Gaming the "System of Systems"

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> "As military science develops, innovation tends to be more difficult than less . . . . In these circumstances, when everybody starts wrong, the advantage goes to the side which can most quickly adjust itself to the new and unfamiliar environment and learn from its mistakes." -- Sir Michael Howard, RUSI, 1974

For the third time in this century, the United States is attempting to develop a coherent vision of future armed conflict during an "interwar" period. Again, as was the case following the conclusion of the World Wars, military funds are being constrained, forces reduced, and functions questioned. In an attempt to adjust to these downward trends while preserving their own essence and influence, the armed services are now engaged in a variety of technical, strategic, and doctrinal forecasting efforts to formulate the most likely contingencies and forces "after next."

The key to success in this process, as Sir Michael Howard noted a quarter century ago, is a willingness to experiment and to learn from one's mistakes. Surely, mistakes will be made, because our defense planners face a challenge of enormous complexity. Traditional military missions, once separated in time, distance, platform, and function, are now being fused. This integration of surveillance, information, battle management, and precision strike has become known over the last few years as a "system of systems." Its future shape, sketched by open architectures and subject to serendipity, is far from clear. To develop the necessary coherence in an unsure environment with unclear concepts is truly a daunting task, but one that cannot be deferred.

One of the more useful methods of peering into an uncertain future, history has suggested, is the use of wargaming. Contemporary lessons of wargaming can add considerable richness in strategic thinking to the rather perfunctory exercises in post-Cold War downsizing that presently dominate American efforts at sizing and shaping the armed forces of the future. This article reviews briefly some of the contributions of wargaming in the past, notes ongoing efforts during the present "interwar period," and risks identifying the most important contributions that current conflict simulations are likely to make to the evolution of US armed forces.

Concept

Since the end of the Cold War, efforts to affect the size and shape of future US military forces can be divided into two principal approaches having very different methodologies and strikingly different implications. The first set of studies, driven primarily by budget concerns in their fashioning of a smaller and more affordable version of Cold War forces, demonstrates the implicit hazard of "making yesterday perfect."[1] Examples of this approach include the Base Force of the Bush Administration, the Bottom-Up Review in the first Clinton Administration, and now the Quadrennial Defense Review. Despite being repackaged with new-sounding phrases (e.g., "major theater wars" and "small-scale conflicts") these would-be strategies feature nothing more innovative than straight-line reductions drawn proportionately across service budgets and programs. The apparent outcome, if not the purpose, of these quadrennial reviews is being able to fight the last war more affordably.

The second effort--far more interesting, much less publicized, and far richer historically--is the conduct of simulated conflicts, or wargames, in the laboratories of the nation's think tanks and war colleges. Here the country's strategists, rather than its accountants, wrestle with constrained budgets, demanding scenarios, plausible adversaries, and multiple contingencies in an attempt to "look back from the future."[2] The purpose of these politico-military games is to

provide insights and gain a common understanding of the hypothetical contingencies, level of conflict, technical leverage, operational concepts, doctrinal relevance, and organizational structures that have merit across the planning spectrum over the longer term. That is a big task, but the iterative nature of numerous exercises conducted over many years, while incorporating the views of a multitude of players, can produce meaningful insights.

Key to the long-range planning approach embedded in wargaming is appreciation of our current situation and its historical antecedents, if any. Andy Marshall, the Director of Net Assessment in the Pentagon and a notable consumer of wargaming, has argued that the circumstances facing the United States today, in terms of strategic uncertainty, are quite similar to those we confronted in the early 1920s.[3] The beginning of that interwar period saw the emergence of new technologies with startling potential military applications. In that period of politico-military uncertainty, the collapse of our principal adversary, and no declared opponents, it was far from clear how we might apply those capabilities to deter or defend against a future threat. During that 20-year period, wargames not only calculated the results of colliding military forces, but also offered an opportunity to prepare and to innovate before the war clouds gathered on the horizon. If similar fortunes are now at hand, can they be integrated and managed in the context of a "system of systems"?

