PROBLEMATIZING POPULATION: A (VIRTUAL) CRISIS OF HUMAN NUMBERS AND ECOSYSTEM COLLAPSE

Despite the often rapid growth of its population, throughout the 1950s, 1960s, and 1970s China officially had no population crisis. On the eve of the reform era, Deng and other political leaders had expressed concern about the burdensome impact of population growth on the achievement of the Four Modernizations, but there was no sense of alarm. In early 1979, China's social scientists had put empirical flesh on those concerns by describing a population-economy imbalance in the state plan in which rapid population growth represented at worst a potential threat to the nation's economic well-being. All observers believed that future population growth would be very worrisome, but the specifics eluded them.

Beginning in late 1979, the Song group profoundly recast the population problem by revealing the (purportedly) precise numerical extent of that increase and by drawing attention to the fearful environmental consequences of that gargantuan growth in human numbers. In doing so they effected a profound paradigm shift. In China, population had conventionally been viewed as part of society, to be analyzed by the theories and methods of the social sciences. The natural scientists redefined population as a biological entity located in nature and subject to "natural laws" that were comprehensible only by the theories and methods of the natural sciences. Responding to Deng's invitation to utilize Western science (while ignoring his instruction to create "modernization with Chinese characteristics"), Song and his colleagues drew on a particular body of Western population science (the ecological work of the COR and some associated control theory applications) that treated population as a biological universal, subject to universally applicable models in which local culture, politics, and society did not matter. Drawing ideas, images, and facts from the COR and from China's own strategic military doctrines, the Chinese cyberneticists created a narrative about a population crisis that was ruining the country's chance of becoming a rich, powerful, modern nation by century's end.

In China, the political climate for such ideas remained difficult if not hostile. Although some ideas of this sort had begun to enter the country in the opening to Western economics that occurred in the late 1970s (Hamrin 1990: 36–38), notions of population crisis remained ideologically suspect and politically dangerous.¹⁵ The PRC's official position, articulated at the United Nations conference at Bucharest only five years

earlier, was that the notion of a third-world population crisis was Malthusian heresy. The Bucharest statement was also scathing in its criticism of the reams of statistics—on food supply, natural resources, and so on—amassed to prove the existence of a demographic crisis. In Marxist China, population could impose a “burden” on the socialist state plan, but it could not constitute a Malthusian “crisis.” The terms “burden” and “crisis” belonged to two warring discursive worlds. The natural scientists and others who were attracted to such constructions were thus constrained to avoid explicit crisis language, creating instead a *virtual crisis*—a picture of ecological and thus economic devastation that was catastrophic in all but name. Equally important, they had to find a way to *de-Malthusianize* the notion to make it politically viable in a context in which anti-Malthusianism was the party line.

From their writings and from interviews with social scientists and government officials who worked with them, it is clear that Song and his colleagues found the COR writings on the global and third-world population crisis intellectually compelling (IF, 12/21/03, BJ). The statistics on the exponential growth of the population, the destruction of natural resources, and other matters helped them see, probably for the very first time, the apparently terrible scale of China’s population problems, a subject new to these men who had spent their professional lives thinking about weapons development, not social ills. Despite the skepticism about the extreme version of these ideas in the West, the evidence suggests that the Chinese scientists deeply believed that the Club’s work represented the very best international scientific thinking on population.¹⁶ Seeing the Club constructions as highly illuminating of the Chinese situation, the Song group proceeded to craft a narrative of a Chinese population crisis, drawing heavily on the Club’s vivid images and riveting statistics (without, however, citing their sources). They resolved the ideological problem by redefining the whole package of ideas they were using. No longer were the notions of population explosion and ecological devastation matters of Malthusian ideology. In the scientists’ hands, they became *international scientific truths*. The Song group redefined the Malthusian story as scientific fact by using the language of numbers, emphasizing the truth-telling capacity of statistics, and mobilizing the ocular techniques of science, while using terminological and citational practices that worked to distance the work from its Western (Malthusian) sources.

In this section I track this hybrid, scientific-political process, showing how the scientists rhetorically created the crisis, scientized and

depoliticized it, and finally intensified its political appeal by packaging it in a larger narrative of nation drawn from the doctrinal repertoire of strategic defense science. Whereas the social scientists acknowledged their location within society and politics, the natural scientists drew a sharp rhetorical line between science and society, claiming that their science was objective, not subjective, and rational, not biased. Yet their science *was* humanly constructed, and thus socially and politically shaped, in ways that deeply mattered. The scientists' individual political histories, disciplinary backgrounds, and institutional locations would all leave an imprint on their formulation of the population problem and its necessary solution, producing a policy proposal that was much more extreme than that advanced by the social scientists.

A Crisis in Numbers and Pictures: The Club of Rome in China

In the biological view of population, humans are biological organisms, animals like any other animals, who live within and thus depend on the natural environment. Following the Western ecologists, the scientists took it as axiomatic that, as human population grows, people take more resources from the biological world in order to survive. In doing so, they threaten to exceed nature's "limits" (*jixian*) and destroy the balance and stability of the ecosystem. The natural scientists thus spoke in the name of nature—indeed, of the environment of the whole earth—emphasizing their concern with preserving its stability and sustainability in the face of the depredations of rising human numbers.

In chapter 3 we saw how China's social scientists exploited numbers, tables, and simple line figures to provide newly ocular proof of the seriousness of China's population-economy imbalance. The natural scientists used the same sorts of scientific tools to create a population-environment crisis. They largely bypassed economic concerns—which, after all, had been thoroughly explicated by the social scientists—focusing instead on issues of time and space, more specifically, the acceleration of population growth over time and its ruinous effects on China's natural environment. The natural scientists' formulation of the problem was more powerful than the Marxian economists', not only because a "crisis" is a more gripping construct than an "imbalance," but also because they spoke on a grander temporal and spatial scale. Their subject was the whole earth, not merely the Chinese nation; and a time span covering thousands of years, not just the hundred-plus years since the Western incursion. Moreover, while the social scientists had only indigenous

images to draw on, and rather stale Marxian ones at that, the natural scientists were able to draw on images from abroad that were new and arresting.

