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Review essay

Want not, waste not: The environmental impact of two generations of WMD proliferation and the implications for Asia

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Abstract. Over the past fifty years the development and testing of weapons of mass destruction (WMD) have caused tremendous environmental, health and social damage to various parts of the planet. Six books dealing with various aspects of WMD are reviewed here, with the goal of broader conclusions about the relationships between political systems, culture, and environment. The requirements of local culture have strongly influenced decisions to acquire WMD, and the manners in which these weapons have been developed, tested and used. The Former Soviet Union is highlighted, since in that closed society WMD development and testing have been especially devastating. States considering WMD must be made aware of the true costs, and non-proliferation thinking must therefore include deep sensitivity to not only political decision-making, but local culture. Suggestions are offered about how an "anthropology of WMD" might contribute to non-proliferation.

Arjun Makhijani, Howard Hu, and Katherine Yih, editors, *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects*, (Cambridge, MA, MIT Press, 1995).

Nikolai N. Egorov, Vladimir M. Novikov, Frank L. Parker, and Victor K. Popov, editors, *The Radiation Legacy of the Soviet Nuclear Complex*, (London, Earthscan, 2000).

Sir Frederick Warner and René J.C. Kirchmann, editors, *Nuclear Test Explosions, Environmental and Human Impacts*, (New York, John Wiley and Sons, 1999).

Russell J. Dalton, Paula Garb, Nicholas Lovrich, John C. Pierce, and John M. Whiteley, editors, *Critical Masses: Citizens, Nuclear Weapon Production, and Environmental Destruction in the United States and Russia*, (Cambridge, MA, MIT Press, 1999).

Itty Abraham, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State*, (London, Zed Books, 1998).

Avner Cohen, *Israel and the Bomb*, (New York, Columbia University Press, 1998).

Introduction

> On February 9th 1996, an R-5M rocket was launched from the Kapustin Yar missile test site in the Astrakhan area and flew unnoticed high above thousands of sleeping Kazakhs carrying a live nuclear warhead. Fortunately, the test was a success: the missile stayed on course, landing precisely on target among the sand dunes of the Karakorum desert in Central Asia. It safely discharged its nuclear load, prompting great celebrations among the designers and scientists responsible for the project.
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> It was largely the brainchild of a legendary rocket scientist, Yefim Slavsky, who was under orders to upgrade the R2 (range of 550 km) and R5 (1200 km) because they had proved to be unreliable carriers for the new nuclear super weapon. Sergei Korolov, later head of the Energiya Design Bureau, designed the R-5M especially for a nuclear warhead. The missile performed successfully in testing throughout 1955, hitting its target 21 times out of 24. All that remained was to test it with live ammunition. The February 1956 test was designed to simulate an 80 kT weapon but with an actual yield of only 0.3 kT. However, this would have been a disaster if the rocket had landed on a populated area. So if there were any sign that it was deviating from its course, the tracking service in the Kapustin Yar bunker was given the password "Ayvengo!" which would initiate immediate detonation in the air. In the event it was not needed and the desert target area was enclosed in barbed wire until radioactivity had decayed to safe levels.[1]

What is the connection between modern political systems and how they treat their environments? How do different parts of societies contribute to debates over weapons of mass destruction (WMD)? What are the implications of past and present WMD production for defining criminal behavior and for local and international law? How can citizens and policy-makers in all parts of the world understand the environmental problems created by the production of WMD to inform decision-making about national and international priorities? And what is the role of culture in conditioning responses to nuclear weapons and nuclear waste?

As usual, the past is prologue, but in unexpected ways. As a variety of states rush forward to embrace WMD, the dystopian experiences of the two major Cold War powers with the environmental consequences of their production may now be reviewed to hint of problems to come. In the Middle East and South Asia, in particular, any number of states possess, have sought in the past, or are seeking WMD. A broad swath of the Old World that saw the first agriculture, the first cities, and the first empires, is at the forefront of the next wave of proliferation. How future regimes will deal with the environmental and political consequences of WMD production or aspirations are anticipated

by the variety of paths taken by the first generation of nuclear proliferators, primarily the United States and former Soviet Union (FSU), and the second generation, including India and Israel.

As the volumes discussed below demonstrate, our understanding of many hidden dimensions of the Cold War has improved immensely. The Cold War was the context in which WMD production became a vast component of world industry. Solving the environmental problems it created will be an international undertaking, the extent and nature of which is only now becoming clear. But nuclear war has always been among the subjects which defies a dispassionate viewpoint. As the volumes discussed below demonstrate, a variety of contrasting expectations, languages, and concerns prevail, which are nonetheless politically and economically articulated with one another.

Culture has always been a part of historical approaches, if only implicitly, in terms of interactions of personal, institutional, and social dynamics unique to particular societies and situations. But it is finally being incorporated explicitly into analyses of international relations, complementing existing liberal and neo-realist approaches, for example in recent discussions of the "strategic personalities" of nuclear proliferators.[2] A similar evolution is taking place in security studies with respect to the environment. This ranges from the enhanced role played by the military in addressing its own and other threatening environmental problems, environmental causes of ethnic, national, and regional instability, and redefinitions of "security" to encompass various global and human concerns. In all these approaches, the sovereign position of the state as the beginning and ending point for security is being confronted.[3] Culture, security, and environment have not, however, coalesced fully, as continuing resistance to incorporating the environmental consequences into nonproliferation arguments has shown.[4] As the discussion below will suggest, an appreciation of the entire lifecycle of WMD materials must be complemented not only with cultural perspectives regarding their generation but also attitudes toward their potential use, and eventual disposal.

Culture has numerous definitions, and for purposes of this review it is sufficient to say that culture comprises integrated patterns of belief, behavior, and knowledge, transmitted by learning.[5] Because culture is polythetic it can have local, strategic, political, environmental, and institutional dimensions. Together, these provide a useful framework, admittedly diffuse, to discuss how nuclear weapons and waste were created, understood, and ultimately disposed of and safeguarded.

