S|S|S

Inventing Annihilation:

Comments on Lynn Eden's *Whole World on Fire: Organizations, Knowledge, & Nuclear Weapons Devastation*

Hugh Gusterson

In the 1980s the pediatrician Helen Caldicott, the Billy Graham of the antinuclear movement, went from city to city in Ronald Reagan's America to do what she called 'the bombing run'. Seeking to counteract the delusional qualities of government statements that nuclear war could be limited and winnable, and blending the intensity of an activist with the dispassionate authority of a doctor, Caldicott evoked the effect that a 1-megaton bomb would have if dropped on the city where she was speaking, specifying how many people would be burned, crushed, blinded, maimed, and irradiated. As a young activist for the Nuclear Freeze Campaign, I watched the extraordinary effect Caldicott had on audiences, many members of which would silently weep as she spoke.

Lynn Eden opens her fine book, *Whole World on Fire* (2004), with her own version of the bombing run. Chapter 1 ('complete ruin') is, at 20 pages, a meticulously detailed, dispassionate, and precise account of the damage she would expect from a 300-kiloton bomb dropped over Washington DC. It sets forth in straightforward language exactly the range and dynamics of such a weapon's blast and fire effects, and specifies the damage we could expect to landmarks in and around the nation's capital. The point of this chapter and of the book as a whole is to argue that US war planners have tended to underestimate the damage nuclear weapons would cause and that, in particular, they have done so because they have paid little attention to the fire effects of a nuclear explosion. Eden argues that US war planners brought from World War II to the atomic age a cognitive predisposition to figure bombing damage in terms of blast effects rather than fire effects. Eden calls this the 'blast frame', and she shows how it led US war planners to develop what she calls 'knowledge-laden routines' – algorithmic practices for predicting the damage particular weapons would inflict on particular targets. These routines bracketed damage from fire, which was seen as unpredictable. This distortion became even more pronounced with the development of hydrogen bombs, since fire effects

Social Studies of Science **36/4(August 2006) 634–640**

ISSN 0306-3127 DOI: 10.1177/0306312706064813
www.sagepublications.com

scale up faster than blast effects when explosive power increases. The 1980s and 90s saw an attempt, particularly by the physicist Harold Brode, to develop an alternative 'fire frame' and to get the military to rethink its algorithms for predicting atomic destruction. Seemingly on the verge of acceptance in the Pentagon in 1992, Brode's recommendations were instead shelved.

Eden has devoted more than a decade to her study of nuclear war planners, and her book offers a rich evocation of the arcane, not to say surreal, cultural world of the people who have devoted their lives to planning and debating scenarios for the use of nuclear weapons. Eden quotes one of these men – and they do almost all seem to be men – as saying of his nuclear war planning work, 'it was fun to see results after predictions. I had no particular political attitude. Like most engineers, I wasn't concerned with the politics and the rights and wrongs of humanity ... It was a matter of doing something useful' (p. 135).

Although Eden describes the world of nuclear war planning with disciplined restraint, its bizarre qualities are nevertheless in plain view. Nuclear explosions that would incinerate entire cities bear innocent names such as Mike, George, Ruth, Zebra, and Nectar and – in a turn sure to infuriate some Native American activists – Apache, Mohawk, and Navajo. Then there are the experiments. Pigs were dressed in military uniforms and stationed near nuclear explosions to determine the degree to which uniform material offered protection. Government scientists meticulously built replicas of suburban tract homes to see if different carpet and curtain fabrics were less likely to catch fire in a nuclear attack and, in a neat convergence of petty suburban moralism and nuclear war-planning, warned that those who left trash in their yards were more likely to see their houses burn down when they dropped the Big One. Perhaps most bizarrely of all – though Eden does not mention this particular experiment – government scientists crammed dollar bills into a heavy safe near Ground Zero to see if money would survive a nuclear war – as if money would have any utility or meaning in a world where most of the things one would buy had been utterly destroyed (Else, 2004).