Interwar Gaming: Service and Platform Specific

A great deal of analytical thinking about military matters conducted during the 1920s and 1930s was aided and facilitated by conflict simulations. For the most part, however, these wargames tended to be service specific, with little participation by other services. For example, the Naval War College initiated a series of wargames to determine the relative utility and employment of aircraft carriers versus battleships, the Army experimented with the employment of tanks on infantry-dominated battlefields, and the Air Corps Tactical School developed concepts for strategic bombing and close air support. These weighty issues suggest that the term "war*game*" should not be interpreted to connote a less than serious approach. The archives at the Naval War College in Newport, Rhode Island, document more than 300 wargames played during the interwar period, many of which stressed the strategic environment of war in the Pacific and the operational concepts for employing aircraft carriers in such a conflict.[4]

Using insights generated by the strategic "chart maneuvers" conducted at its War College (and reinforced by tactical experience), the Navy developed the requirements for a measured, step-by-step offensive campaign, and began to appreciate the potential of naval aviation to operate as a principal offensive system, rather than as a "scouting arm," for the main battle fleet.[5] Through gaming and exercises, US naval aviators developed several important hypotheses: the principal role of the carrier would be to defeat the opponent's attacking aircraft carriers; a key measure of carrier effectiveness was the number of aircraft that could be airborne simultaneously, and an aircraft carrier's contribution was substantially enhanced when two or more carriers operated together.

Although the wargaming initiatives at the Naval War College may be the best known American efforts at interwar innovation, the other services were also engaged in efforts to define their future. During the period in question, from 1918 until 1940, the Army War College, then located at the Washington Barracks, now Fort McNair, focused on the following issues:

- World War I mobilization lessons learned
- The organization and workings of the French and German general staffs
- The role of the motorized vehicle and of aircraft in future conflicts[6]
- Projections of the effects on future war of emergent technologies such as portable radios[7]

While Eisenhower's anecdote on being counseled by the Chief of Infantry to desist from his innovative tendencies is widely cited,[8] it is not generally appreciated that the Army actively engaged in future war planning during this period, specifically in the development of War Plan ORANGE, the US strategy to defeat Japan in the Pacific. Although the Army adopted a far more defensive stance and frequently questioned the wisdom of extending an open ocean war to the Far East, it also recognized that a Japanese threat to US Pacific territories justified investments in air power, shore fortifications, and mobile defenses. In a rare display of interservice cooperation, the Army in the 1930s recognized the need for Marine Corps amphibious capability to conduct opposed landings on Pacific islands that in the future would be used as bomber bases.[9]

These early manifestations of what we have come to recognize as "jointness" imply that strategic thinkers were also busy at the Air Corps Tactical School at Maxwell Field, Alabama, the center of excellence for air power thinking between the wars. Many of the fundamental principles of a strategic bombing campaign were developed during this period, enabled by technical improvements in heavy bombers' range, payload, and defensive armament. In this case the Air Corps' system of professional military education served as incubator and evaluator in the development of air combat doctrine. In the 1930s version of this battle of personalities over roles and missions, it was the bomber advocates who prevailed over the fighter pilots.[10]

This brief accounting of a remarkable period in American military innovation serves as a reminder that strategic thinking and wargaming conducted during times of peace can produce significant advantages in subsequent conflicts. Caveats apply. Norman Friedman has pointed out that the benefits of gaming accrue when the assumptions on which they are based stay stable for a long period of time.[11] In the 1920s and 1930s the wargamers at Newport were able to anticipate almost every move their potential adversary might make (except *kamikazes*, as Nimitz noted in a postwar letter to the Naval War College), by rehearsing the naval war in the Pacific time and time again. Wargames also need to be verified in real-world exercises, and the Navy was able to conduct such demonstrations and incorporate those experiences into the next year's games. The US Army, however, did not conduct multidivisional maneuvers in the interwar period. Only at the Command and General Staff College at Fort Leavenworth could large-unit training occur, and that concept of training has been described by one source as "archaic," owing to its view of future land warfare being determined by the outcome of mathematical formulas.[12] Additionally, the Army Air Corps, lacking the number of airplanes required to conduct realistic exercises, inadequately tested its theory that a formation of self-defended bombers would always get through. That shortcoming would result in US airmen paying a high price in aircraft and lives lost when the interwar period came to a close and warfighting was a game no longer.

Cold War Gaming: Strategic and Global

Ignoring the brief interwar period between victory in the Pacific and initiation of the Cold War, the US-Soviet competition was the longest, most successful, and least bloody of all American "wars." Like the period between the World Wars, the international situation from 1949 to 1989 remained stable enough, and the identifiable adversary remained constant enough, to allow lasting assumptions and to permit repetitive exercises. Most fortunately, of course, the forces planned to support these simulations never had to be employed in a global conflict.

