REVIEW ARTICLE

Opening the Closed World of the Cold War and American Nuclear Strategy

MARK RIX

The Closed World: Computers and the Politics of Discourse in Cold War America

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ABSTRACT *It is argued in this paper that the closed world of computer simulations and nuclear games which Edwards describes is an imaginary place. Indeed, Edwards' closed world is a caricature of the real world of Cold War and American nuclear strategy. His account of the imaginary world and its development draws on and perpetuates the folklore of Cold War and American nuclear strategy. The folklore, which fails to acknowledge the frightening realities of the strategy of nuclear deterrence, has achieved a high level of academic respectability in the United States and elsewhere. Even though Edwards does not simply accept the folklore chapter and verse, enough of it survives intact in his book to leave his history of computers in the Cold War wanting at key stages and in important respects. Because he likens nuclear war to a computer game, he seriously underestimates the grave risks and dangers that accompanied American preparations and planning for nuclear war with the Soviet Union. In the end, Edwards trivialises the deadly serious business of nuclear war planning and preparation.*

Keywords: computers, Cold War, nuclear deterrence, RAND Corporation, politics, discourse.

Preamble

It is too easy when thinking about the role which computers played in the Cold War, especially their role in the nuclear strategies which the United States and the Soviet Union developed for that conflict, to take virtual flight from the real world and escape into an imaginary world like that seen in films and fiction. In this imaginary world, cyborgs—hybrid human/machine information processors—sit at computer screens in a command centre playing a simulated nuclear war game. In keeping with the rules of the game, the cyborgs manoeuvre and *threaten* to use fantastically destructive, but for that reason unusable, nuclear weapons affixed to various kinds of intercontinental delivery

system (jet bombers, ballistic missiles). In a computerised command centre on the other side of the globe, cyborgs in the service of the enemy perform the same kinds of game-like, rule-bound rituals. The object of the game is to out-manoeuvre and tacitly out-bargain the other side. The two opposing war systems, each containing many layers of integrated, programmable systems arranged hierarchically according to degree of complexity, are themselves components of the overarching system of Cold War. The Cold War is a closed world of two opposing, but integrated, war systems locked into a seemingly never-ending, virtual game of nuclear threat and counter-threat, a simulated war of position and manoeuvre. In the closed world, indeed, the price for avoiding holocaust is a simulated nuclear war virtually without end.

This admittedly is a caricature of the closed world depicted in *The Closed World*, but it is not a grotesque distortion of it. The caricature effect is, instead, a product of gathering and rearranging in a single paragraph, in order to produce a composite picture, the various elements and images of the closed world scattered through Edwards' book. Of course, there are points of direct correspondence between the closed world portrayed by Edwards and the real world of Cold War and American nuclear strategy. For example, the technologies he describes actually belong in the real world, so do the characters and many of the settings. The problem is more that Edwards' closed world *is* a caricature of the real world, and a grotesquely distorted one at that. For example, he assigns the technologies and characters roles that they did not and could not fill and gives them a part in an imaginary story. Likening nuclear war to a computer game, Edwards seriously underestimates or overlooks the grave risks and dangers that attended on American preparations and planning for nuclear war. In the end, therefore, he trivialises the deadly serious business of nuclear war planning and preparation. His closed world is an imaginary but deceptively appealing place.

Inside *The Closed World*

Edwards announces the theme and central argument of *The Closed World* on the opening page of the Preface:

> Of all the technologies built to fight the Cold War, digital computers have become its most ubiquitous, and perhaps its most important, legacy. Yet few have realized the degree to which computers created the technological possibility of Cold War and shaped its political atmosphere, and virtually no one has recognized how profoundly the Cold War shaped computer technology. Its politics became embedded in the machines—even, at times, in their technical design—while the machines helped make possible its politics. This book argues that we can make sense of the history of computers as tools only when we simultaneously grasp their history as metaphors in Cold War science, politics, and culture (p. ix).

Given that Edwards regards digital computers as the most important and enduring legacy of the Cold War and as the technology which, in effect, made the Cold War possible, it is little wonder that *The Closed World* is 'built around a history of computers'. Adopting a novel approach to this history, however, Edwards treats computers both as a 'central technology of Cold War military forces' and 'as an axial metaphor in psychological theory' (p. x).

Few would disagree that computing machines *were* a central technology of the military conflict at the core of the Cold War, but why treat them as an 'axial metaphor in psychological theory'? This is because computers, which Edwards considers both as 'tools' and as 'models and metaphors', 'connect cognitive psychology and artificial

intelligence to high-technology warfare and to the institutional structure of the modern state'. Armed with this conception of computers, and gazing through something he calls the 'lens of the American political imagination', Edwards interweaves 'three apparently disparate histories—the history of American global power, the history of computing machines, and the history of mind and subjectivity as reflected in science and culture' (p. xv).