In the West, public, political, academic, and scientific cultures have never been in synch about WMD, especially nuclear weapons. Political economy, professionalization and compartmentalized education, and the climates of secrecy and fear (which remain even today), have all contributed to a break-

down in dialogue over WMD. A simplistic formulation is that scientists serve state institutions or its political economy, and in turn support state agendas, while academics participate from many sides and with different analytical frameworks. Finally, the public obtains heavily refracted information from the state, the academy, and from science, and holds attitudes ranging from awe to disdain toward all these subcultures. Contradictory expectations and modes of communication obviously prevail in democracies, while fear, secrecy, and compartmentalization have structured totalitarian states. These latter features are obviously present in democracies as well. All contribute to the fundamental contradiction between the values of democracy and the grave responsibilities of elites responsible for nuclear weapons.[6] In this clash of sometimes mutually incomprehensible and perhaps irresolvable narratives, the environment has been among the most deeply wounded.

Cultural disparities – In addition to the obvious constraints of superpower competition and secrecy – have contributed to the difficulties establishing a social consensus on WMD. In the aftermath of the Cold War gaps between communities in both West and East have closed but the volumes discussed below still echo the cacophony that arose during the anti-nuclear protests of the 1960's and later. In particular, as the cases of India and Israel show, cultural needs and languages from outside the neo-realist framework of security and deterrence have long taken precedence. In all these situations, environmental concerns have been relegated to the sidelines. Without understanding various cultures of WMD, scientific, political, military, ethnonationalist, postcolonial, and so on, no consensus on even the most pressing environmental issues will emerge.

Apostates and disciples of nuclear energy

Physicians have long been at the forefront of opposition to WMD. *Nuclear Wastelands* provides a useful and accessible overview of nuclear history and health issues. Published originally in 1995 by the International Physicians for the Prevention of Nuclear War, the volume has been reissued in paperback and updated. There are excellent discussions of the fundamentals of nuclear weapons and the life cycle of nuclear materials from the extraction of raw materials, to the fabrication, deployment, and dismantling of weapons.[7] The risks of contamination are discussed for each stage, as are the health effects of radiation, from the genetic to epidemiological levels. The military and civilian nuclear industries of the West and the FSU are also reviewed, with particular attention to major weapons complexes. The somewhat more brief discussions

of Chinese and French nuclear programs are especially welcome, since these have received far less attention than those of the US and FSU.[8] The sections on India, Pakistan, North Korea, Argentina, Brazil, Israel, and Iraq require much more updating and are weakened by a simplistic view on the causes of proliferation. Overall, however, the volume is a useful complement to the standard histories of the American and Soviet nuclear programs, such as those by Richard Rhodes, Stephen Schwartz, David Holloway, and Thomas Cochran et al.[9] It is a successful primer which deserves wide attention.

But ultimately the volume's effectiveness is severely diminished by occasional lapses into emotionalism and moralistic interpretations of the Cold War. As might perhaps be expected from physicians and public health specialists, diagnosis leads to prescription, as analyses and advocacy are conflated, but the results are unfortunate. The authors are generally unwilling to acknowledge that there was uncertainty in the past regarding radiation dosages (see below), much less contradictory geo-political issues that influenced official decision-making for the worse. But regarding all nuclear activities everywhere as a giant Tuskegee experiment by evil governments and their amoral scientist lackeys explains nothing. The disregard of historical context is the single overriding, almost deliberate, flaw of *Nuclear Wastelands*.

Not all nuclear experiences were or are morally equivalent in design or execution, although the West encroached dangerously into a gray area, and perhaps beyond. It is undeniable that difficult, even callous, choices were made in the past by the US and its allies in the development of WMD. Secrecy and lies, inadvertent and deliberate ignorance, racism and chauvinism, all were ample supply, and the effects on health and democracy were profound. The authors of *Nuclear Wastelands* are entirely correct in stating that the American WMD complex had the ironic effect of damaging those which it was designed to protect. But the Soviet experience is wholly different in qualitative – and moral – terms. Stalin, Beria, and their legions of prison laborers created a WMD complex to protect first and foremost their totalitarian regime and its ideology. The willingness, indeed, eagerness, to make active sacrifices – in human terms – as a cost of doing business distinguishes the Soviets from the American approach. The attitudes of the American defense and nuclear establishments were a disturbing blend of arrogance and ignorance, sometimes deliberate, about the environmental, health, and political consequences of WMD development. They dominated society for decades, but at the same time opposing voices did exist. The same cannot be said for the Soviet Union. Even the belated acknowledgment of responsibility and assumption of liability by the U.S. Government for human radiation experiments has no parallel in the FSU. There can be no excuses for American abuses, and the the issue of human experimentation and national security is yet another dimension of the

the contradiction between democracy and stewardship of WMD. But at the same time, there is no moral equivalency between the historical experiences of the United States and the Soviet Union.[10]

While to physicians it may not seem there is much difference between killing people softly through ill-conceived medical experiments and slaughtering them wholesale in the gulag, historians and policy-makers must see these as wholly different. As a growing literature, including the volumes reviewed below, make clear, the environmental destruction in the FSU dwarfs that in the United States. The speed, scale, and intent of Soviet environmental destruction place it further in a unique category, shared perhaps only by parts of Eastern Europe and China.[11] While environmental problems today are overwhelmingly conditioned by economic factors, the roots of Soviet and Russian attitudes towards the environment stand at the problematic intersection of culture and ideology, especially Marxism-Leninism, and economic development.[12] In Marxist-Leninist ideology nature was seen as providing virtually limitless resources to the coaxings of technology, a meeting of modernist, evolutionary expectations and romantic notions of the soil. Nature could be remade, the courses of rivers reversed, but the vastness and beauty of nature was such that it provided an infinite reservoir. The attitude of capitalism toward nature is equally complex and no less imbued with contradiction, perpetual low-intensity conflict between dominion and stewardship.[13] But these are modern and atypical examples: societies across Asia, in their religious, ethnic, and even national senses, have been developing attitudes toward nature for, in some cases, millennia. A simple, modernist (and vaguely imperialist and condescending) prescription, WMD and wastes are bad, will not suffice.