Wargaming during the Cold War initially focused on a hypothetical strategic nuclear exchange between the superpowers. The early versions of these games tended to rely on mathematical formulas that proved effective at calculating megadeaths but were unable to demonstrate much political relevance. Later versions of these wargames developed at the RAND corporation, however, began to factor in political role-playing, to test the requirements of nuclear deterrence and to develop alternative strategies such as "counterforce." In an attempt to deal with the uncertainties of nuclear warfare (a wargame that clearly could not be exercised with much fidelity in the real world), force planners at Santa Monica and in Washington began to develop hypothetical contingencies based on certain assumptions, and to explore the implications of those scenarios in a series of games with differing outcomes.[13]

As the nuclear stalemate deepened and variations on nuclear wargames were depleted, this way of envisioning future conflict returned to the gaming of conventional conflict and the planning of general purpose forces. And while there continued to be a focus on the quantification of opposing forces in plausible conventional conflict, there was also a concentration on the interaction that would occur as Soviet and American war planners examined their options in a dynamic environment. An understanding of this interaction, it was argued by a number of influential Cold War strategists, could be gained only through rigorous, iterative wargaming.[14]

The annual GLOBAL series at the Naval War College, which began in 1979, emerged as a highlight of Cold War gaming efforts. These wargames were established when conventional wisdom dictated that US naval forces in the Mediterranean would be destroyed by the Soviets in a matter of hours, and that remaining American forces would be well advised not to proceed more than halfway across the Atlantic owing to the Soviet submarine threat. These assumptions were tested and found to be flawed. It became clear that although the initial emphasis was on naval force employment in a global environment, the activities of the other armed services would have a major influence on the game's outcome. Therefore, as the architects of the GLOBAL series have explained, by the end of the first five-year

series the interaction of military play was clearly joint with the full cooperation of the Army and Air Force war colleges at Carlisle and Maxwell.[15]

As important as the joint, interactive nature of the game was, GLOBAL increasingly was recognized for the realism injected into the decisionmaking that represented what might be expected in a global superpower military confrontation. Also significant in these early games was an evolution of offensive strategies on the part of the "Blue" force as the players began to appreciate the survivability of forward-engaged maritime forces and the synergistic contributions of joint and combined forces. Equally revealing was the shift over time to an outcome that favored conventional rather than nuclear escalation, and the opinion that US and NATO forces would ultimately emerge victorious from a conventional war of extended duration once the economic capacities of the West had shifted to military production. Issues of particular interest provided the foundation for the iterative process of "game-study-game." They included the following:[16]

- The absolute necessity for the prompt use of strategic warning
- The requirement to examine military strategies for protracted conventional war
- The need to explore the longer-term effects of horizontal escalation
- The benefits of early identification of technological needs

During the Cold War, the GLOBAL wargames were lauded for making significant contributions to the formulation of national military policy and strategy. One of the reasons for this favorable appraisal was the growing involvement of the military services and relevant civilian agencies of the federal government in a common forum. Another was the opportunity to challenge conventional wisdom by imposing real-world constraints on untested theories. Much like the games of War Plan ORANGE in the interwar years, wargaming proved its value, whether in the questioning or disapproval of certain strategic concepts or in the documentation of what appeared to work. Finally, this sorting out of the conventional from the game-tested wisdom helped the players, in the real world after the exercise was over, to focus on the pertinent second-order issues. Although neither GLOBAL nor War Plan ORANGE can lay claim to winning the wars they gamed so often, in each case it was a process of education, the prospect of innovation, the evaluation of new concepts, and ultimately the focus on human decisionmaking that made the contributions of these wargames notable.

After the Cold War: Gaming a System of Systems

The discussion so far has suggested that wargaming clearly has something to offer the development of strategic thinking, but seems to work best where the external environment remains relatively stable and the strategic competition is long-term. Now, in a world perhaps even more complex than in previous eras, we are confronted with ongoing revolutions, declared and emerging rivals, transnational problems, troubled states, and a rash of regional flashpoints.[17] If the prescription for the kinds of military forces required to deal with such a wide range of contingencies is one of flexibility and agility, how might wargaming contribute to our post-Cold War strategic thinking?