Perhaps because he gazes back on the Cold War through the lens of the American political imagination, Edwards' history of computers in that conflict contains some glaring blind spots, distorted images and out-of-focus interpretations. The closed world which he describes and analyses is an imaginary world—if his book is any guide, the American political imagination is a fertile and inventive one, given to flight from the real world. Edwards' account of the imaginary world and its development draws on and perpetuates the folklore of Cold War and American nuclear strategy; this folklore has achieved a high measure of academic respectability in the United States, and elsewhere. To be sure, Edwards does not simply accept the folklore chapter and verse—at times he refuses to be taken in by it, and offers worthwhile correctives to its pro-American, anti-Soviet excesses. However, enough of the folklore survives intact in his book to leave his history of computers in the Cold World seriously wanting at key stages and in important respects.

The Folklore of Cold War and American Nuclear Strategy

According to the folklore, during the Cold War the strategy of nuclear deterrence created a sort of closed world in which the threat of massive, retaliatory nuclear strikes by the United States prevented or 'deterred' the Soviet Union from launching a massive, pre-emptive nuclear strike against America and its allies.[1] The success and efficacy of this system of nuclear threat and counter-threat were predicated on the ability of the United States to protect its strategic nuclear weapons and their 'delivery systems' (intercontinental jet bombers, intercontinental ballistic missiles) from destruction in a Soviet pre-emptive or first strike. Thus, the United States was only able to 'deter' a Soviet nuclear attack by preserving or protecting the retaliatory *capability* of its strategic nuclear forces. Protection of this capability would ensure that the United States would be able to launch a devastating retaliatory strike against the Soviet Union. Two of the requirements for the successful pursuit of a strategy of nuclear deterrence by the United States, then, were the development of a retaliatory capability large and strong enough to devastate the Soviet Union and the protection of this capability from a Soviet surprise, first or pre-emptive nuclear strike.

Taking this view of the strategy of nuclear deterrence and its requirements to its logical conclusion, it is evident that the United States and the Soviet Union were both locked into, or enclosed within, a 'delicate balance of terror'.[2] The delicacy of the balance was a function of the need for the United States to maintain, in a high state of readiness, a large enough strategic nuclear strike force to devastate the Soviet Union (including any Soviet nuclear weapons not used in a first strike) and to protect this force from a Soviet attack, however large. Maintaining a strategic striking force that was permanently at the ready to retaliate promptly and massively to a Soviet first strike was just as necessary for successful deterrence as was the protection of the force from destruction in such an attack. The retaliatory capability of the strategic force was predicated on its protection from attack. The slightest hint that American strategic nuclear forces were 'vulnerable' to a Soviet attack, and therefore bereft of sufficient retaliatory capability, would have invited just the calamity for the United States and its

allies that it was the weapons' sole purpose to prevent. In other words, 'vulnerability' undermined deterrence. Moreover, maintaining the force in a permanently high state of readiness demonstrated American determination and resolve, and therefore underwrote the credibility of America's retaliatory threats. Invulnerability, readiness and credibility were thus all necessary conditions of deterrence.

Looking beneath the 'delicacy' and 'terror' of the strategic nuclear balance into which the United States and the Soviet Union were both locked, the strategy of nuclear deterrence was in effect a practical prescription for the non-use of nuclear weapons, retaliatory or pre-emptive, by either side. How was this so? By the protection of a capability to devastate the Soviet Union even after it had launched a first strike, the United States would at once 'deter' the Soviet Union from using its nuclear weapons pre-emptively and obviate the need for the United States to use *its* nuclear weapons in a retaliatory manner. By steadfastly maintaining the 'balance of terror' in this way, not only would the United States keep itself and its allies free from the horror of nuclear war, but also, ironically, the Soviet Union (this was, after all, a condition of the United States itself avoiding nuclear holocaust). The 'delicacy' of the balance was a small price to pay for this highly laudable and mutually beneficial result. The 'logic of nuclear terror' was compelling and inescapable. Apparently inescapable, too, was the closed world it circumscribed.

Because nuclear strategy was in effect a process of issuing threats and counter-threats, the theory of games (or game theory) could be usefully employed in modelling and analysing the process and in determining the timing, magnitude and method of communicating threats in order to secure the most favourable outcome for the United States under the conditions which prevailed at any particular time. In other words, the beauty of game theory was that it seemed to model faithfully the closed world of the Cold War, and therefore appeared to be the perfect tool for devising and employing appropriate nuclear policies and strategies. Indeed, this evidently highly abstract mathematical model had a very real and a very important practical application—nothing less than ensuring the survival of the United States, its Western allies and Japan (and, by default, the Soviet Union). Game theory could not of course efface 'the Soviet threat' but it could certainly help in dealing with it in the most effective manner possible under very difficult circumstances for the United States.[3]

The theory of games, or game theory, was an ideal analytical tool for a situation in which two 'players' were inescapably locked in combat—more particularly, conflict that had the real potential to be mortal for both sides—in which, therefore, there had to be present some elements of cooperation if each was to avert total annihilation. Any cooperation between the two sides was a function of the desire of each to avoid its own devastation. In this situation, deterrence was the only logical, and prudential, strategy for the United States to adopt and follow. It has already been noted that this strategy effectively proscribed a Soviet first strike by ensuring that the United States had the capability to launch a devastating retaliatory strike even in the event of such a reckless Soviet action. Deterrence incarcerated the United States in a closed world strategic system, but it also so incarcerated the Soviet Union. The price of national survival for the United States was constant vigilance and the preservation of a retaliatory capability sufficient to enable an effective American counter attack. In effect, the price of survival for the Soviet Union, given that the United States was relying on the deterrent effect of the retaliatory capability of its nuclear weapons, was a moratorium on the pre-emptive use of its nuclear weapons. This moratorium was, of course, externally imposed which was one essential difference between Soviet and American nuclear strategy.