What are the implications for the next generations of nuclear proliferators? Part of the equation concerns varying cultural attitudes toward nature, the environmental, and waste. Another is that new and threshold nuclear states operate within the international order and have cadres of scientists and technicians at least partially trained in the West. They are therefore members of an international physics and engineering community, with growing awareness of ecological issues, but one very different than that of physicians. And they are also controlled by political leadership confronted by all manner of other ecological problems. New environmental sins are therefore of commission rather than omission. In the globalization of nuclear weapons, states have frequently been willing to impoverish the present and pollute the future, but also, as Brazil, Argentina and South Africa have shown, to unilaterally dismantle nuclear programs.[14] The ideological and cultural justifications for the production of nuclear weapons and their environmental consequences in next generation proliferators are not simply part of cost-benefit analyses, but a

complex interplay between cultures, local and international, technical and political, traditional and modern, and so on. This is in part the premise of the "New Environmental Paradigm" (see below), but as will be shown, that paradigm privileges economics over culture.

Physicists are another breed altogether. The international culture of physics which prevailed during the 1920's and 1930's was co-opted by the state during the Cold War but never entirely disappeared. It might be argued that the internationalism which prevails today is a function of American domination of higher education and big science. This dimension of American neo-imperialism deserves separate study.

The volume edited by Egorov et al. is in many respects exemplary of the new levels of cooperation and openness which characterize scientific inquiries into WMD, and which, it may be hoped (however faintly), inform policy-making. The International Institute of Applied Systems Analysis (II-ASA), with grants from the European Union and US Department of Energy, supported the International Science and Technology Center in Moscow in establishing a project on the Soviet radiation legacy. Data were provided by the Russian Ministry of Nuclear Energy, Minatom, and then collated and standardized by expert groups. As with the volume edited by Warner and Kirchman discussed below, it is important to note the vast amounts of data collected by scientists in the FSU which only now are being made available. While the scope of specific problems may have been clear to individual scientists, it is fair to ask whether the overall scale and complexity of nuclear related problems was understood until recently by the scientific and political leadership or the general public.

The volume presents detailed chapters on mining, processing and enrichment, nuclear fuel production, nuclear power plants and research reactors, storage and reprocessing, and even naval power plants and nuclear explosions. Amounts of solid and liquid nuclear waste are measured not only in cubic meters but also their radioactivity in curies (an older standard now replaced by becquerels). The glaring omission, however, speaks directly to the heart of the contrasts that frame our discussion. The chapter on nuclear weapons production comprises one page of text and two brief tables, with data supplied by Minatom. Similarly, little information is presented on accidents in naval reactors at sea or elsewhere within the vast military complex. The admirable openness which characterizes the vast bulk of the volume merely heightens the lacunae. Given the strides taken in cooperative threat reduction and efforts to address the radiation legacy these gaps are puzzling but not unprecedented.[15]

There are many other examples of the FSU's schizophrenia regarding WMD production and its environmental consequences. Another example is

the now resolved case of Aleksandr Nikitin, a former Soviet naval officer turned environmental activist accused of espionage and disclosure of state secrets by writing an open source report for the Oslo-based Bellona Foundation on nuclear waste from the Russian Northern Fleet.[16] Accused and imprisoned in October 1995, Nikitin was acquitted in December 1999, only to have the verdict appealed by the prosecution, and then his acquittal finally upheld by the Supreme Presidium. Other cases, such as that of the former naval officer turned journalist Grigory Pasko, accused of passing secrets in the form of environmental information to a Japanese television network, remain in the courts. The on-going censorship of publications relating to the environmental impact of military activities generally is another example. Far more frightening are allegations that biological warfare programs have continued, in contravention of international agreements.[17]

The increasingly hostile reaction of the Russian Federal Security Service (FSB) and powerful factions within the military industrial complex contrasts with that of the increasingly reinternationalized scientific elite, such as the contributors to the Egorov et al. volume. The official retrenchment is visible in the expansion of nuclear and military cooperation with Iran, and hostile reactions to accusations from the United States about proliferation, including a threat from the Atomic Energy minister to withdraw form the Comprehensive Test Ban Treaty. The overall attitude of the FSU's political leadership should be contrasted with newly independent states such as Kazakhstan, which have denuclearized and where inherited biological weapons complexes have been at the forefront of conversion and openness.[18]

The hostility should be explained by a number of factors. These would include official anxiety over the loss of superpower status and the Soviet empire, the desire to maintain the economic prerogatives of nuclear and defense industries, inertia within entrenched bureaucracies and their cultures of secrecy, and the continued place of nuclear weapons in the national psychology of the FSU and Russia. Among other things, the breakup of the FSU has meant the end of the sacral and hierarchical privileges of the security services and military industrial complex, and the subversion of virtually every category system, and it will require decades before new patterns of institutional thinking and behavior are established.[19] Weapons of mass destruction are both ego and id, and this has especially grave implications for new and borderline nuclear powers.

Nuclear Test Explosions, Environmental and Human Impacts, edited by Warner and Kirchmann, is perhaps the epitome of international technocracy and cooperation. The volume is the product of international scientific culture: the Scientific Committee on Problems of the Environment (SCOPE), established

by the International Council for Science (ICSU), with key meetings funded by NATO. For the reader interested in how subsurface nuclear explosions eject and aerosolize soil, how horizontal scattering of contaminants may be described with a two-dimensional Gaussian distribution, or how dose reconstruction were assembled for various test explosions (coconuts were sampled extensively in Marshall Island tests), this is the book. The quantities of data are staggering, and for the reader willing to take the challenge, the results are terrifying.