Despite the recognized difficulty of wargaming in a time of uncertainty, there is renewed interest and activity in the armed services' use of wargames to prompt innovation and insight. The GLOBAL games at Newport continue to attract both quality players and great attention regarding their outcomes and findings. Recent reports include:

- The requirement for US attack submarines to demonstrate an ability to support joint operations in littoral waters
- The need for naval forces in the littoral to regard land-based theater ballistic missiles as a serious threat
- The expansion of the air superiority bubble over the beach, which extends as far inland as weapons can be fired from the littoral, and as high as necessary to intercept incoming ballistic missiles
- The reemergence of ocean mine warfare as a significant issue

In February 1997 the Army's Training and Doctrine Command (TRADOC) directed the first of an annual series of "Army After Next" (AAN) games--the AAN being viewed as what the presently planned "digitized" Army (Force XXI) could evolve into in two or three decades. Based largely on GLOBAL precedents, this was a three-week, 300-person effort based on a year 2020 scenario involving a strong peer competitor. To an extent and granularity never before approached, this wargame tested the strengths and vulnerabilities of a powerful US space-based C3I system,

closely integrated with the sensor and reporting technologies associated with surveillance and reconnaissance, and the linking of those information systems to platforms capable of precision strike--all key elements of a "system of systems."[18] This information infrastructure operated in support of an extremely mobile, nonlinear, and self-supporting Army "battle force," with US Marine Corps equivalents, having an improved ability to maneuver owing to a reliance on air- and naval- delivered long-range precise fires in lieu of organic artillery. Some findings of this game included:[19]

- The strong influence of space-based systems on ground combat operations
- The vulnerability of ground forces to information warfare attacks
- A reluctance on the part of national leaders to commit ground troops to a region early in a crisis
- Dramatically shortened time frames in which critical decisions had to be made

Gaming in an uncertain security environment challenges us to break with tradition and examine all assumptions if we are to gain insights into the future of war comparable in value to those generated during stable interwar periods. A useful framework for those developing and guiding forthcoming wargames is to suggest what we should *not* expect to gain from contemporary wargaming, what we have a right to expect, given both the accomplishments of the past and the challenges of the future, and finally what these games clearly offer to future national reviews of defense strategy and forces.

First, just what sorts of issues and ideas should we not expect from wargaming in the post-Cold War era?

- Not "tactics" per se. Tactics, in the last analysis, serve to implement or compensate for imperfections in hardware or doctrine, and are best developed by iteration in battle labs, simulators, and field exercises--as close to the realities of the battlefield as possible, and well positioned to quickly devise modifications or alternatives when surprise occurs.
- Not the relative "goodness" of a B-2 or Seawolf SSN as compared to competing vehicles, but rather the utility of "stealth" as one characteristic of a combat platform in its overall contribution to a successful campaign.
- Not an answer on how to defeat a particular enemy in a specific crisis, but insights into the complexities of warfighting at some time in the future.
- Not answers, but issues--how to conduct combat, not by whom or with what.

Next, what insights should we rightfully expect from joint, iterative, and continuing strategic wargaming, even in an era of uncertainty?

- A sense of the expected benefits accruing from platform and weapon characteristics, such as operational, precision, or near-precision strike capability and low or very low observability.
- Proposed strategies from which to extract suggested doctrine (at the appropriate doctrinal center), to shape exercises whose data, if successful, would support the formulation and evaluation of tactics (at battle labs).
- Potential generic advantages to be gained through deployment of new technologies applied to ships or aircraft, and air or space-borne anti- missile lasers.
- The retesting of traditional assumptions such as "nuclear attack submarines exist primarily to engage an opponent's submarines" or "if forward bases are unavailable to deploying ground-based tactical aircraft, the United States will not commit armed forces to a regional conflict." Similarly, we should expect warnings about drawing false conclusions, such as "the Navy will never operate aircraft carriers in the Persian Gulf."

Third, what trends appear to be emerging from contemporary wargaming that can help shape our (significantly downsized) armed forces for the next century? What are the lessons we have learned and where are the lessons to be learned? Thus far, in gaming a "system of systems," the following strategic concepts appear to be the most worthy of iterative study and refinement: surveillance and precision strike capabilities, information technology and warfare, advanced battle management, and, of course, the advantages that might accrue by using key capabilities in mutually supporting ways.