As was noted above, game theory was an abstract mathematical theory. It had

initially been developed to study economic behaviour, more specifically, the interdependent behaviour of individual buyers and sellers in the market place. However, it was believed by its practitioners to be equally useful in the analysis of social, political and strategic situations of all types where the participants were assumed to have both conflicting and common interests. It was also observed above that deterrence situations were presumed to be of this type and therefore could be included within the compass of game theory. Moreover, 'economic behaviour' and 'strategic behaviour' were presumed to be subject to the same conditions, opportunities and constraints—and therefore amenable to the same means and type of analysis—because states, like individuals, were regarded as rational, self-interested value maximizers. This, as is well known, is the founding assumption of classical economic theory and, by extension, neo-classical economic theory as well.[4]

The most important game theory practitioners were a group of strategic theorists at the RAND (Research and Development) Corporation, a 'think tank' located in Santa Monica, California which was established by the newly independent United States Air Force in 1946 to study problems of air warfare.[5] The most prominent RAND theorists during the 1950s were Albert Wohlstetter, Bernard Brodie, Thomas Schelling and Herman Kahn.[6] The RAND theorists were not so much concerned with the practicalities of nuclear deterrence, but established the theoretical underpinnings and constructed the conceptual framework of the strategy. These theorists, struck by the enormous chasm between conventional and nuclear weapons, but deeply worried about the aggressive and malevolent intentions of the Soviet Union, conceived of the strategy of deterrence. As seen, this strategy sought through the threatened or non-use of nuclear weapons to avert war by 'deterring' Soviet aggression.

The theory of games helped to generate the image of nuclear war as a potentially gruesome, but actually bloodless and clinical, game of ping-pong. Not only did it generate this image, it also made it a highly formalised abstraction. Game theory analysed not so much the reciprocal strategic behaviour of the United States and the Soviet Union *qua* states as the reciprocal behaviour of two abstract strategic nuclear *systems* which were in grave, indeed mortal, conflict with each other. In other words, the US and the USSR were not regarded as historical, political and cultural entities but rather as complex combinations or systems of human beings and machines each of which was somehow driven by ideological animus toward the other (the Soviet Union more so than the United States).

Game theory both accommodated and reinforced the view of the conflict between the United States and the Soviet Union as a game in which the adversaries were little more than complex but simple-minded machines that were engaged in a childish, you-started-it-first, tit-for-tat contest or competition—but one played for incredibly high stakes. Game theory insisted that one's own best moves could only be planned if due regard were given to what the enemy's best moves would be under the same circumstances. Thus if, as in the early Cold War, American strategic bombers were stationed at bases in close proximity to the Soviet Union, according to conventional military logic they would have been able swiftly and easily to strike at targets within the territory of the USSR. However, as cautioned by game theory, the Soviet Union would have been able at least as easily and swiftly to strike and destroy the American bombers.[7] Given the view of the Soviet Union and its intentions then prevalent within the strategy and policy making circles of the United States, the American bombers were believed to be much more vulnerable to Soviet attack than Soviet targets were to an American strike precisely because the Soviet Union was much more likely to launch a first strike than the United States. The 'ideological animus' of the Soviet Union towards the United States was

malevolent and aggressive, that of the United States towards the Soviet Union essentially righteous and defensive.

It is precisely because Edwards characterises the Cold War as a closed system, in which deterrence and the threat of the use of nuclear force were the key elements, that he finds in game theory such a useful metaphor for the Cold War and arms race. However, for him game theory is not simply a metaphor and model. In keeping with the folklore, he also regards it as a key tool used by those who actually formulated American nuclear weapons policy and strategy. This has enormous implications for his reconstruction of the history of computers and information theory, and for his exploration of the politics of discourse in Cold War America.

Edwards, the Cold War and Game Theory

Edwards defines a 'closed world' in vivid, almost lurid, terms:

> A 'closed world' is a radically bounded scene of conflict, an inescapably self-referential space where every thought, word, and action is ultimately directed back toward a central struggle. It is a world radically divided against itself. Turned inexorably inward, without frontiers or escape, a closed world threatens to annihilate itself, to implode (p. 12).

Armed with this definition, Edwards has no difficulty in likening the Cold War and nuclear strategy to a game, the rules and moves of which were specified by the theory of games. It should be pointed out, however, that while the strategy of nuclear deterrence as here understood, based as it is on the logic of game theory, created and circumscribed a closed world inhabited by the United States and the Soviet Union, the strategy prevented the closed world from annihilating itself. Put bluntly, it stopped the two inhabitants from blowing each other up, by imposing an effective moratorium on the pre-emptive use of nuclear weapons by the Soviet Union thus obviating an American retaliatory strike. The realities and exigencies of nuclear deterrence, *from which there was apparently no escape*, were what, in fact, saved the closed world from implosion. Edwards completely misses this point.