Nuclear test explosions represent the largest systematic modification of the planetary environment undertaken (to date) by our species. Only the haphazard introduction of pollutants and greenhouse gases resulting in global warming comes close, a process that began on a large scale with the Industrial Revolution. In contrast, a total of 541 atmospheric and 1878 underground nuclear tests executed between 1945 and 1998 had a combined yield of some 530 megatons. Consider a few additional numbers. The approximate amount of soil ejected by a subsurface nuclear explosion is 5000 tons per 1 kiloton of explosion yield. Soil particles then solidify in the fireball, after approximately 7 seconds for a 20 kiloton explosion yield and 40 seconds in a 1 megaton yield.

The contributors to *Nuclear Test Explosions* do not make their point so starkly. Rather, they systematically survey the various national test programs, the numerous sources of contamination produced by different types of explosions, the internal and external pathways by which humans can be contaminated, dose estimation from test sites, health effects among populations exposed to contamination, fallout models, and a handy appendix listing all atmospheric tests. While exposure information was collected from the beginning of nuclear programs, the human health impacts were felt and studied intensively from the 1970s onward. “Fallout” was of course a concern from the very beginning of atomic testing, intensified by images at once horrific, such as Hiroshima, and ludicrous, such as Godzilla. But relatively few immediate effects, such as burns and hair loss, were documented in the vast areas touched by fallout from testing. American tests produced such casualties among a small group of Pacific Islanders and an unfortunate Japanese fishing boat crew, and no one in the continental US, while casualties of Soviet tests were localized around the Semipalatinsk Test Site.

The primary long-term effects, such as cancers, appeared after years, even decades. It should be recalled that considerable debate existed in the early years of nuclear programs about what levels of exposure to radiation were “safe” and “acceptable.”[20] The historian’s question of “who knew what when” contrasts with the cumulative and probabilistic approach of epidemiology, where health effects and dose estimates are refined over decades. This returns

us to the intractable issue of "how science works." For the moment, it is sufficient to note the admittedly simplified clash between cultures. Medical science deals in both clinical problems which present at rounds and statistical insights gleaned over decades. Policy-makers attempt to both forecast and effect change: today's unrest, tomorrow's vote, the elections in November. And the military must perceive and respond to threats today and tomorrow, and in the next weapons development and budgetary cycles. Each of these cultures perceives time differently and orders its priorities differently. Perhaps if there had been significant numbers of short-term casualties in the US from testing for nuclear industries, precisely in the form of dramatic injuries such as burns, attitudes might have been different. Add to this the inevitable rationalization and self-justification that are an inevitable part of satisficing behavior – making do with what is[21] – and we have an unhappy part of an incomplete explanation for unpleasant behavior.

All these subcultures, interdependent as they were, choose to do more studies, compartmentalize data, rationalize results, and ultimately generate a vortex of silence, at least for a time. Institutions and cultural behavior, a myriad of small, not grand conspiracies, are the underlying tragedy of American nuclear testing. For Russians, the deadly overburden of totalitarianism and utopian-scientific ideology strangled any calls for change. Data on the environmental consequences of nuclear energy and WMD production were available in the FSU even if they were never assembled as a coherent whole. That the data were ignored by the political leadership, and that the almost completely subservient scientific leadership kept quiet, is not necessarily surprising. Similar experiences characterize many spheres of Soviet science and technology. Many historians and commentators have noted that the situation in the United States was not dissimilar. But the Russian contributors to the Warner and Kirchmann volume still had to draw their graphs and maps by hand. The scientific establishment now is free to discuss much of what occurred during Soviet times, but Russian political priorities still do not include funding the acquisition of decent graphics software. Some cultures change more slowly than others.

Physicists are accustomed with dealing with vast forces at the edge of human comprehension and perhaps this gives them a curious blend of hubris and pause. Social scientists, like physicians, are enmeshed in the quotidian and therefore seek out larger interpretive frameworks and structures to give their data meaning. The data that political scientists use to assess public attitudes and actions are surveys, and the frameworks for understanding are especially broad. Statistical tests of significance are employed to extract meaning, from answers to problematically defined questions. But the emergence of environmental awareness and political will to act on problems will be critical

in Asia, and the major examples are the US and FSU. For these reasons *Critical Masses* is in most respects a landmark contribution. While the anti-nuclear movement in the West has been studied before, that of the FSU has received much less attention. *Critical Masses* takes the problem to ground zero, the industrial centers of weapons production in the US and FSU, namely the Hanford Reservation in Washington State and the Mayak Complex (aka Chelyabinsk-65) in the Urals. The volume presents concise background information about the Hanford and Mayak facilities, and extensive discussions of public perceptions of the environment, environmental group activism, the development of environmental attitudes, and governmental responses.

Modern progressive social science sets a high standard for itself, of theoretical sophistication, methodological rigor, and, at least sometimes, ethics and engagement. *Critical Masses* offers an excellent overview of the structure and legacy of the Hanford and Mayak centers, surveys which amplify the more laconic presentations in *Nuclear Wastelands*. But culture is again the question when it comes to the centerpiece of the book, an assessment of environmental values in and around Hanford and Mayak, and the emergence of environmental activism. At issue is the unfortunately (and unironically) named "New Environmental Paradigm" or NEP, "a view of the world that is seen as a system in which all living things – humans, plants, and animals – are equally important and interdependent."[22]

To understand this particular shade of the green prescription, the authors contrast it with the "Dominant Social Paradigm," characteristic of industrial societies, which comprises four beliefs: "1) people are fundamentally different from all other creatures on earth over which they have dominion; 2) people are masters of their destiny; the can choose their goals and learn to do whatever is necessary to achieve them; 3) the world is vast, and thus provides unlimited opportunities for humans; and 4) the history of humanity is one of progress; for every problem is there is a solution, and thus progress need never cease."[23]

In contrast, the New Environmental Paradigm is "biocentric," "accepts the limits of nature's bounty and a need to adjust human expectations to reflect these limits," and "emphasizes the value of social and collective needs over individual needs."[24] In the view of the NEP, the socioeconomic order is the problem, not the solution. These postmaterial values are presented as a kind of intellectual or evolutionary innovation and the substantive chapters of *Critical Masses* test these perceptions in American and Russian groups around Hanford and Mayak. Proximity to the Hanford facility, education, ethnicity, age, social status, and political affiliation all contribute to stronger environmental orientations – primarily among better educated young people. Overall, around Mayak environmental values are similar to those which prevailed in the West

prior to the 1970's. *Critical Masses* presents extensive documentation and thoughtful interpretation, but there are deeper issues left unaddressed.