Their textual and pictorial representations seemed to show two things: that China's population was growing at a historically unprecedented pace and that the increase in human numbers was depleting natural resources, ruining the environment, and preventing the Chinese nation from achieving its rightful place in the world. In creating this story, the scientists drew heavily on images and numerical concepts popularized by the COR. These Western constructs brought out the fearsome nature and consequences of rapid population growth in ways that were new to China at the time. Here I examine a handful of these techniques that helped the scientists and their readers see the terrible scale of China's problems. Central to all of them was a rhetoric of numerical fact and scientific truth. Paul R. Ehrlich of *Population Bomb* fame was a master of the effortless conversion of population numbers into objective scientific facts and truths apparently devoid of subjective human origins: "In a book about population," he wrote in his characteristic confiding yet authoritative style, "there is a temptation to stun the reader with an avalanche of statistics. . . . After all, no matter how you slice it, population is a numbers game" (Ehrlich 1968: 17). The Chinese scientists quickly mastered this rhetoric of numbers, effectively scientizing and factifying ideas that were at root humanly shaped.

In creating this narrative of crisis, the scientists emphasized the vast temporal and spatial scale of their concerns. An especially effective device was to lay out first the population problems of the whole earth, and then those of China, suggesting that China's problems were not only shared by people around the globe but also contributed mightily to the world's problems:

Statistics have shown that in the last century, the speed of growth in the world's population has risen to historically unprecedented heights. After living on earth for several million years, in 1830 the population of mankind reached 1 billion. In the following 100 years, however, it added another billion, reaching 2 billion in 1930. In terms of the speed of population growth, 100 years was the equivalent of several million years. Adding the third billion took only 30 years, placing the world's population at 3 billion in 1960. Adding the fourth billion required only 15 years, so that by 1975 world population approached 4 billion. . . . It is projected that by 2000 it will exceed 6 billion. Starting from 1830, then, the time needed for the world's population to increase 1 billion [shrank from] 100 years [to] 30 years, 15 years, and 10 years.

Population growth in China has followed a similar pattern. In the early Qing dynasty (1760) the population was 200 million; by 1900 it had risen to 400 million, by 1954 to 600 million, by 1969 to 800 million and, according to projections, by 1982 it will exceed 1 billion. It took several hundred thousand years to reach 200 million in 1760. Thereafter, the time required to increase 200 million [has fallen from] 140 years to 54 years, 15 years, and 13 years. (Song 1999[1980a]: 550)

This passage makes highly effective use of a staple in COR writings: the concept of the shrinking time it takes a population to double or grow by a certain large amount (e.g., Goldsmith et al. 1972: 6–7). In China in the late 1970s, when population was thought of in the staid terms of imbalances in the state plan, these scientific notions of human numbers rising imminently out of control would have been fresh and even frightening.

A closely related concept that Song borrowed and used to good effect was that of exponential population growth, in which a population grows slowly over long periods before beginning to rise explosively in recent time. One vivid graph showed China's population remaining low for 3,750 years, rising worryingly in the next 200 years, and then spiking up to one billion in the final few decades before 2000 (figure 3). The tone of the writer's commentary conveyed the alarm readers were supposed to feel: "Facing the rapid increase in population, countries everywhere are watching developments with grave concern" (Song 1981: 25–26). Although the numbers were presented as unquestionable facts, those facts were humanly created through the choice of time period (long or short) and the choice of measure of population growth (aggregate numbers versus, say, natural growth rate). Had the author instead shown trends in population growth in the 1970s, the alarm would have been more muted; indeed, the tone would have been upbeat. According to figures available at the time, the years 1971–1979 saw the crude birth rate and natural growth rate fall by a striking 50 percent (from 30.7 to 17.9 per 1,000 and from 23.4 to 11.7 per 1,000, respectively [Tian 1985[1981]: 81]). Although the graph helpfully highlighted the large effects of population momentum on growth in human numbers in the near future, the very long time frame used told a more gripping story about the urgency of the problems China faced. In shaping their numbers to tell a particular story, the scientists were simply following the practices of ordinary science. What was out of the ordinary was the story they told, what it obscured, and the unusual political context in which it was introduced.

Song also borrowed and creatively adapted some of the colorful images crafted by the Club writers. For example, the image of people