For Edwards, game theory is so important precisely because in the closed world the actual use of nuclear weapons was not possible and, therefore, nuclear strategy could be nothing more than a game. According to him, nuclear weapons were 'ultimate weapons' which imposed 'ultimate limits' on the use of military power. In view of the 'contradictions' and 'terrors' of these weapons, in the closed world 'war itself became as much an imaginary field as a practical reality' and nuclear strategy little more than a 'many-leveled game' (p. 14). Indeed, as Edwards argues, the imaginary in fact became more than real:

> Inside the closed horizon of nuclear politics, simulations became more real than the reality itself, as the nuclear standoff evolved into an entirely abstract war of position. Simulations—computer models, war games, statistical analyses, discourses of nuclear strategy—had, in an important sense, more political significance and more cultural impact than the *weapons that could not be used*. In the absence of direct experience, nuclear weapons in effect forced military planners to adopt simulation techniques based on assumptions, calculations, and hypothetical 'rules of engagement' (p. 14; emphasis added).

In the imaginary, closed world, game theory was the pre-eminent 'systems science' (other system sciences were cybernetics, information theory, communication theory and systems analysis). Conceiving of nuclear strategy as a problem that could be 'system-

atized, mathematized, modeled, and reduced to an algorithm', the strategic theorists at the RAND Corporation found in game theory the perfect tool of analysis (p. 114). It followed that for these strategic theorists, the weapons of nuclear war, the United States and the Soviet Union, and nuclear war itself were all highly complex systems subject to rational–technical control; the combination of these systems in the Cold War produced an even larger and more complex system also subject to rational–technical control. According to the theorists, game theory allowed them—and the policy makers and military planners they supposedly advised and guided—to exercise such control. The application of statistical theory, systems analysis and game theory to the analysis and modelling of nuclear war relied heavily on the use of digital computers. It was little wonder, then, that at RAND nuclear strategy became a matter of algorithms, electronics and programmed systems.

In Edwards' view, closed-world discourse led US military planners and policy makers into an excessive reliance on computers and related high-technology weapons systems. This discourse, which named 'a language, a worldview, and a set of practices', combined and was constituted by (amongst other things): '[t]echniques drawn from engineering and mathematics for modeling aspects of the world as closed systems'; and a 'language of systems, gaming, and abstract communication and information that relied on formalisms to the detriment of experiential and situated knowledge' and included a 'number of key *metaphors*, for example that war is a game and that command is control' (p. 15).

Closed-world discourse and the technologies with which it was associated played an important part in American attempts 'to manipulate world politics'. This discourse describes the 'language, technologies and practices that together supported the visions of centrally controlled, automated global power at the heart of American Cold War politics', a discourse created and sustained with the indispensable support of computers. Computers 'allowed the practical construction of central real-time military control systems on a gigantic scale' and 'facilitated the metaphorical understanding of world politics as a sort of system subject to technological management' (p. 7). The metaphors, technologies, techniques, fictions and so on which were constitutive of closed-world discourse 'linked the globalist, hegemonic aims of post-World War II American foreign policy with a high-technology military strategy, an ideology of apocalyptic struggle, and a language of integrated systems' (pp. 7–8).

Not only was closed-world discourse central to American ambitions for world control, so was cyborg discourse—the 'discourse of human automata: of cybernetic organisms for whom the human–machine boundary has been erased'. The 'collaboration' of these discourses was both material and metaphorical. It was material 'when artificial intelligence technologies and human/machine integration techniques were used for military purposes' and metaphorical in the creation of an 'interpretation of the inner world of human psychology as a closed and technically manipulable system' (p. 27). With the boundary between humans and machines obliterated, and human beings effectively reduced to programmable sub-systems of ever more complex closed, human/machine systems (including, ultimately, the overarching system of nuclear conflict and Cold War), the world became much more amenable to rational–technical control. Game theory modelled this world perfectly and served as the most effective tool for manipulating it. Without digital computers, game theory would almost certainly not have had such applications.

Computers, Game Theory and Nuclear Strategy in the Closed World

Edwards is probably correct in asserting that 'RAND's most important contribution was not any specific policy or idea but a whole way of thinking: a systems philosophy of

military strategy', specifically, the strategy of nuclear war. He is also correct in crediting such RAND strategic theorists as Brodie, Wohlstetter and Kahn with developing the 'key nuclear-age concepts' of 'nuclear deterrence' and 'limited war' (p. 116).

However, Edwards is much wider of the mark when he gives the RAND theorists credit for formulating 'nuclear war-fighting doctrine'. It will be seen below that the strategic and war planning undertaken by such agencies as the Joint Chiefs of Staff (JCS) and the Strategic Air Command (SAC) was always predicated on the pre-emptive use of nuclear weapons, not, as with the strategic theorists, on preserving their retaliatory capability in order to deter a *Soviet* pre-emptive strike, thereby obviating the use of nuclear weapons altogether. Put another way, these agencies planned to use nuclear weapons in accordance with a doctrine of war-fighting which regarded nuclear weapons as qualitatively little different from 'conventional' high explosive and incendiary weapons and therefore just as potentially useable as were their conventional counterparts. In short, the theorists' philosophy of military strategy, given expression in the theory of nuclear deterrence, was radically at odds with the view of nuclear strategy nurtured within the strategic and war planning agencies and thus also with the war plans they produced.