Are the terms of the "NEP" and the "DSP" appropriate for Russia? Would they be even remotely applicable to the Third World? These formulations are strongly conditioned by a society's level of economic development, and in *Critical Masses* the analysis is framed by the dichotomy of capitalism and (mostly dead) communism, which looms so heavily that we must ask what is being measured. Politics and economics cannot be arbitrarily separated from culture, but the sheer centrality of these two sites to their countries' nuclear programs gives them unique status. While the authors are conscious that Mayak and Russia are in the midst of an agonizing transition from communism, the realities of how culture evolves from oppression past and present do not seem to have been completely understood. Here the insights of sociology would have been usefully supplemented by those of psychology, or at least a close reading of *Darkness at Noon* or *The Gulag Archipelago*.[25] Beyond this, how would the variables in question be measured in a "traditional" society? What relevance or resonance would terms like "biocentric" find in the Middle East or South Asia? What would these terms mean to Muslims or Buddhists or animists? How do social location, victimization, or values models of social mobilization apply to agrarian, patriarchal, and caste societies? And by extension, what prescriptive value would these terms have?

The questions surrounding the premises of *Critical Masses* point to an issue in the structure of American social science. Though its values are not articulated as clearly as among physicians, the core sociological enterprise here seems a projection of "an idealized view of self-propelling individuals and interest groups, imbedded in nature, dynamically recreating on American soil a progressive liberal society".[26] This unconscious manifestation (and projection) of American exceptionalism is unlikely to have much explanatory power when applied to beliefs embedded in a deeply complex matrix of cultural beliefs, including ethnicity, language, caste, and religion. Simply the economics of waste recycling in the developing world, an economic necessity for large numbers of people and frequently a caste prerogative, make distinctions between "anthropocentric" and "biocentric" orientations seem arbitrary and limited. Furthermore, archaeological research in the west has shown a significant divergence of stated and actual behavior when it comes to consumption and waste disposal.[27]

Between culture and power

Environmental attitudes are a fundamental component of personal, political, and cultural identities. As noted above, the Cold War and its bulging arsenals

of nuclear weapons were the products of poorly perceived cost-benefit analyses, to which the environment fell victim. There was overt competition and barely concealed hostility, which all too frequently exploded in proxy wars. The bilateral dynamic was clear and the emergence of other first generation proliferators, Britain, France and China, may all be understood as responses to the pivotal relationship between the US and USSR. The second generation of proliferators, however, are quite different, the motivations behind their choices to go nuclear are complex, and the environmental sacrifices they made have yet to be acknowledged.

Abraham's discussion of India's nuclear program is a major contribution. Thanks to, and occasionally in spite of, the formidable theoretical apparatus of post-colonialism, Abraham demonstrates how nuclear weapons acquired the status of a fetish for Indian nationalism. As an engine of development and modernization, Indian science was called upon to contribute to the newly independent state. The enterprise of science itself, with nuclear energy as a symbol of achievement, were the primary goals. Protected by the institutions of the state, Indian science labored to produce an indigenous atomic reactor which would power and rewrite India's modernity. But during the 1950s this could only be accomplished by cooperation with the more developed nuclear states, which undermined the authenticity of the Indian project. This contradiction was compensated for, in part, by the non-aligned position of the Indian state and the leadership role of Indian science in international atomic energy institutions.

By the 1960's, however, a series of developments shifted India's atomic priorities toward the national security stance. The slow development of power reactors, the brief and humiliating war with China, Chinese atomic testing, and wars with Pakistan, all created crises for Indian science. Weapons production had always been a hedge for political elites, establishing priorities and negotiating international agreements, while scientific elites made parallel technical choices, particularly regarding the building of unsafeguarded reactors which would produce plutonium. Still, India was capable of producing atomic weapons by the late 1960's but did not do so until the "peaceful nuclear explosion" of 1974. It did not detonate another weapon until 1998.

The conventional logic of international relations was defied – for a time – by unique tensions between scientific and political leadership, and at a larger scale, between colonial and post-colonial India. One of Abraham's great contributions is showing the debates at the political levels, and the thinking of key Indian scientists through their writings and letters, an analysis which owes much to Bruno Latour. That Abraham's exemplary work was conducted without access to classified materials merely amplifies the accomplishment. In structure and scope it is a *tour de force* of interdisciplinary writ-

ing. Abraham's analysis is an invaluable complement to more straightforward historical and political studies of India's nuclear and strategic programs.[28]

Culture, not deterrence, stand at the origins of the Indian WMD program. While the logic of deterrence is now firmly in place in India, as it faces both Pakistan and China, the fetishistic attraction remains, especially for Hindu nationalists, and new cultural mythologies vie dangerously with inadequate command and control structures.[29] In this doubly charged situation, the environmental consequences of WMD have remained local rather than national or international concerns.[30]

If India's nuclear weapons began as a post-colonial fetish, ego and id colliding, Israel's experience has been conditioned (or overdetermined) by a touch of the superego. Cohen's volume on Israel's bomb is a landmark that pierces the carefully constructed opacity and reveals a unique ethnonational defense program.[31]

In some respects Israel represents the post-colonial path not taken by India. Whereas all nuclear programs have been submerged in extreme secrecy, in India there was genuine tension between atomic energy as national security or national development. Within Israel it was always conceived as the final line of defense, so final in fact that for many years policy regarding the actual use of nuclear weapons was never even discussed, and the red lines were reached neither in 1967 or 1973. The Israeli nuclear program certainly did not simply emerge in a fit of absent-mindedness, but it illustrates how a powerful cultural motivation can be coupled with technology to produce WMD capabilities which only then must be incorporated into strategic and operational thinking. They must also be protected, defended, justified, and concealed from, among others, the very society that fostered it.