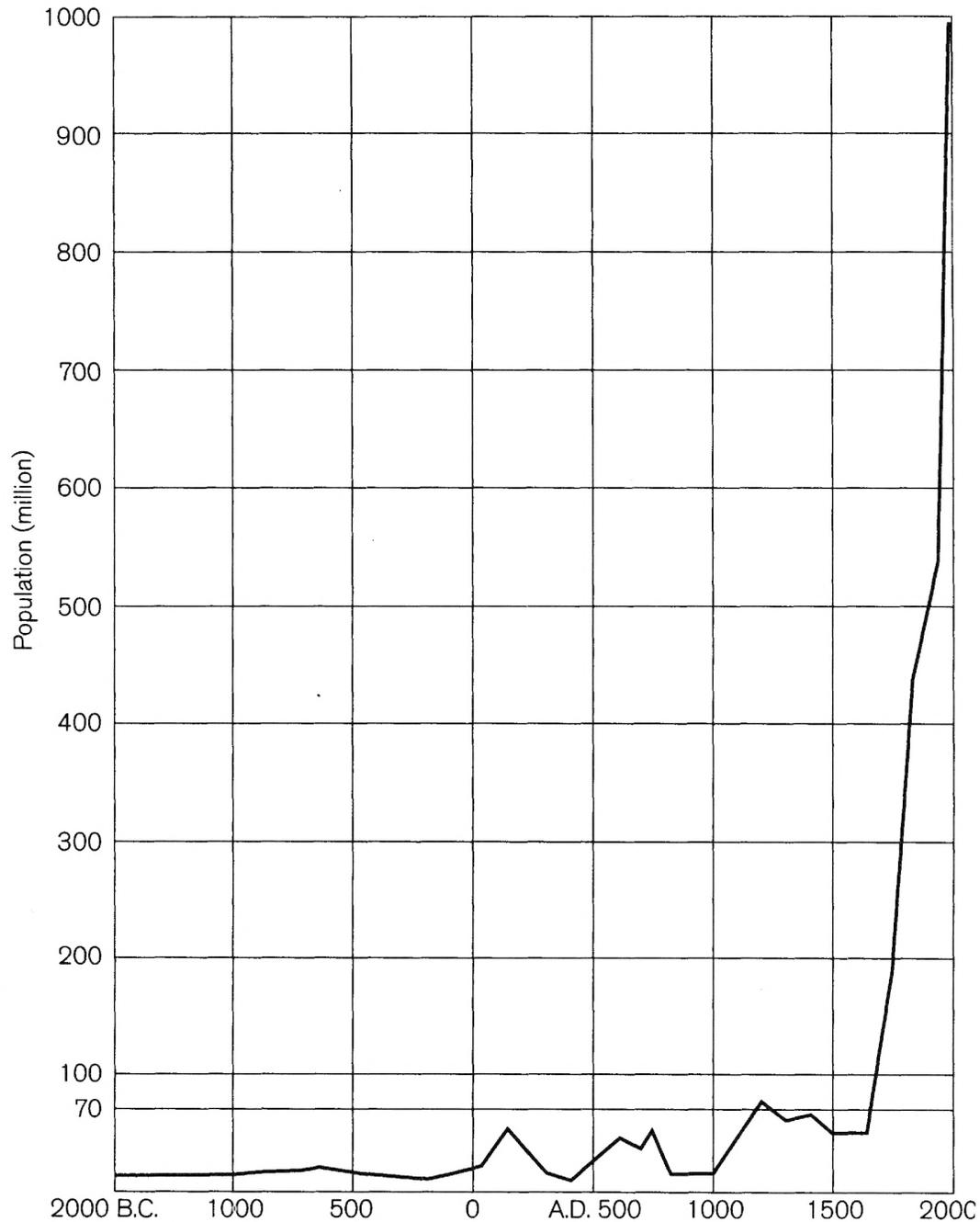


Figure 3. Estimated historical trend of Chinese population, 2000 B.C.–A.D. 1980 (Song, Tuan, and Yu 1985: 2).

covering every square inch of the earth, popular in the Western work, appears as well in Song's writings. Although by the late 1970s such images had become a tired staple of population alarmist writing in the West, in China at that time they were new and provocative.

The rapidly accelerating rise in human numbers was so worrying to the scientists because the increased numbers were destroying the ecosystem,

pushing up against nature's "limits to growth" and threatening human survival. Painting scary scenarios of ecological devastation, scenes that echo those in the COR work, Song warned:

Before the appearance of human beings, more than half the land was covered with forests. . . . Now forest coverage is about 30 percent worldwide; in China that figure is only 12 percent. . . . As population increases, now people have only 5 *mu* of arable land per person globally; in our country there is only 1.5 *mu* per person. . . . According to the calculations of the U.S. international grain policy research institute . . . after 1985, if the population growth rate is not lowered, every year there will be a shortage of 100 million tons of grain and 50 million tons of protein. . . . Because of large-scale use of fertilizer and pesticides, ports, lakes, rivers, bays, and streams have become highly polluted. Two hundred eighty species of mammals, 350 species of birds, and twenty thousand species of plants have been killed or rendered extinct. [All this] followed the growth of population. . . . We must admit that, as the population rises, people take more resources from nature and the ecosystem in order to survive. However, the expendable power of nature's stability has limits. To guarantee future generations adequate or even good survival conditions, *we cannot exceed our limit on taking natural resources*. . . . [We certainly must not] destroy the ecosystem's balance and stability. (Song 1999[1980a]: 552–553; emphasis added)

Another metaphor that found its way to China was that of the earth as a spaceship. This image, now a stale cliché in the West, was meant to suggest that "outer space offers no escape from the laws of population growth [on earth]" (Ehrlich 1968: 21; also Goldsmith et al. 1972: 18). Song elaborated this image, adding charming references to Chinese folktales and reporting the dismal results of space explorations to the moon, Mars, Venus, and Mercury: no other planetary body can support human life. He concludes:

Science has proved that there is no place for humans within this 4 light-year earth limit. Earth . . . is the only hope, a "spaceship" that has set its course around the sun. There is nowhere people can call upon around the solar system, there is no "station" where the spaceship Earth can dock in the next several hundred thousand years, there is no new land in space to which humans can migrate. (Song 1999[1980a]: 551)

This spaceship metaphor would certainly have been colorful and new in China at the time, but its rhetorical power was greater than that, for it tied the population work to space science, Song's own field and one of the most prestigious domains of knowledge. The reference would also have tied him to the great space scientist Qian Xuesen.

Scientizing—and Depoliticizing—the Club of Rome

In using the Club of Rome material Song had to exercise supreme caution, for the official ideology remained resolutely Marxian while the COR work was indubitably Malthusian. One long-term population insider in the central government explained the ideological politics of population to me this way:

In principle, after the arrest of the Gang of Four [in October 1976] ideas such as those of the Club of Rome were no longer dangerous. Indeed, top government leaders had already articulated the notion that population growth was outstripping economic resources. In practice, however, one could never be too cautious because there would also be “some people” [that is, leftists or radicals] who will have doubts about the COR. After all, Ma Yinchu had insisted that his ideas were proletarian and socialist, but he was severely criticized for being bourgeois and capitalist. In China it is officially unacceptable to support the Malthusian idea of “population absolutism” (*renkou juehui lun*), which holds that there are absolute laws of population that apply everywhere. In Marxian China, population can only be relative to the mode of production. For this reason, it was politically imperative for Song to deny that his population thought was Malthusian. Song had to say that his work was socialist and he had to clearly distance himself from the COR. (IF, 12/15/03, BJa; remarks paraphrased from interview notes)

Song protected his work from political and ideological attack in part by scientizing the ideas. He used a number of techniques to convert these ideas from “Malthusian ideology” into “international scientific truth.” These included speaking the language of numbers, stressing the truth-telling ability of statistics, underscoring the worldwide acceptance of the ideas, and stressing the language of “scientific” and “natural laws.” (Such rhetoric will be discussed in detail in a later chapter.) Although he used precisely the kinds of “masses of statistics” the Bucharest statement had decried—indeed, some of his numbers and even text were drawn directly from the COR texts—by reframing the numbers in the authoritative language of international science, he effectively domesticated and depoliticized the ideas of the COR, rendering them politically acceptable.

Song also defused the dangers by adopting specific conversational, terminological, and citational practices that removed any traces of a connection between his work and its Western Malthusian roots. First, he seems to have talked little about these issues publicly. According to one informant, in key early 1980 meetings on population policy, Song never mentioned the

Club of Rome work or the fundamentally Malthusian character of his ideas (IF,12/15/03,BJa). In discussions with me two decades later, Song maintained that he had encountered the Club of Rome work relatively late in the process, he “paid no attention to it,” and it “had little effect” on his work (IF,12/24/03,BJa). These statements are puzzling. Perhaps Song was trying to maintain a safe distance from a source that, at the time it was used, remained dangerous. Perhaps, as some Chinese suggested, he was seeking to preserve the aura of originality for his own work by denying knowledge of the Western work from which it drew. Or, more generously, perhaps in Song’s thinking, his “work” (or signal contribution) was methodological (the mathematics of population), not thematic (apocalyptic visions of environmental collapse). Or perhaps his understanding of the term “Club of Rome” just differed from that used here.