This cleavage between theory and strategy was only heightened by the theorists' use of game theory, systems analysis, statistical techniques and so on which took to a higher level of abstraction their belief or assumption that 'deterrence', as they understood the term, was the sole purpose of nuclear weapons. As the theory of deterrence became more and more abstract, so did it become less and less relevant to the concerns and preoccupations of the military planners. Because computers enabled game theory and associated models and techniques to be applied to strategic analysis, they also played a large part in taking deterrence theory to ever higher levels of abstraction—and irrelevance.

As observed by Edwards,

> [t]he effect of computing at RAND was to increase vastly the abilities, and with them the ambitions, of systems analysts and others concerned with mathematical modeling and simulation. The appearance of 'hard' answers achieved by extensive quantitative analysis and simulation lent an air of certainty to results even when based on uncertain assumptions, especially at a moment in American history when the prestige of science and technology had reached an all-time peak. By 1960 RAND estimated the amount of its total effort devoted to 'analytical, computer, and simulation techniques' at 18 percent, not including an additional percentage devoted to computers in weapons systems (p. 121).

Computers were at the interface of humans with other complex technologies. Enabling humans and machines to interface, computers constituted—'conceptually, practically, and metaphorically'—hybrid human/machine organisms as information processors (p. 125). Computers also helped to create a 'closed world of semiotic values' which served as the backdrop for imaginary, bloodless wars in which non-usable weapons and strategies could be tested and nuclear war scenarios played out without the combatants getting their hands dirty or soiling their consciences.

According to Edwards, '[t]o a remarkable extent the Cold War was actually prosecuted through [computer-generated] simulations' (p. 120). Indeed, the computer simulations of imaginary nuclear wars were 'more than a game' for, he contends, computers enabled 'computer-age commanders' to conduct nuclear wars using 'equipment that not only resembled, but sometimes actually *was*, the equipment used for real war'. Thus, '[t]he closed world within the machine, and the closed world of real strategy

it supported, blurred together in an intricately woven, discursively constituted whole' (p. 125).

Because Edwards believes that the Cold War was 'actually prosecuted' using computer simulations, he is able to contend that it 'can best be understood in terms of *discourses* [such as those of the closed-world and the cyborg]'. These discourses linked technology to strategy and culture, humans to machines, nuclear war to computer-generated games played by cyborgs, and reduced the United States and the Soviet Union to simple-minded, disembodied abstractions. The Cold War was 'quite literally fought inside a quintessentially semiotic space' which existed in 'models, language, iconography, and metaphor, embodied in technologies that lent to these semiotic dimensions their heavy inertial mass' (p. 120).

Edwards' use of the phrase 'heavy inertial mass' implies that the reality of Cold War and American nuclear strategy was not entirely as he describes it. It also opens up for investigation the possibility that, if the weapons of nuclear war themselves had a weighty inertial mass, then so did the agencies in the American state, such as the JCS and SAC, which were responsible for strategic and war planning. This would suggest that in any history of the Cold War, nuclear strategy and computers, the influence of these agencies should be, to continue with the metaphor, given due weight. Questions about their conception of the proper purpose of nuclear weapons and their view of what sorts of weapons, delivery systems and command and control technologies an effective nuclear strategy required would then have to be asked and adequate answers to them sought. This would expose the extent to which the imaginary closed world of simulations and games portrayed in Edwards' book, and in the folklore of Cold War and nuclear strategy, diverged from the real world of nuclear weapons and American strategy. After all, the task of nuclear war planning was not just a virtual game played with high technology toys in a simulated world represented by colourful graphics on blinking computer screens. It was a much more serious and potentially much deadlier exercise than that. In the real world, therefore, computing and war machines played a very different role from that which they played in Edwards' closed world.

The Real World of Nuclear Weapons and American Nuclear Strategy

In an apparent vindication of the strategic theorists' ideas about the purpose and role of nuclear weapons, a national policy of 'deterrence' was approved by the American National Security Council (NSC) in November 1948.[8] This policy made possession of the atomic bomb the centrepiece of American strategy. However, this was an apparent and not an actual vindication because there were two conflicting concepts or notions of 'deterrence' then (and for most of the Cold War) in circulation in the American strategic community. One of these concepts belonged to the strategic theorists and the other to the strategic and war-planning agencies. The folklore of Cold War and American nuclear strategy fails to account for the fact that there was not one but two concepts of 'deterrence' which were, moreover, entirely inconsistent with one another. Because there is no acknowledgement in the folklore of the existence of two concepts of 'deterrence', the belief or assumption that the strategic theorists invented American nuclear strategy, which is central to the integrity and persuasiveness of the folklore, therefore is able to stand without challenge or qualification.

The national policy of 'deterrence' approved by the NSC in 1948 was, not surprisingly, an endorsement of the concept employed by the military planners who worked for the strategic and war planning agencies, not the theorists' concept. In what, then, did the military planners' concept consist, and how did it differ from the theorists'?