The writing of the post-colonial project, if indeed Israel may even be regarded in this way, proceeded somewhat differently, and Cohen uses declassified documents, especially official correspondence, to create an extraordinarily detailed reconstruction. The parallels with India are remarkable. Both atomic energy programs were conceived in the immediate aftermath of decolonialization. Both nations were young and enthusiastic, and threatened by their neighbors as partition plans went wrong. Atomic energy was an article of faith, the limitless supply of energy, too cheap to meter, a vision forcefully pushed on the international scientific community by the American government, and on governmental scientific advisors to governments by the emerging atomic energy industry. In both India and Israel there was little clarity regarding what could or should be achieved by an atomic energy program. Both had highly charismatic, Western-trained scientists – Homi J. Bhaba in India and Ernst David Bergmann in Israel – pushing the project on political leaders, with whom they had close relationships. Similar choices were faced

about where to situate atomic research, in independent institutes, university departments, or government laboratories, and about the types of reactors to build first, swimming pool-type research reactors or full-scale power reactors. Even the same types of fuels were debated, especially the question of thorium, and most fatefully, whether to attempt construction of the entire fuel cycle as the final hedge, thereby allowing the reprocessing of weapons grade plutonium.

Many more parallels could be cited, all centering around the tensions between the projects' legitimacy and authenticity as indigenous products, their speed, efficiency and cost, and the evolving notions of nonproliferation, all the while playing major powers and weapons suppliers off one another. The usefulness of atomic energy in meeting electrical generation needs diminished as the true costs and complexities of power reactors emerged, and were decisively eclipsed in the early 1960s by the potential contribution to "security." Energy and security had gone hand in hand, but one had been the public face, the other private, never fully conceived or understood, but always standing there, as if hiding in plain view. The Israeli program was completed in 1966–67, and the initially offhand formulation that Israel would not be the first nation to introduce atomic weapons into the Middle East was elevated to national policy.

The dynamic range of ambiguity, from rumors at one end to outright testing at the other, became the center of Israeli strategic thinking. A shift occurred after the Six-Day War and the decision not to sign the Non-Proliferation Treaty, away from ambiguity toward opacity, from a public posture of confusion about capability to ambivalence about usage, and deterrence strategy has essentially remained there ever since. Even in times of crisis when the survival of the state was threatened, no overt atomic threats were made, either directly or through intermediaries. Opacity successfully increased Israel's leverage in acquiring conventional weapons and security assurances from the United States but the contradictions of unconventional weapons – that use means almost certain suicide – were discovered almost as soon as they became available.

Opacity is a variant of deterrence, but as Cohen points out it has become a cultural norm as well as a strategic posture. While for a time opacity may have served Israel well, it generates a fundamental contradiction with democracy, creating a security culture which is incapable of seeing beyond its own responsibilities. The price of opacity is felt in the environmental domain as well, where various consequences remain poorly understood. Cohen's soul-searching is the work of a patriot and a believer in democracy, one who a breached a major taboo and paid a price.[32] Given the continuing revelations about Iraqi nuclear, biological and chemical weapons programs, and their

disregard of conventional deterrence thinking, and the breakdown of Israeli-Palestinian negotiations, opacity may be a feature of Israeli strategy for the foreseeable future. But there are also intriguing hints that the changing strategic environment, particularly Iranian WMD development, could bring a more open Israeli stance, in the context of arms control negotiations.[33] Nonetheless, it mut be emphasized in the context of the present discussion, that environmental issues related to WMD in Israel have been relegated far to the background.[34]

Abraham and Cohen have made invaluable contributions, and it is intriguing to imagine each writing a book on the other's topic. Both the cases of India and Israel demonstrate that culture and history are equal partners with rationality when it comes to nuclear weapons, and both illustrate that the received wisdom about the causes of proliferation can be simplistic.[35] If an appreciation of these is vital to understanding the generation of nuclear weapons, it is even more important when discussing how societies respond to the environmental consequences.

Toward an anthropology of weapons of mass destruction

If culture is a partial explanation for the proliferation of WMD then it must also be at least part of the solution. An anthropology of WMD would address the continuum from motivation and development to deployment and use. It would integrate study of cultural attitudes toward security generally, as well as toward waste, pollution, the environment, and the partitioning of these attitudes within nation-states. An important goal of a demand-side perspective would certainly not be to pander to religious or cultural fears and fetishes, but rather to construct individualized approaches for dealing with WMD. The purpose would be to find more convincing arguments for societies not to develop, deploy, or use highly toxic and expensive weapons systems. If WMD are developed, culturally attuned arguments must be developed to address the problem of wastes.