Terminological practices also worked to create distance between Song’s work and its potentially dangerous origins. In writings published in China, Song and his colleagues avoided the language of population “crises,” “catastrophes,” “explosions,” and “bombs.” In all their voluminous writings on population—including dozens of articles and two books—I found no use of these terms. The group was less restrained in speaking and writing in the West, where Malthusian views generally and population explosions specifically were more commonly accepted. In a talk given in the United States in late 1980, Song would speak of the “explosive population expansion waves” of the 1960s and 1970s (Song 1982: 385). In a 1985 book published in the United States in English, Song, Yu, and a Chinese American demographer abandoned all caution, depicting China’s population growth as an “eminent [*sic*] threat” and a “time-bomb waiting to be detonated” (Song, Tuan, and Yu 1985: 266–267). We may never know whether such language was quietly circulating in China in the late 1970s. That seems unlikely, however. Twenty-five years later key population officials readily recalled that Chen Muhua had used the phrase “explosive growth of population” in a December 1979 speech. Their recollection of the use of this relatively mild term suggests the political sensitivity of the Club language at the time. The term “population bomb,” they indicated, was forbidden or, as they put it, “not approved by China’s leaders” (IF,12/17/03,BJb; 12/24/03,BJb). Song seems to have taken the safe route of avoiding all such terms in his published Chinese-language texts.

Citational practices had the same politically distancing and protecting effect. In their work published in China, the cyberneticists liberally

cited Western work in mathematical and cybernetic demography, but they omitted citations to COR-type work. References to the two reports to the Club of Rome, Meadows et al.'s *Limits to Growth* (1972), and Mesarovic and Pestel's *Mankind at the Turning Point* (1974), appear only in the 1985 book that was published abroad (Song, Tuan, and Yu 1985). (The Chinese-language version of the same book [Song and Yu 1985] omitted these citations.) Ehrlich's *Population Bomb* is not cited anywhere in the cyberneticists' huge corpus of writings on population.

Did Song in fact have access to these materials in late 1979 and early 1980, when he was doing his most influential research? Based on interviews with government officials and researchers close to him, I believe that he did have access to at least some of the Club literature, probably acquired through his personal contacts with European scholars, but that he kept that information (as well as the materials) to himself.¹⁷ It is possible that in 1978–1980, Song got his COR-type ideas primarily from Goldsmith et al.'s *Blueprint for Survival* (1972), a text Song encountered during his 1978 trip and cited in a piece of writing dated July 1, 1980, but not published until 1982 (Song et al. 1982). The influence of *Blueprint*, which includes an introduction by Ehrlich, is clearly evident in Song's writings, which occasionally directly reproduce material from that work. (Unfortunately, plagiarism from Western works was not uncommon in China at the time.) Whether Song saw *Limits to Growth*, *Mankind at the Turning Point*, or *Population Bomb* remains uncertain. Several social scientists told me that they themselves did not see any Club texts until 1982–1983, when *Limits to Growth* was translated into Chinese.¹⁸ By that time, however, the notion of crisis was quite unexceptional—indeed, according to several informants, “sense of crisis” (*weiji gan*) had become the official construction of the population problem, precisely because Song had desensitized it by reframing it as scientific truth.

Military Metaphors: A Threat to China's National Security and Global Ambitions

Since the party's early days in Yan'an, Mao and his successors have crafted a powerful narrative of the fall and rise of the Chinese nation that has served to legitimate the political order and the party's place within it (Apter and Saich 1994; Kluver 1996). According to this narrative, the PRC, through heroic efforts of the leadership and masses, has freed itself from poverty and feudalism and will one day stand among the world's

most modernized, prosperous, and important nations. Although the story of population crisis was riveting, what gave it power and urgency in the political arena was its connections to this larger, historically developed narrative about the struggles of the Chinese nation to gain wealth, power, and position on the global stage. In creating those connections, Song appears to have drawn on an unusual source: strategic defense doctrine.

In framing their concerns about population and the environment, the scientists advanced two larger theses that closely paralleled arguments long used in the defense community to justify large expenditures on strategic weaponry. In the population domain, however, the enemy was not external, but internal: the Chinese people themselves. In the first thesis, China's impending population explosion was depicted as a threat to national security and even survival, for by degrading the nation's ecosystem, population growth would eventually destroy the resources necessary to sustain human life (Song 1999[1980a]; Song 1981). This first thesis drew heavily on the catastrophic framings of the Club of Rome, but its language of threats to national security would have come easily to scientists accustomed to making the case for military resources in such terms.

A second thesis appears to have been directly modeled on a doctrine that lay at the heart of military thinking. As Feigenbaum has shown, during the Mao era China's military scientists had developed and successfully promoted a unique doctrine of techno-nationalism that framed the acquisition of atomic bombs and nuclear missiles as strategic matters affecting not just China's security, but also its military and economic competitiveness, standing, and power in the world (2003: 13–68). Realizing China's destiny as a great power was a burning desire of Mao and many other leaders of the Chinese revolution. As noted in chapter 3, in mid-1978 Li Xiannian had told the new Birth Planning Leading Group that birth planning was a "strategic issue" that affected the nation's prosperity, wealth, and power. The Liu group had elaborated that notion, providing empirical evidence that population was a source of China's backwardness and failure to achieve its rightful place in the world. In early 1980, Song would give that term a new, quasi-military cast by suggesting that China's population growth constituted a threat to the world and, in turn, China's standing in the global community.¹⁹ The larger argument, pieced together from several sources, ran as follows. As the world's most populous and a still fast-growing country, China was the single greatest contributor to the explosive rates of global population growth that were threatening human survival by destroying the world's

environment (e.g., Song 1999[1980a], 1982). If China's population growth continued unchecked, it would not only undermine the Four Modernizations, keeping China from catching up with the advanced nations and regaining its proper place among the world's powers. It would also damage China's international reputation, as the explosion of Chinese numbers worsened the state of the world at large. This is not what an ambitious nation seeking acceptance by the world community wanted. By arresting the fierce growth of its human numbers, China could accelerate its own modernization and at the same time help to alleviate a global crisis. From a shameful contributor to the world's problems, China would become a proud solver of those problems. Through population control, then, China would join the world's powers as an economic powerhouse and a socially responsible, morally commendable member of the world community of nations. Compared to the social scientific construction of population as a problem of imbalance in domestic development resources, these new, almost militaristic framings of population as problems of national survival and global position both raised the stakes involved in gaining control over population growth and intensified the sense of urgency surrounding that project.