In 1948, prior to the first successful Soviet atomic test that was conducted the following year, for the military planners 'deterrence' was at best an unintended by-product—intimidation—of the planning for the early use of nuclear weapons in a war with the Soviet Union. Nuclear weapons were at this point regarded by the planners as a counterweight to an alleged Soviet superiority in conventional weapons (infantry, artillery, tanks, etc.) in Europe. After the Soviet atomic test in 1949, 'deterrence' for the planners became the by-product of planning for the pre-emptive use of nuclear weapons (basically, 'pre-emption' meant getting in the first blow, delivering a first strike). By the mid- to late-1950s both the United States and the Soviet Union had equipped themselves with thermonuclear weapons (hydrogen bombs) and intercontinental strategic bombers. At this time, 'deterrence' for the military planners (and, by extension, America's civilian policy makers) became squarely equated with pre-emption itself. That is, by the mid-1950s the military planners were firmly of the view that, in order to 'deter' a Soviet first, pre-emptive or surprise attack, it had to be pre-empted. In other words, for the planners, an American first strike was the only way of 'deterring' a Soviet first strike.[9] This was a considerable distance indeed from the theorists' conception of 'deterrence'—as the credible threat of devastating retaliation. It was precisely because the planners did not regard nuclear weapons as a distinct class or category of weapons the sole purpose of which was 'deterrence' as understood by the theorists, that they were able to plan to use nuclear weapons in war with the Soviet Union and to do so in a manner which would forestall anticipated Soviet aggression.

Planning for nuclear war within the conceptual framework of pre-emption imposed very different priorities from those that would have been obtained had planning been in accordance with the strategic theorists' concept of nuclear deterrence. For example, while 'deterrence' as the theorists understood it required that the retaliatory capability of American nuclear weapons and their delivery systems be protected from a Soviet pre-emptive nuclear attack aimed at them, the military planners did not have to concern themselves with this issue. Instead, they were primarily concerned with the question of whether the weapons and delivery systems had the capacity to deliver a pre-emptive strike against Soviet strategic nuclear forces which would destroy the retaliatory capability of *those* weapons. This was the over-riding consideration in all American planning for nuclear war with the Soviet Union.

Strategic and war planning was a routine, bureaucratic process undertaken by military officers and civilian bureaucrats who worked in the planning agencies. Planning involved procedures and operations to which computers and related information and communication technologies could easily be applied or adapted. As David Rosenberg has pointed out, the formulation of nuclear strategy was a 'governmental process rather than an intellectual exercise', consisting of 'concrete decisions regarding war plans, budgets, forces, and deployments'.[10] The JCS strategic planners were responsible both for determining the deployment and manner of employment of available forces in a war in the immediate future, and with setting force requirements over the medium term (4–6 years). Amongst other tasks, they also set targeting and damage criteria for using nuclear weapons.[11]

SAC was the United States' strategic nuclear striking force which, at least until the early to mid-1960s, had primary responsibility for carrying out the massive 'time-urgent' nuclear strikes against Soviet targets which were specified in JCS war plans; it also annually submitted its own war plans to the JCS for review and endorsement. SAC thus had effective control over operational planning. This gave it the responsibility for preparing 'actual plans for war-time operations and employment, including target

specification, weapons and delivery systems to be used, weapons effects, and routes to and times over targets'.[12] These were all tasks requiring the computation and manipulation of large quantities of data and information, for which computers were well suited.

As the number of weapons in the American nuclear arsenal grew prodigiously through the 1950s—from 1000 weapons in 1953, the stockpile grew to a mind-boggling 18,000 by the end of the decade[13]—the scope of SAC's planned air offensive against targets in the Soviet Union and its Eastern European allies expanded accordingly. The prodigious growth in size of the arsenal necessitated a corresponding expansion in the fleet of delivery vehicles. As the stockpile grew, so did the number of targets but at a rate in excess of the arrival of new weapons. This created a need for new weapons and delivery vehicles, which in turn caused the target list to expand, and so on *ad infinitum*.

The rapid growth in the size of the weapons stockpile and delivery fleet, and the endless expansion of the target list (with targets combined and recombined in various 'target complexes' and 'target systems' to make a variety of attack options possible), produced logistical, organisational, resource allocation, budgeting and other problems for the Joint Chiefs, SAC and the United States Air Force (USAF). These problems were similar to those faced by managers in the mass production and distribution industries. Military planners and civilian managers were all concerned with maximising the effectiveness and efficiency and minimising the costs of the systems that they oversaw. It was here that such systems sciences as systems analysis could be useful, for they grew out of models and techniques which were developed to assist in the management and control of these industries and other large, highly complex systems. The point, however, is that these systems sciences, and the information and computing technologies which enabled them to be used in a variety of civilian and military contexts, were employed by the military planners and the strategic theorists but for different ends which were dictated by their radically different assumptions regarding the proper purpose and role of nuclear weapons. Nowhere was this more clearly the case than in Albert Wohlstetter's work for SAC.