An anthropological approach, which addresses the many different dimensions of culture, is preferable to the largely sociological approaches which have prevailed in political science analyses of WMD. Even progressive challenges to traditional security thinking have tended to separate "norms," contextual behavior, from "identities," constructions of nation and statehood, but situated largely within a framework of *global* collective beliefs and expectations. Culture in the local sense is secondary. The same disregard for culture below the level of the nation or state (the primary structures of the international community) is found in most discussions of environmental security. The taboos on the use of WMD have been examined in this respect but ana-

lyses have remained resolutely in the international sphere. The sociological focus on the behavior of competing institutions is therefore too limited.[36]

The same limitations prevail in nonproliferation thinking. As has been noted above, nonproliferation thinking has been reluctant to emphasize environmental issues. Traditional, rationalist/realist arms control mentality stresses conventional arguments for limiting the spread of WMD through test bans and technology control regimes, maintaining deterrence between superpowers, and arms reductions from a supply-side perspective. Understanding demand outside of the zero-sum environment of the international community, or specific bi- and multi-lateral relationships, is rarely considered. Arms control treaties are a case in point. The START treaty of 1992 negotiated reductions but did not take into account the ultimate disposition of surplus and waste nuclear materials. Under the Cooperative Threat Reduction Program control protocols for fissile materials were introduced, but only to limit the spread of materials to proliferators, not to reduce the global environmental impact. Other arms reduction treaties such as the plutonium disposition treaty of 1995 have specified the destruction of specific fissile materials.[37] Regimes such as the Wassenaar Arrangement instituted voluntary export controls on specific and dual-use technologies, such as those related to ballistic missiles.

These approaches, though necessary, are only nominally multilateral; primarily they entail curbs on the behavior of superpowers, quasi-superpowers, and industrial exporting states. More importantly for the issues addressed here, they have not reduced substantially either the incentives for proliferation or the disposition of toxic, non-fissile waste materials. In the case of fissile material controls they may even increase the potential for proliferation, by commodifying plutonium, encouraging the development of reprocessing facilities, and creating a global network of shipment. In short, they are not effective means of integrating arms control and environmental protection. They do not provide a full explanation of why societies seek WMD, or how to dissuade them.

How might culture be incorporated beyond the levels of "norms" or "strategic personalities"? Anthropology is especially well-prepared to contribute to the study of WMD in three areas; local knowledge, narratives, and structural relationships. Many questions remain to be asked. How do local geographies affect cultures of WMD? Local places and meanings are obviously affected by the placement of installations and waste, but do these in turn feed back into political attitudes on the legitimacy or desirability of WMD? Certainly in the American West WMD and the creation of the "gunbelt" brought tremendous economic growth, but clashes with the indigenous perception of the "West" as something opposed to or apart from government. While this contradiction has yet to be fully played out, it has contributed to, or at least

informed, some of the grassroots opposition to the continued militarization of the West.[38] How has WMD exacerbated or meliorated class and ethnic divisions in various societies? To use the example of the American West once again, Native Americans have been among those ethnic groups most severely impacted by WMD development and testing, compounding the longterm destruction of those cultures. What constitutes "security" for different cultures? How are concepts of security generated and transmitted, what is the role of culture-specific variables, such as language, religion, and ethnicity, and what are the local structures of dissemination, and the dynamics of consent or resistence? What role do religious traditions play in constructing "biocentric" values, and how are they mobilized by environmental movements?[39] The full spectrum of anthropology's sensitivity to human livelihoods, social relationships, and sense of the environment, should be brought to bear on the problem of WMD.

Conclusions

The first two generations of WMD states have gravely damaged the environment and themselves in search of "security." What are the implications of this sad recitation for Asia? Environmental ethics, never mind environmental security, are a problematic feature in many Asian societies. Little systematic work has been done about cultural attitudes towards the environment in Asia generally, and a detailed discussion on the basis of information extracted from innumerable ethnographies cannot be attempted here. Only a few general observations may be offered.

WMD invariably become symbols of national pride, rather than primarily tools of international competition, and the environmental implications are especially grave. Though overwhelming, the concept of "national security" entails an implicit series of cost-benefit analyses: how much money, secrecy, and damage are sustainable in the pursuit of defense? Institutions and actors develop structures and ideologies which make these analyses unbalanced or temporarily moot, but the questions remain or reemerge, at least in society at large. But when WMD become part of a pervasive sense of national identity, dissent is dramatically marginalized, dissenters become cultural as well as political traitors, and the consequences are absorbed and hidden. Even more frightening is when WMD become part of a tiny subculture focused on a totalitarian leadership, utterly disinterested in public welfare. The Soviet Union and Iraq are the most prominent examples of this, and the consequences have been severe.

A cultural perspective permits identification of apostates and disciples of WMD, and some notion of their interrelationships. It should not be assumed,

for example, even in extreme cases such as Iraq and North Korea, that policy and scientific communities are in full agreement.[40] As the discussion of the US and FSU has shown, physicists and physicians, if nothing else than because of their internationalism, can raise the alarm over nuclear weapons and nuclear waste. They may not, however, be counted on to communicate that effectively, to either policy-makers or the public. A cultural perspective also provides insight on how ideas are generated and disseminated in a particular society, how those ideas do or do not resonate within existing ideational and social frameworks.

Finally, as noted at the outset, WMD defy dispassionate analyses. An anthropology of WMD, as called for here, might inevitably, or even deliberately, conflate analysis with advocacy. The question of engagement stands at the heart of progressive anthropology, as it does in every academic discipline. If nothing else the story of the first two generation of WMD shows how the moral component in science, and science education, should never be kept too far from view.[41]