In drawing attention to the human constructedness of the crisis story, I am not suggesting that China had no population crisis. A crisis of human numbers was both real *and* constructed. My aim in emphasizing its human making is to underscore the historical contingency of the crisis story. Created from two unusual sources, that story bore the traces of the particular time in which it was made and of the particular specialists who made it. The historical specificity of the story is worth remembering because the messy, humanly shaped, empirically weakly verified account of demographic crisis would become an "international scientific truth" about the fundamental cause of China's backwardness. The constructedness of the story is also important because the problematic procedures by which it was created were veiled in the powerful language of numbers and facts and, in this way, closed to scrutiny. The population crisis story would have powerful effects, in part because it quietly built on the story of economic imbalance. The social scientists had laid the political groundwork by purveying a pedagogy of numbers—a new way of thinking through population problems in numbers—that factified the leaders' account of population growth harming the nation's economic recovery. The crisis story would not replace the economic story, but come to envelop it in a much more urgent account of temporal and spatial disaster facing

the Chinese nation as it sought to emerge as a global power. But I am getting ahead of myself.

THE SCIENTIFIC SOLUTION: ONE CHILD FOR ALL,
BEGINNING IMMEDIATELY

Once the problem was defined as a population-environment crisis, the solution could only be a drastic one, for now the survival of China's ecosystem, and, in turn, the economic security and global ascent of the Chinese nation, hung in the balance. But what kind of policy solution was needed? By reducing population to a few simple biological variables (births, deaths, age structure, and so on) unaffected by social, cultural, and political entanglements, the natural scientists were able to apply mathematical methods and new computer technologies to a subject that had been treated in qualitative or only simple statistical terms. *Mathematization*—the use of scientific procedures that work to attribute mathematical order to natural objects and relationships—was a powerful device. This procedure was more powerful than mere quantification because it placed nature within a theoretical domain of pure structure and universal reason. Through mathematization, population became subject to a “higher order” of logic (Lynch 1990). In this section I examine which mathematical techniques were applied and with what consequences for the policy solution. In the next part of the book we see how those practices achieved their political effect.

In 1978–1979, the Song group used the COR's notion of an “optimal population” determined by its environmental “carrying capacity,” as well as control theory, to perform two crucial sets of calculations. In the first they determined the future ideal or target population to serve as the objective of population policy. The control or optimization problem was to determine the best fertility trajectory by which to reach that long-term goal, given specific constraints. As part of that work, the researchers projected future population growth under different fertility assumptions. On these bases, they then formulated the quantitative goals of population policy for recommendation to the nation's decision makers. Their quantitative research showed that “the only solution” was a policy to encourage all couples to have one child beginning immediately, regardless of the costs to individuals and society.

The engineering model in *The Limits to Growth* that is shown in figure 4 vividly captures the type of thinking that was carried to China—and that

found its ideal application in the one-child policy. Population processes and their various causes and consequences can be found in the upper left-hand portion of the figure. Although the Chinese scientists may not have seen this particular figure, they stressed in interviews that their defense engineering concept of “systems management” was virtually identical to the systems engineering models of the COR such as that depicted here (IF, 12/21/03, BJ).

The Optimal Population: 650–700 Million

Analytically, the first step was to establish the size of an “optimal” population for one hundred years in the future. Determining the future target population was the crux of the whole problem, “the crucial topic of the theory of population control,” for without a numerical target, the authors pointed out, there was no “rational,” scientific basis for any particular population policy (Song, Tuan, and Yu 1985: 214). In ascertaining the size of such an optimal population one hundred years in the future, the Song group used the conditions of the “modern” countries as their goal and guide. Considering the “ideal” levels of economic development, food resources and diet, and ecological balance and fresh water resources, the scholars determined that the most desirable population in 2080 would be between 630 and 650 million (on economic grounds), 680 million (on the basis of food resources), and from 650 to 700 million (in terms of ecological balance). Rounding off, they concluded that the ideal future population was 650 to 700 million, roughly two-thirds of China’s 1980 population (Song 1981: 28–30; Song and Yu 1985; Song, Tuan, and Yu 1985: 213–285).²⁰ This low target would have far-reaching implications, for it suggested that China had already exceeded its “carrying capacity,” that below-replacement fertility was imperative to achieve sustainability, and that the longer China waited for fertility to decline, the more environmental and economic damage it would sustain.

Although these calculations were presented as objective scientific exercises, inevitably the researchers’ calculative practices would bear traces of their disciplinary training as well as the political context of early post-Mao China. For example, the decision to base the calculation of the optimal population only on material factors such as economic development and environmental stability reflected the authors’ training in a highly mathematical science that treated people as biological organisms. Here the Chinese scientists followed their European mentors. The choice of the developed countries as the standard or model countries

reflected PRC leaders' aspirations for China to develop quickly into a global power. Both choices were of course defensible, but they made a big and unacknowledged difference to the outcomes. For example, the scientists argued that for the Chinese people to be well nourished, their per capita daily protein consumption should rise from the current level of 56 grams to the 85 grams common in the diet of "industrially and agriculturally developed countries." The proportion of animal protein in the diet should grow from its very low current level to the 70 to 80 percent level seen in the French and American diets (Song 1981: 29). Given the constraints on China's agricultural development, achieving such large changes in the Chinese diet would necessitate large shrinkages in the population. The choice of standard countries thus led to the conclusion that a major reduction in population size was technically necessary. Similarly, the exclusion of social and cultural desiderata, such as preferences for several children or family arrangements that made sons essential to family survival, led to a target population that was much smaller than it would have been had such factors been built into the model. The neglect of broad modernizing changes—in public policies, child values, family structures, and so forth—that had promoted fertility decline in the West and would surely have the same effect in China biased the forecasts of population growth sharply upward.