In 'A Delicate Balance of Terror' Albert Wohlstetter demonstrated that 'vulnerability' was the lynch-pin of a strategy of deterrence as conceived by the theorists. This article summarised two highly classified reports that had been prepared for SAC earlier in the 1950s by Wohlstetter himself and a team of other analysts at the RAND Corporation.[14] In the two studies, Wohlstetter and his cohorts had shown that, based on the assumption that SAC's bombers comprised a deterrent force, SAC's overseas bases (and the aircraft stationed at them) were vulnerable to a surprise Soviet attack and therefore did not have the capability to deter such an attack. Thus, at precisely the time that the military planners at SAC (and the JCS) were thinking of 'deterrence' in terms of pre-emption, Wohlstetter was warning that they did not have the retaliatory capability to deter a Soviet pre-emptive strike. Indeed, Wohlstetter was driven to publish the 'Balance of Terror' article by his frustration with the SAC military planners who refused to heed his advice precisely because they were not interested in 'deterrence' as he and the other strategic theorists such as Bernard Brodie conceived of it.[15]

The first of his reports in particular demonstrated that systems analysis and related systems sciences could be profitably employed in strategic analysis. This classified report, *The Selection and Use of Strategic Air Bases*, reported the findings of the study that had been conducted by Wohlstetter and his team into alternative basing systems for SAC's bombers (including the then-programmed system). The study considered the comparative

costs and benefits of the different basing systems against the vulnerability of each to a surprise Soviet attack. The retaliatory capability of the strategic striking force hinged on the vulnerability of the bases at which it was located. Thus, the effectiveness of each basing system was judged in terms of its vulnerability for, of course, the capacity of nuclear weapons to deter an enemy nuclear attack was inversely proportional to their vulnerability. The important point here is that Wohlstetter's study helped to establish the view among the strategic theorists at RAND that *quantitative* strategic analysis was good strategic analysis.[16] Systems analysis was a vehicle for the direct application to strategic analysis of the mathematical and statistical methods of neo-classical economics and econometrics—and of computers.

Wohlstetter's two reports recommended a number of steps that should be taken by SAC to protect the retaliatory capability of the bombers (and, therefore, their capacity for 'deterrence' in the strategic theorists' sense). One of the recommendations of R-290, the second report, was that the bombers of SAC be placed underground in hardened shelters to protect them from a Soviet surprise nuclear attack thus safeguarding their retaliatory capability. It also recommended that SAC adopt several other ground defence measures to protect the bombers. SAC, not surprisingly, wasn't at all interested in ground defence systems—what would be the point in having its bombers sitting on the ground passively awaiting a Soviet pre-emptive strike? After all, SAC's war planning was based on the assumption that the Soviet Union, like the United States, gave top priority to pre-emptive counterforce targeting—the targeting of the enemy's nuclear weapons and delivery systems in a first strike.

The basing system chosen by SAC, contrary to Wohlstetter's recommendation, placed a heavy reliance on aerial refuelling thus enabling intercontinental operation of its bombers (Wohlstetter had recommended ground refuelling at overseas bases). These measures were designed to allow SAC to deliver a quicker, more effective pre-emptive strike and to reduce the importance of overseas bases. As the B-52 bomber (with genuine intercontinental range) became available in numbers through the mid- to late-1950s (and, later, intercontinental ballistic missiles), SAC was able to realise its ultimate goal of developing a 'true inter-continental bombing capability', making overseas bases redundant.[17]

It should not be thought that SAC was altogether blasé about the problem of vulnerability. Its planners were concerned with the bombers' vulnerability to enemy air defence fire on their way to the single massive pre-emptive strike they planned to execute in the event of war, while they were delivering the attack, and on their way back home after the attack. Readiness was also a concern. SAC planners were worried about the timing of the planned offensive—they wanted to ensure that SAC would be able to pre-empt the feared Soviet pre-emptive strike.

With these concerns and worries in mind, SAC improved response and tactical warning times. In the late-1950s it was also making arrangements to put about a quarter of the B-52s on airborne alert. However, because of the prohibitive cost of continuous airborne operations, the JCS while in principle supporting the notion of airborne alert, decided that it should only be put into effect when it was absolutely necessary to do so. Instead, by 1959 one-third of the bomber force had been put on ground alert. Showing scant regard for the problem of vulnerability as Wohlstetter and the other strategic theorists conceived of it, in 1957 SAC began to cut back on air defence missiles, jet interceptors, survivable command and control systems and other air field defence programmes.[18] Curiously, given his account of American nuclear strategy in 'the closed world', this is an episode which Edwards himself recounts (p. 110).

It would be wrong to conclude, however, that SAC regarded command and control

systems, particularly computerised and highly centralised ones, as unimportant to its mission and operations. It was very interested in them, but only to the extent that they increased the likelihood that a pre-emptive strike executed by its bombers and missiles would be successful. This is precisely why it was not worried about their vulnerability (or, 'survivability'). The SAC Control System (SACCS) was one such computerised command and control system. As Edwards admits, SACCS was a 'control system for penetrating the closed Soviet empire', not for warning of and intercepting an impending Soviet pre-emptive strike (pp. 107–8). SACCS' software had 'over a million lines', 'consumed 1,400 man-years of programming' and was the 'first major system ever programmed in a higher-level language' which, moreover, was created especially for the system (p. 107). This system and its successors, like the World-Wide Military Command and Control System (WWMCCS), were designed to augment SAC's offensive capabilities.