It is very difficult as a practical matter to gain access to the secret world inhabited by such experts, and harder still as a matter of taste to know how to write about it without either replicating the chilling emotionlessness with which nuclear war planners discuss their work, or else wallowing in the shrill critiques of some anti-nuclear activists. Eden's accomplishment is extraordinary on both counts. A meticulous researcher, she has read extensively in the gray literature of the war planners and succeeded in getting interviews, about two dozen not for attribution, with some of the most important of them. It is evident from the interview material in the book that she developed a remarkable rapport with many of these men. As for the history she assembles with forensic skill in this book, she tells it with analytic rigor and a lean matter-of-factness without ever losing sight of the terrible destructiveness of nuclear weapons.

I have three comments to make about Eden's argument. I shall make the first two quickly, then concentrate on the third. My first comment, I confess, is of a kind that annoys me greatly when I am the author being reviewed, since it takes the form of acknowledging that the author has done immense and exhaustive research and written a very long book, but then asks for still more. What I want to know more about is the damage-prediction routines of other countries. As a way of denaturalizing the US approach to damage prediction, Eden tells us early in the book that the British, unlike the Americans, came out of World War II with a 'fire frame' for damage prediction, and then mentions at the end of the book that in the mid-1990s the head of Strategic Command in the USA discovered that the British included fire-damage modeling in their war planning. Since Eden discusses two contending approaches to fire damage modeling in the USA, neither of which proved persuasive to top Pentagon officials, it would be useful to know more about the approach the British took. How were British war planners able to resolve the technical doubts about fire-damage prediction that afflicted their transatlantic counterparts? Also, since the US and British nuclear weapons complexes have traditionally been deeply integrated, sharing considerable weapons design information as well as the Nevada Nuclear Test Site itself, one wonders why British algorithms for modeling fire damage had not migrated across the Atlantic. Had US and British war planners not shared their methods for bomb damage assessment through the cold war? One also wonders, of course, about other nuclear powers besides the British. Especially once the cold war ended, would it have been possible for Eden to find out how Russian war planners went about their dark art? Did the Russians follow the US or the British model, or hew some third path of their own? And what about the French and the Chinese, the other official nuclear powers?

My second comment concerns the striking absence of reference to US Presidents and their administrations in Eden's book. In most histories of nuclear weapons it has become customary to periodize the nuclear age with reference to administrations: Truman decided to go ahead with the hydrogen bomb; Eisenhower went for the New Look and massive retaliation; John F. Kennedy lurched from escalating the arms race to the Partial Test Ban Treaty; Nixon pursued détente and strategic arms control; and so on. I note that in the index to *Whole World on Fire* Truman rates two entries, Eisenhower none, John F. Kennedy two, Lyndon B. Johnson none, Nixon none, and Carter none. Eden assumes that the defense bureaucracy whirrs along in the background according to its own logic, and that 'frames' are more important in the telling of this story than Presidents and the senior officials they appoint. As Eden says (p. 294), 'this is not an actor-centered story; always these individuals worked within organizations that provided the context for their activities.'

E.L. Doctorow (2004) has said, 'the President we get is the country we get. With each president the nation is conformed spiritually. He is the artificer of our malleable national soul. . . . The people he appoints are in his image. The trouble they get into and get us into, is his characteristic

trouble.' We do not have to go quite this far to wish we heard a little more about Presidents in this book. Let me cite two episodes as examples of ways in which reference to Presidents might be illuminating. Both are drawn from Chapter 10 where Eden seeks to explain, not altogether satisfyingly, why Brode's fire modeling was rejected in 1992 and why there was renewed interest in it in the late 1990s. She ties the second episode to a new interest in the Pentagon, not well explained in the book, in predicting and thereby minimizing collateral damage in US strikes abroad. Eden's attempts to explain both of these episodes in terms of organizational dynamics seem to me to sell the story short. Surely the 1992 decision not to completely rethink the Pentagon war plan partly reflects the notorious lack of imagination of the George H.W. Bush administration, and surely the interest in collateral damage in 1998 reflected the priorities of the Clinton administration which, that very year, was fighting a war in Kosovo that involved unprecedented efforts to minimize collateral damage.