Detailed descriptions of the calculations underlying the estimates of the optimal population, published later (Song, Tuan, and Yu 1985; Song and Sun 1981), reveal a set of highly complex exercises involving consideration of dozens of factors and the experiences of numerous countries. Despite the rhetoric of scientific accuracy, the results might best be described as highly precise—yet highly inaccurate. For, despite their efforts to locate the necessary data, the Chinese researchers suffered from the same problem that plagued their European counterparts: the complex economic, ecological, social, and demographic data needed for their calculations simply were not available. As late as 1985, the authors acknowledged that "we are greatly constrained by [the un]availability of data" (Song, Tuan, and Yu 1985: 248). Moreover, the whole project of estimating the growth rates of dozens of indexes for each decade for the next one hundred years necessarily entailed making countless heroic assumptions about relationships between variables on the basis of little more than educated guesswork. Like the COR models, the Chinese work thus represented a kind of measurement without data, leading to the appearance of precise knowledge of quantities and relationships that were in fact unknown. Although the researchers inserted brief caveats in

the methodological sections of their scientific writings (e.g., Song, Tuan, and Yu 1985: 214), they treated the limitations as technical problems, to be noted in passing as methodological concerns. As with the Club models, the results were highly sensitive to the assumptions and data that underlay them. Yet nowhere did the Chinese scientists work out what substantive difference it might make to their conclusions if 10 percent or 40 percent or 70 percent of their estimates were far off the mark. And such caveats disappeared in discussions of the results. Exhibiting the kind of bold (over)confidence noted by the critics of the Club of Rome, the results were invariably presented as scientific and correct. What was lost from consideration was the huge difference it would make to population policy whether the target was 700 million, 900 million, 1.1 billion, or some other figure. Given the flimsiness of its empirical foundations, to a Club critic the Chinese work might well have appeared highly problematic if not actually meaningless.

Projecting Population: Huge Numbers Ahead

The next step was to perform a series of projections of population growth one hundred years into the future to determine the *current* population policy that would produce that *future* optimal number. Using methods that were unnecessarily complicated, though by no means wrong, Song and his colleagues developed a mathematical model in which the initial conditions and key parameters (in particular, fertility pattern, mortality function, age structure, and sex-ratio function) were given, and the control variable (the one that was altered) was the total fertility rate (TFR).²¹ The results were striking. They showed that if fertility remained at recent or present levels of 2.3 or 2.0 children per woman, China's population would top 1.8 billion and 1.6 billion, respectively, in the next hundred years, greatly exceeding the ideal size. Yet if fertility were lowered to 1.5, the population would grow to 770 million, very close to their ideal. At 1.0, it would sink to 370 million, half the target level. (So, readers may wonder, why a one-child policy? Keep reading for the answer.)

These results would be presented as scientific truths but, given the research climate at the time, the science behind them would necessarily be limited. Today most demographers consider such long-range projections essentially meaningless, especially when unaccompanied by discussion of the range of uncertainty, since population growth in the distant future is affected by a large number of unpredictable factors (Cohen 1995:

109–110; Bongaarts and Bulatao 2000: 188–195). These particular projections were more problematic than most, given the absence of reliable demographic data for the country as a whole (though even better data would have shown the same general upward trend). In a 1999 interview, one member of the group described how they managed the fact that, as he put it, “there were no [good] input data” (*meiyou shuju*): they pulled together numbers from various urban and rural local studies that they deemed relatively typical and reliable as well as some 1975 and 1978 data from the Public Security Bureau. The data were “difficult” (*kunnan*) but, they felt, “workable” or “reliable enough to use” (*kao de zhu*) (IF,11/16/99,BJa). The Chinese scientists were doing what all scientists faced with data limitations do: they improvised, making the most of what was available. Moreover, at a time when large-scale statistics were first becoming available after a data dearth of two decades, the feeling was that some numbers, whatever their flaws, were better than none.

In some of their scientific publications, the authors noted that the accuracy of the projections depended on the accuracy of the input data. Yet they presented their results without discussion of the extent or direction of possible inaccuracies. Following conventional practice at the time, when most national statistics were still deemed state secrets, they were also reticent about the sources and characteristics of their input data. Perhaps because political limits made it impossible, they provided no information on what organization conducted the survey, how the samples were drawn, or whether the data were adjusted for factors such as age structure. When their work appeared in the popular media or in reports for government officials, all caveats disappeared. In those important sites, the authors represented their results as accurate, beyond question, and, most important, sound, scientific bases for policymaking. The result, of course, was to remove issues such as data limitations from consideration.

The Optimal Policy: Rapid and Universal One-Childization

In devising the policy solution to the problem, Song and his colleagues (especially Yu) turned to the cybernetic techniques of optimal control whose use Song had pioneered in the development of missile guidance systems. From a mathematical point of view, missile control techniques lent themselves readily to population control problems, because the trajectories of missiles and populations charted over time followed similar

lines and because the optimization problems for controlling the two objects took functionally similar forms.²² In missile control science, the optimization problem is to determine the shortest time in which a missile can reach a particular target at a given range. Following the lead of the Dutch scientists Olsder and Kwakernaak, Song and Yu posed the optimization problem for population as finding the best fertility trajectory (number of children per woman in each time period) that would produce a future ideal population target, given certain constraints (Kwakernaak 1977; Olsder and Strijbos 1976). Although different parameters (missile velocity, position, and thrust, as opposed to population density, death rate, and migration rate) produced somewhat different models, the mathematics of partial differential equations used in the two cases was virtually identical. In an interview, Song stressed the relative ease of the conversion. Because of their familiarity with the equations, he recalled, his team was able to finish the work quickly, perhaps in as little as one week (IF,12/24/03,BJa). Another Chinese control theorist who performed similar exercises using difference rather than differential equations assured me that population math was much less complex than missile math: while missile control required about seventy equations, population control required only ten (IF,12/16/03,BJc).

The straightforwardness of the task was due in part to the relegation of social and political questions to the margins and to the adoption of highly simplifying assumptions or model constraints. These two features of the scientists' work, common to all optimal control models, had clear precedents in the Dutch work. For example the Chinese scientists' lack of concern with questions of implementation and social costs was shared by the European control theorists, who explicitly placed these issues off their agenda (e.g., Kwakernaak 1977: 375; Olsder and Strijbos 1976: 722). The simplifying assumptions were also drawn from the Dutch work, but in this case the Chinese researchers significantly adapted the model constraints to fit their technocratic views of the proper balance of power in the political context of the PRC.