Notes

1. "A Secret Soviet Nuclear Test," *Jane's Foreign Report*, August 15, 2000, (2605).
2. See for example the essays in Utgoff, 2000. See generally Katzenstein, 1996 and Pasic, 1998.
   Strong objections are voiced by Desch (1988) on the grounds that cultural approaches have frequently been mistaken in their predictions, particularly with regard to the Soviet Union, and that culture, as an ideational concept, is too vague to create testable models. But his attitude reveals the point about culture, in this case disciplinary, demonstrating that IR studies have become so compartmentalized, aloof, and abstract that it cannot even converse with other disciplines. On this see generally Kurth, 1998. The point has also been made in the context of Cold War studies that conventional IR theory cannot understand history and new data, much less predict in real-time the thinking of heavily shielded institutions and individuals (Wohlforth, 1999).
3. For overviews and programmatic statements on environmental security see Florini and Simmons, 1998; Matthews, 1989; Dalbenko and Dalbenko, 1995, and Deudney and Matthew, 1999.
   For a discussion of environmental pressure and conflict see Homer-Dixon, 1994 and 2000. This particular topic has been extensively explored by anthropologists, many of whom have long seen resource scarcity and population pressure as "prime movers" (e.g., Carneiro, 1988). For a sharply critical view (predicated on the alleged inability of the environmental security paradigm to predict conflict) see Levy, 1995.
   Extensive resources on environmental security can be found at the Woodrow Wilson Center's Environmental Change and Security Project (http://ecsp.si.edu/default.htm).
4. Guruswamy and Aamodt, 1999. See now Joffe, 2001.
5. See for example Kuper, 1999.
6. For an early discussion of the role of scientists in nuclear policy see Gilpin, 1962. See also Badash, 1995; and Herken, 2000. See also the important discussion of Dahl, 1985.

7. The books reviewed here may be read in conjunction with more technical discussions such as U.S. Congress, Office of Technology Assessment, 1993; and Baca and Florkowski, 2000.
8. For a recent history of the French nuclear program see Mongin, 1997.
9. See Rhodes, 1986; Rhodes, 1995; Schwartz, 1998; Holloway, 1994; and Cochran et al., 1995.
10. See the full report of the U.S. Advisory Committee on Human Radiation Experiments at http://tis.eh.doe.gov/ohre/roadmap/achre/report.html. For a broad discussion of human experimentation and ethics see Moreno, 1999.
11. There is an extensive literature on Soviet and Russian environmental problems, most of it in Russian. For a sample of work in English see Goldman, 1972; Peterson, 1993; Komarov, 1994; Feshbach, 1995; Richter, 1997.
    For China, see the resources of the Woodrow Wilson Center's Environmental Security and Change Project (see above note 3).
12. See J. Debardaleben, 1985; Ziegler, 1987.
13. Stoll, 1997.
14. See the extensive resources at the Center for Nonproliferation Studies (http://cns.miis.edu/index.htm), and the Federation of American Scientists (http://www.fas.org/nuke/guide/index.html).
15. Note that some of these data are available in other sources, not least of which the many NATO Advanced Research Workshops, now published by Kluwer Academic Press.
16. See their web site at http://www.bellona.org.
17. Boreiko, 1994; Alibek and Handelman, 1999.
18. "Russia could withdraw from CTBT: minister," Agencie France Presse March 21, 2001. For Kazakhstan see Bozheyeva et al., 1999.
19. Douglas, 1986.
20. See for example Hacker, 1994.
21. Simon, 1981.
22. Dalton et al., 1999, p. 118.
23. Ibid., p. 199.
24. Ibid., 201, 202. See also numerous papers published in *Environment & Behavior* and the *Journal of Environmental Education*.
25. For a comparative study of environmental attitudes in Sweden and "posttotalitarian" Latvia and Estonia see Gooch, 1995. For studies from Mexico and Nigeria see Corral-Verdugo and Armendariz, 2000; and Adeola, 1996.
26. Ross, 1991, 473.
27. Kwawe, 1995; Rathje, 1989.
28. Especially Perkovich, 1999.
29. Zook, 2000; Nizmani, 2000.
30. "Bhabha Atomic Research Centre 'digs up' a controversy," *The Hindu* April 24, 2000.
31. For extensive resources on world nuclear programs see http://www.fas.org/nuke/guide/index.html.
32. Cohen was forbidden by military censors from discussing nuclear issues and was questioned for several hours upon his return to Israel in early 2001. He was not, however, arrested. Nevertheless, opacity continues to erode, possibly by design. See "Obsessive Secrecy Undermines Democracy," Reuven Pedatzur, *Ha'aretz*, Tuesday, August 8, 2000, "Fighting to Preserve the Tattered Veil of Secrecy," *Ha'aretz*, August 6, 2000, "Author of Book on Nuclear Reactor Questioned by Police,"*Ha'aretz*, March 13, 2001. A brief

nuclear policy debate was conducted in the Israeli parliament in early 2000. See Datan, 2000.

33. "Iran's Nuclear Perspective," Reuven Pedatzur, *Ha'aretz*, Thursday, September 7, 2000; Cf. Steinberg, 2000.
34. Remote sensing data have recently led to speculation that low-level wastes are buried near the Dimona nuclear facility. The issue of nuclear wastes have also been politicized by Israeli Arab opposition parties and by neighboring countries, with improbable claims of wastes being dumped from Uganda to Mauritania. Beyond several accidents at the Dimona facility (see www.fas.org/nuke/hew/Israel/Dimonanews.txt), there are no scientific data regarding the environmental impact of Israel's nuclear program. But there is growing concern within Israel about nuclear and other environmental issues.
35. E.g., Hajjar, 2000; Cf. Ahmed, 1999.
36. See the essays in Katzenstein, 1996. See also Homer-Dixon 2000 and Deudney and Matthews (eds.), 1999. For the presumed WMD "taboo" see Price and Tannenwald, 1996. Contrast the evidence in Tucker, 1997 and Haselkorn, 1999, and the approaches taken in Lavoy et al. (eds.), 2000; and Utgoff (ed.), 2000.
37. See the resources at http://www.state.gov/www/global/arms/bureau_np/treaties_np.html. See also Rauf et al., 2000.
38. Hevly and Findlay, 1998. For the the creation of the American military industrial "gunbelt" see Markusen et al., 1991.
39. See Foltz, 2000; and Schultz, 2000.
40. The example of Hamza, 2000 may be read as a commentary on the conflict between physics and morality. For a complementary perspective, see Gusterson 1996, an excellent example of WMD anthropology, based on fieldwork at Lawrence Livermore National Laboratory.
41. For a classic example of an engaged anthropoogy see Scheper-Hughes, 1993. On science education see Burkhardt, 1999.

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