For my third and most substantive comment, I want to locate *Whole World on Fire* in the context of the Sociology of Scientific Knowledge and science studies more generally. Eden argues that technical knowledge about the damage of a nuclear attack is necessarily produced within a shared cognitive 'frame', which both constrains and enables the process of scientific inquiry. Eden's notion of 'frames' here bears a strong family resemblance to Thomas Kuhn's (1962) notion of paradigms and to Ludwig Fleck's (1979) notion of 'thought styles'. As Fleck puts it, in a passage that brings to mind US war planners' simultaneous rich understanding of blast damage and myopia about fire damage: 'to recognize a certain relation, many another relation must be misunderstood, denied, overlooked' (1979: 30). As Kuhn and Fleck both argued, once paradigms or thought styles get locked in, they exert enormous cognitive power, blinding investigators to anomalous evidence and to questions outside the frame. Eden's book is a masterly documentation of this phenomenon and of the phenomenon, described by Tom Hughes and others, whereby lines of research that attract lots of resources generate dense and expansive grids of knowledge, while under-resourced approaches stall in a way that is often misattributed after the fact to their own supposedly inherent inadequacy.

So far, so good. Where I part company with Eden, however, is in her treatment of physicist Harold Brode and the 'fire frame' for calculating damage. Brode is an exception to Eden's rule, quoted above, that 'this is not an actor-centered story'. In fact, the text is very much constructed around Brode as the central actor, albeit a thwarted one. Chapter 1 opens with a lengthy quote from Brode and, whereas other defense intellectuals appear intermittently for a chapter or two, Brode is the one person who reappears throughout. Brode is to this book a little like what Colin Powell is to much of Bob Woodward's recent writing: key informant in the research for the text, hero within the text.

Brode's casting as hero both enriches and deforms the text, since he hovers ambiguously between the role of, on the one hand, just one more expert in a book of many contending experts and, on the other, a sort of

über-subject, the guardian of the real in the text. The ambiguity of Brode's role leaves us not so much with one book as with two, each fighting the other for the upper hand. The first is a science studies monograph, along the lines of Donald MacKenzie's (1990) excellent history of missile guidance, which probes with meticulous care the ambiguities and lacunae in a field of knowledge whose confident predictions belie its heavy dependence on calculation, extrapolation, and simulation. The second is a bureaucratic politics book that asks why a bureaucracy full of smart people failed to adopt persuasive scientific knowledge about fire effects. This second book, in its eagerness to persuade organizational sociologists and security studies scholars of the importance of fire over blast and frames over bureaucratic interests, tends to bracket important questions about the robustness of Brode's claims about fire effects.

If one reads *Whole World on Fire* a little against the grain, the text is replete with evidence that Brode's claims about fire were not only contestable but were in fact highly contested by colleagues. While Brode insists that nuclear weapons ignite mass fires that are largely impervious to local weather conditions and are highly predictable because of their own self-sustaining physics, it is clear from the book that many of his colleagues are skeptical. Brode's main antagonist, Stanley Martin, describes fires as 'highly stochastic outcomes, whose criteria of onset of quantification are poorly established at present' (p. 264), while another colleague referred to Brode's algorithms for predicting fire damage as 'computer fantasies' (p. 254). Martin disagreed with Brode that weather conditions were largely irrelevant to the degree of damage caused by fire in a nuclear attack, while there was dispute in the community of fire experts as to whether blast effects fanned fires or blew them out, and there was even one fire expert who questioned whether there had really been a firestorm at Hiroshima. This left me wishing for a Donald MacKenzian analysis that, instead of reifying 'firestorms' as a natural category, inquired into their social construction.

Brode's heavy reliance on computer-modeling of fire effects gives particular cause for concern in this context. Brode borrowed a hydrodynamic code from Los Alamos and modified it to simulate fire effects (p. 231). In my own research on weapons designers at the Los Alamos and Lawrence Livermore National Laboratories, I have found that they disagree about the precise reliability of such codes. They are also much more comfortable using them to interpolate between data points well established through nuclear testing than to extrapolate (as Brode does) to regimens largely unknown through empirical measurement. This is because such codes often include what computational physicists refer to as 'knobs' – fudge factors that do not model known physical processes but which do make the codes' predictions conform to empirical measurements. Within a physical regimen well bounded by the measurements they seem to help predict, these fudge factors may be innocent; outside that regimen, they become a wild card. I do not know what role such fudge factors play in Brode's codes, but it would be an important question to explore.