Kwakernaak's calculations for the Netherlands took two constraints into consideration: an economic constraint, by which the dependency burden (the number of old and young dependents supported by the working-age population) would be prevented from becoming too heavy, and a sociopsychological constraint, by which the speed and extent of fertility decline would be prevented from exceeding socially acceptable limits. Song and his colleagues considered the age constraint, but gave

the psychosocial constraint little weight (on the age constraint, see Song, Tuan, and Yu 1985: 251–252). “If social customs and psychological conditions are considered,” they wrote, “[i]t may not be possible for [the TFR] to go less than 1, because it is hardly acceptable to the Chinese not to bear any children at all” (p. 251). Beyond this consideration for the absolute minimum they arbitrarily assumed the Chinese people would tolerate, they gave scant attention to the actual fertility preferences of the people. Instead, the authors argued that women’s fertility could be planned (that is, controlled at any level scientists and party leaders felt desirable) “due to [the PRC’s] unique social systems” (p. 249). Although they did not elaborate, clearly what this meant was that the masses’ preferences could be altered through party propaganda and education (or, if that failed, force), a fundamental political presumption since the rise to power of the CCP and, of course, a core tenet of the Leninist theory of the party as the leading force in society. What was new in the Song group’s proposal was the technocratic assumption that the party’s policy should now be shaped by technoscientific experts, producing a political realignment in which the people’s reproductive preferences would be bent to the scientist-planner’s will. Whereas the Dutch researchers suggested reducing fertility by 40 percent over the relatively long stretch of forty years, using different assumptions the Chinese scientists proposed reducing fertility by well over 50 percent (from 2.3 to 1) in a mere five years. The techno-political assumptions built into the model would make a big difference to the policy outcome.

In sinifying the European work, the Chinese scholars made another consequential alteration as well. The proposal to shrink the Chinese population by one-third drew inspiration from British and Dutch research suggesting the desirability of reducing those nations’ populations by 45 percent and 63 percent, respectively (Goldsmith et al. 1972: 46; Kwakernaak 1977: 359). In the European work, however, the notion of radically shrinking these national populations was but a heuristic device for thinking through policy options. When it was transported to China, what had been merely a *scientific exercise* in Europe was transformed into a *concrete policy proposal* for use on a real population—a different prospect altogether. Although social science critiques of such plans would have alerted people to the dangers in both cases, in the European case their significance would have been largely academic. In the PRC case, such critiques would have had real-world political, social, and ultimately bodily significance of a most profound sort. Song’s readers could not have known about this fundamental modification of the

European work—and he did not tell them. Given their emphasis on pragmatic adaptation of international science, China's policy makers might not have cared in any case.

The mathematics of optimization produced a striking policy proposal. The math showed that, given the conditions just discussed, the “optimal” trajectory was to rapidly reduce fertility to one child, so that by 1985 all couples would have but one; maintain fertility at that level for the next twenty to forty years; and then gradually raise it to replacement level of 2.1 children per woman. The solution was, in the Song group's term, rapid one-childization (*yitaihua*) countrywide (Song 1999[1980a]; Song et al. 1982). The idea of pushing people's childbearing up and down like a lever in a machine might strike readers as strange or disturbing. Yet it followed logically from the treatment of fertility as a “control variable” that scientists can manipulate at will. As Olsder and Strijbos put it, “Given a certain initial age profile the population must be ‘steered’ as quickly as possible to another . . . by means of a suitable chosen birth rate” (1976: 722; Song, Tuan, and Yu 1985: 12). In applying a mechanistic model to human beings, the Chinese researchers were simply following the lead of their European predecessors. With its language of modern science and human progress, the European work must have made the quite radical policy proposals just described not only thinkable, but also reasonable, scientifically respectable, and even progressive. Later the Song team would strongly and consistently present their proposals as scientific and progressive because evidently they believed that they were.

As physical scientists and engineers, the Song team did not fully appreciate the vulnerability of their object of control, population, to complex sociocultural and political-economic influences. Perhaps they simply were not interested in such matters; both Song and Yu indicated that what intrigued them was the mathematics of population (IF, 12/21/03, BJ; 12/24/03, BJa). Nevertheless, the issue of enforcement was an essential part of policy analysis. Although they were working in an unfamiliar field, the scientists did not reach out to the social science community for help in seriously grasping and incorporating social dynamics into their models. To be sure, they included the economist Tian Xueyuan in their group, but that was a largely token gesture that did not alter the cybernetic science. Instead, in a bold move of natural-scientific imperialism, the military scientists redefined population as a biological object belonging to their empirical domain, nature, and extolled the language

of natural science, mathematics, as the infallible producer of precise and accurate truths (e.g., Song 1999[1980a]; Song and Li 1980[1979]). By defining population as a biological entity whose main features could be captured in a few vital rates, the scientists could construe messy, hard-to-quantify forces such as peasant reproductive culture, social structure, and politics as peripheral matters that did not alter the essential conclusions reached by the mathematics of control theory. By defining questions of the enforcement and human costs of their preferred policy as external to the science of population control, the military scientists were able to promote a radical policy of one child for all as the best and only scientific solution to the problem. These procedures—redefining the object of interest, reducing the variables of concern, using mathematics to predict human behavior—were of course all legitimate scientific operations. But they were not good routes to making social policy, for in the real world of Chinese society the messy stuff of peasant economics, son hunger, and political struggle were certain to impinge to mar the implementation of the mathematically perfect solution.

In the earliest presentations of the scientific results, the scientists described the one-child-for-all policy as “the most ideal scheme” or “the most effective solution.” This best-choice discourse, however, was soon transformed into an “only choice” discourse, again in the name of science. Although the source of the phrase is impossible to pinpoint (indeed, the phrase may well have multiple origins), strikingly similar phrases were used in the world-in-crisis work of the Club of Rome. In *Blueprint for Survival*, the editors of *The Ecologist* warned that mankind faced a choice between two outcomes: “a succession of famines, epidemics, social crisis and wars” or “a succession of thoughtful, humane and measured changes” (Goldsmith et al. 1972: 3). As noted earlier, Song Jian was familiar with this text, for he cited it in several papers. The authors of the first report to the Club of Rome (*The Limits to Growth*) saw “no other avenue to survival” (Meadows et al. 1972: 199). Chapter 9 of the second report to the Club of Rome (*Mankind at the Turning Point*), titled “The Only Feasible Solution,” used catastrophic rhetoric similar to that deployed in the policy recommendations of the Song group (Mesarovic and Pestel 1974: 114). Whatever the source(s) of the phrase, its use would spread rapidly. The notion that a one-for-all policy was “the only way” or that there was “only one choice” would do a lot of political work, as we shall see in the next part of the book.