Conclusion

Edwards is aware that the closed world of computer simulations and nuclear games which he describes is an imaginary place. The real world of nuclear weapons and American nuclear strategy was considerably more open and, therefore, vastly more dangerous than he pretends. Its openness was largely a product of the planning for the pre-emptive use of nuclear weapons routinely carried out by the American war-planning agencies. Had Edwards paid more attention to the activities of these agencies, and their conception of the proper purpose of nuclear weapons, he would have had to acknowledge the extent to which the real world diverged from the imaginary closed world of computer-generated simulations and clever games portrayed in his book. A quite different history of computers and information theory and the role they played in American nuclear strategy would have been the result.

Notes and References

1. Other works which give voice to the folklore include, for example: Fred Kaplan, *The Wizards of Armageddon*, Simon & Schuster, 1983; Alexander L. George and Richard Smoke, *Deterrence in American Foreign Policy: Theory and Practice*, Columbia University Press, New York and London, 1974; Barry H. Steiner, 'Using the absolute weapon: early ideas of Bernard Brodie on atomic strategy', *The Journal of Strategic Studies*, 7, 4 December 1984, pp. 365–93; and Michael Howard, 'The classical strategists' in his *Studies in War and Peace*, Maurice, Temple, Smith, London, 1970. The folklore is subjected to sustained critique in Mark Rix, *Discipline and Threatened Punishment: The Theory of Nuclear Deterrence and the Discipline of Strategic Studies, 1946–1960*, Ph.D. thesis, University of Wollongong, 1997.
2. This was the title of a paper by Albert Wohlstetter published in *Foreign Affairs*, 37, January 1959, pp. 211–34. Wohlstetter was a leading RAND strategic theorist in the 1950s and early 1960s. 'The Delicate Balance of Terror' is examined later in this article.
3. For an extended study of how game theory could be profitably employed in the analysis of strategic problems such as 'deterrence' (as understood by the strategic theorists) see Thomas Schelling, *The Strategy of Conflict*, Oxford University Press, London, Oxford and New York, 1963 (reprinted 1973).
4. John Von Neumann and Oskar Morgenstern, *Theory of Games and Economic Behavior*, Princeton University Press, Princeton NJ, 1944. In this book, the authors attempted to demonstrate that game theory could be applied to economic behaviour and all types of social and political conflict.
5. For a study of the RAND Corporation and the activities of its personnel, written from the perspective of the folklore, see Bruce L. R. Smith, *The RAND Corporation: Case Study of a Nonprofit Advisory Corporation*, Harvard University Press, Cambridge MA, 1966.
6. The founding work in deterrence theory is Bernard Brodie (ed.), *The Absolute Weapon: Atomic Power*

and World Order, Harcourt, Brace &Co., New York, 1946. Brodie's *Strategy in the Missile Age*, The RAND Corporation/Princeton University Press, Princeton, NJ, 1959, is arguably the most authoritative work in deterrence theory published in the 1950s. See also H. Kahn, *On Thermonuclear War*, Princeton University Press, Princeton, NJ, 1960.

7.   This insight informed the RAND studies of SAC's system of air bases which were conducted by a team of RAND analysts led by Wohlstetter. The findings of these studies (discussed below) were summarised in the 'The Delicate Balance of Terror'.

8.   NSC 20/4, 'US objectives with respect to the USSR to counter Soviet threats to US security', 23 November 23 1948, in Thomas H. Etzold and John Lewis Gaddis (eds), *Containment: Documents on American Policy and Strategy, 1945–1950*, Columbia University Press, New York, 1978, pp. 203–11.

9.   An extended discussion and analysis of the development of the military planners' concept of 'deterrence' appears in Mark Rix, *op. cit.*, Chapters 4 and 5.

10.   David Allen Rosenberg, 'U.S. nuclear strategy: theory vs. practice', *Bulletin of the Atomic Scientists*, March 1987, p. 20.

11.   David Allen Rosenberg, 'The origins of overkill: nuclear weapons and American strategy, 1945–1960', *International Security*, 7, 4, Spring 1983, p. 9.

12.   *Ibid*, p. 10 and Rosenberg, *op. cit.*, 1987, p. 21.

13.   Rosenberg, *op. cit.*, 1983, p. 23.

14.   The first of these reports is R-266 (the number which it was assigned at RAND), *The Selection and Use of Strategic Air Bases*, RAND Corporation, April 1954; and, the second, R-290, *Protecting US Power to Strike Back in the 1950's and 1960's*, RAND Corporation, 1 September 1956.

15.   Brodie revealed this to be the case in B. Brodie, 'The development of nuclear strategy', *International Security*, 2, 4, Spring 1978, pp. 67–8.

16.   This point has been made by Kaplan, *op. cit.*, pp. 109–10.

17.   SAC Commanding General Curtis Le May quoted in D. A. Rosenberg, '"A smoking radiating ruin at the end of two hours": documents on American plans for nuclear war with the Soviet Union, 1954–1955', *International Security*, 6, 3, Winter 1981/82, p. 28.

18.   Rosenberg, *op. cit.*, 1983, pp. 47–9.