While Eden is often rhetorically circumspect in her discussion of the fire disputes, her endorsement of Brode's perspective is nonetheless clear. For example, the horrifyingly detailed description of the effects of a 300-kiloton blast over Washington DC in Chapter 1 uses Brode's projections as the basis for its narrative of fire effects – a narrative that lodges preemptively in the reader's mind as fact before the later chapters on the history of fire prediction and all its associated uncertainties. And elsewhere Eden says,

> the much more widely held view ... is that the probability and range of mass fire depends on many unpredictable environmental variables, including rain, snow, humidity, temperature, time of year, visibility and wind conditions. However, the work of Postol, Brode, and Brode's collaborators *shows* [emphasis added] that mass fire creates its own environment. Except in extreme cases, natural environmental factors do not affect the likelihood of mass fire. (p. 27)

Then, in her conclusion, Eden places the Pentagon's failure to embrace fire effects alongside such failures as the sinking of the Titanic and the collapse of the Tacoma Narrows Bridge – surely events where there was much stronger, not to say spectacular, empirical evidence that the experts had made a mistake.

David Bloor, Harry Collins, and others established a tradition, sometimes referred to as the 'strong programme', according to which sociologists of science are not to invoke the 'real' in explaining why knowledge claims either were or were not accepted by scientists. And Bloor (1976) insisted on the 'symmetry principle', according to which we should treat accepted and rejected knowledge claims symmetrically in our narratives of scientific disputes. It goes without saying that this principle applies even more strongly in discussions of scientific debates that do not yet appear settled, such as the one among defense planners over fire effects. Eden, on the other hand, says 'because a controversy has not been settled ... does not mean that some understandings are not better than others' (p. 7). Doubtless some understandings are better than others but, in a context where the experts themselves do not agree, how are we to know which is which? And who is a sociologist to make that determination? Thus I wish Eden had taken a more deconstructive approach and, instead of using Brode as an anchor, had used him as a chisel to open the cracks in the phony facade of certainty that shields the overconfident projections of defense planners about an event, nuclear war, that can be known only as the sum of simulations. Nevertheless, Eden has written a masterful account that shines a light on a powerful, hidden community and surely gives them and us a great deal to discuss.

References

Bloor, David (1976) *Knowledge and Social Imagery* (London: Routledge and Kegan Paul).
Doctorow, E.L. (2004) 'The Unfeeling President', *East Hampton Star* (9 September).
Eden, Lynn (2004) *Whole World on Fire: Organizations, Knowledge, & Nuclear Weapons Devastation* (Ithaca, NY: Cornell University Press).

Else, Jon (2004) 'Rusting Museum of our Attempted Suicide Survives in the Desert', *San Francisco Chronicle* (22 August).
Fleck, Ludwig (1979) *Genesis and Development of a Scientific Fact* (Chicago, IL: University of Chicago Press).
Kuhn, Thomas S. (1962) *The Structure of Scientific Revolutions* (Chicago, IL: University of Chicago Press).
MacKenzie, Donald (1990) *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, MA: MIT Press).

Hugh Gusterson is Professor in the Cultural Studies Program at George Mason University. He is author of the book *Nuclear Rites* (University of California Press, 1996) and *People of the Bomb* (University of Minnesota Press, 2004), and co-editor of *Cultures of Insecurity* (University of Minnesota Press, 1999) and *Why America's Top Pundits Are Wrong* (University of California Press, 2005). He is currently finishing a book about the turn to simulations at US nuclear weapons laboratories forced to give up nuclear testing after the cold war.

Address: Cultural Studies Program, George Mason University, 4400 University Drive, MSN SE4, Robinson Hall B, Room B439, Fairfax, VA 22030-4444, USA; email: hguster@gmu.edu