Implied Enforcement Strategy: A “Big Push” from the Top

Although the Song group defined enforcement as external to their research, both by proposing a radical policy and by remaining silent about how it would be carried out, their work had indirect implications for enforcement. Song’s background in defense science may be relevant here. Song had devoted his career to working on huge, complex, and costly weapons projects that not only served statist ends, but also required state-centric solutions. In an atmosphere of urgent threat to China’s national security, many of those projects were pursued with a “big-push” thrust that entailed total leadership commitment and massive mobilization of the nation’s resources (Frieman 1989: 265; Feigenbaum 2003: 139–140). Song himself was a proponent of big-push approaches to weapons development (Frieman 1989: 284).

The one-child-for-all policy both assumed and required the use of big-push, top-down approaches in the social domain. In the late 1970s, China’s social scientists and population policy makers knew that a one-child family was an impossible demand in the countryside. Abundant research had shown that the organization of rural socioeconomic life and entrenched gender values made at least two children and one son vital to peasant security and even survival (Li Xiuzhen 1980[1979]: 5). Given the large gap separating state demands from peasant desires, a gap that was growing with the spread of rural reform, reaching the one-child-per-couple goal would require a big push from the top, a full mobilization of party and state resources, and complete commitment by leaders at all levels. Campaigns were nothing new in the birth sector—they had been the major mode of enforcing birth policy from the early 1970s. Yet a one-child policy would take the big-push strategy to a new level. Instead of attending to mass views, as required by the party’s mass line, such a policy would require overriding them. Instead of prohibiting coercion, a rule honored in theory if not always in practice during previous decades, the use of coercion would have to be quietly accepted “in the interests of achieving greater goals.” Finally, because of the difficulty of reaching this new goal and the urgency of doing so, the one-child policy would demand an even greater leadership commitment than had been required by the later-longer-fewer policy of the 1970s. Though the scientists did not directly call for a big push on the enforcement front, the tone of urgency with which they pushed their solution—a tone that was also prominent in the work of Goldsmith and other Club writers—made it clear that nothing short of a massive effort would solve the problem.²³

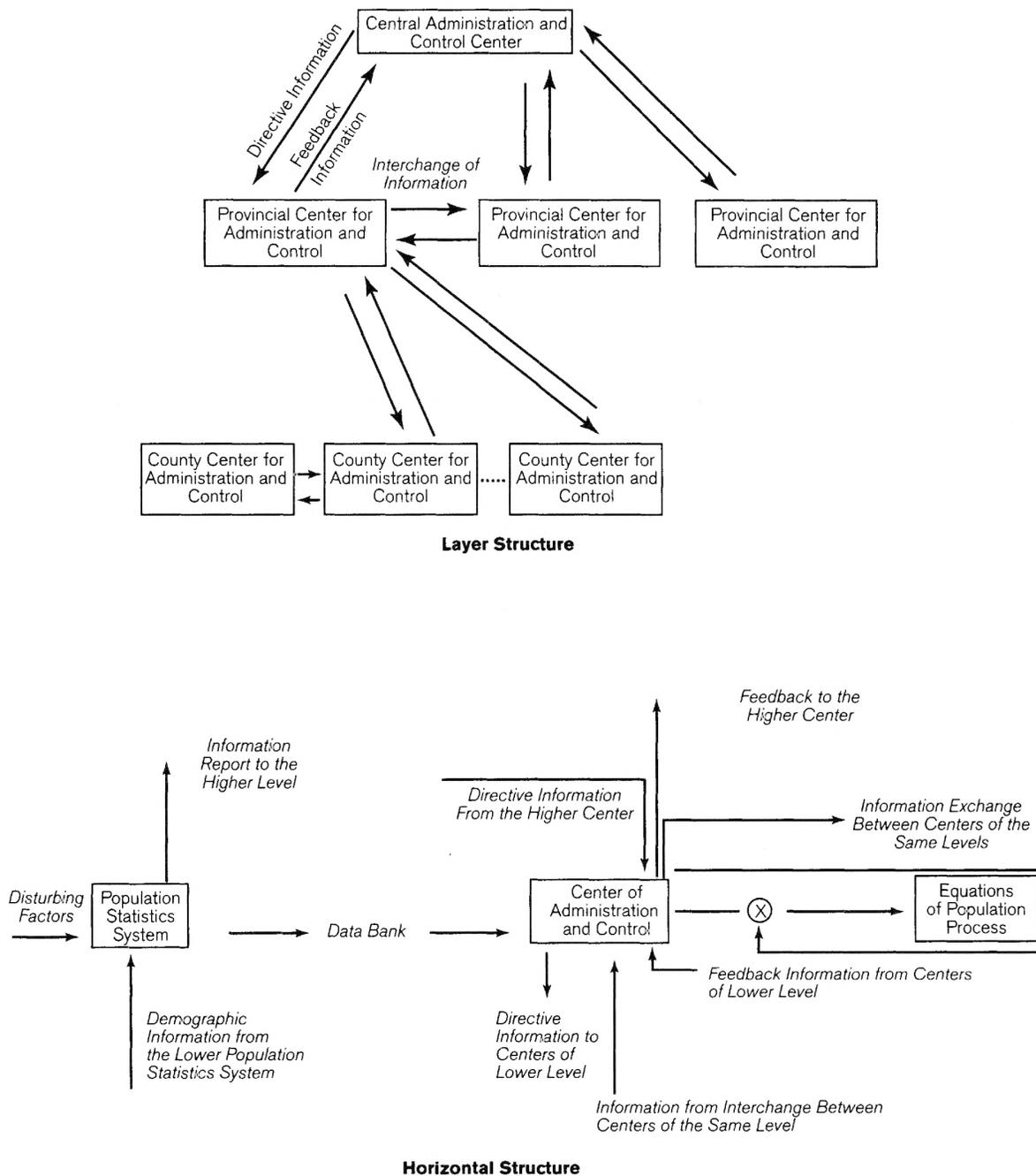


Figure 5. Model of a large population control system (Song, Tuan, and Yu 1985: 30-31).

Such an approach could best be carried out by a nationwide system of planning and target setting centered in the state. Here Song's contribution was more explicit, for his group articulated a new vision of such an apparatus and an ambition to turn it into reality. In their writings Song and his colleagues laid out their ideal image of a birth planning technocracy in which technicians in the state were in charge of designing and running a multilevel system of social engineering aimed at

managing the growth of the entire population from the top, with little input from the objects of control at the bottom (e.g., Song and Li 1979; Song, Tuan, and Yu 1985: 29–32). Figure 5 displays their version of that stratified structure of administration, coordination, and control. I return to this technocratic vision—and its significance—at the end of the next chapter.