Surveillance and precision strike capabilities:

. Interwar games at the Naval War College indicated that aircraft carriers had to be faster than cruisers in order to survive. Similar survival-type games are needed to test current and planned precision strike platforms and systems, such as the survival of carrier battle groups in the littoral, a comparison of carrier battle groups with future surface combatant concepts, and the range and stealthiness required for carrier-based aircraft to prove effective and survivable.

. The February 1997 Army After Next wargame demonstrated that the space-based surveillance systems on which precision strike systems rely were vulnerable and that rapid access to space was a prerequisite for seizing and maintaining the initiative. Wargames must test the availability and utility of terrestrial and airborne surveillance systems, both primary and backup, to compensate for the disabling of space-based resources. They must also examine mixes of airborne and space-based, manned and unmanned, ground surveillance platforms and systems to ensure that a desired level of information reaches the services in a timely manner.

. A real revolution may be emerging with the ability to integrate sensors and weapons to a degree that precision attack opportunities could be recognized, approved, and executed for maximum effect. Such an integration of surveillance and precision strike systems could result in a strategic shift of emphasis to the development of new concepts of conventional deterrence, and to the primacy of the "halting" phase (as opposed to the "buildup" or "counteroffensive" phases) of a US military response to a cross-border invasion.

Information technology and warfare:

. Interwar games and cases point to the importance of developing visions of future conflict, and working them to discern how changes in the external environment could cause the next war to differ from the last.

. Wargames should be developed to provide insight into how required information can be selected from voluminous files, and how defense of one's own information systems and attack on the adversary's information systems will change the nature of the conflict.

Advanced battle management:

. In the 1930s, naval officers recognized that there could be no one best way to conduct a strategic war at sea against Japan; several possible ways had to be pursued simultaneously. In deterring nuclear war and in conducting conventional warfare, the United States has sought multiple avenues of attack and a variety of platforms, weapons, systems, and strategies. Wargaming future battle management systems should examine communication and connectivity architectures that remain open enough to allow innovation.

System of systems:

. Vision is necessary, but not sufficient, to achieve fundamental changes in service values and operational forms and formations. We need to test the balance among joint and combined platforms and forces and to prompt not only technical innovation but also doctrinal and organizational innovation.

. Constellations of advanced battle management and surveillance and precision strike systems--air, surface, and space assets--and individual system architectures, must be gamed and analyzed. These games must test denial of capabilities along linear and multiple dimensions, explore graceful degradation mechanisms, and seek robust and redundant systems.

. The advantages seemingly inherent in US assumptions about the ability of a "system of systems" to overwhelm any adversary may be short lived. In the longer term, those advantages may be considerably diminished as prospective adversaries with their own sophisticated command and information capabilities--acquired commercially--counter US

capabilities.

Observations

The value of wargames in this period will decline if we become complacent and intellectually formulaic in our gaming. Future wargames must rest on sound assumptions about the technical feasibility and affordability of the technologies inherent in a system of systems. Early wargames were not infallible in this respect: an assumption of Newport planners in the early 1920s was that the aircraft carrier--yet to be launched--might embark 100 to 200 aircraft, a significantly larger number than operated from World War II carriers.[20] Current efforts to game a system-of-systems approach can also fall prey to optimistic assumptions of dominant battlefield knowledge and a compliant adversary. If the rules of engagement give Blue perfect information in a frictionless environment, the outcome is preordained. If the going-in assumptions of a wargame are so favorable for one side over the other, it probably isn't really necessary to turn on the computer; a spreadsheet or back-of-the-envelope calculations can just as easily document the apparently desired output.[21]

Future wargaming always must be designed to accommodate actions taken by the adversary if we believe that US force deployment and employments depend on nearly flawless battlefield awareness. The value of recent wargames such as the Army After Next and its follow-on games may be in demonstrating that Red can sacrifice certain assets to degrade our assumed dominant information capabilities and leave us with few options. For that matter, the first use of weapons of mass destruction by a post-Cold War adversary at a GLOBAL wargame a few years ago proved to be such a devastating experience for conventional warfighters that it quickly brought the game to a halt. Each of these events demonstrates the importance of injecting friction-filled adversarial actions into wargames. We have to guard against complacency induced by unwarranted and inevitably unverifiable assumptions of dominant battlefield knowledge.

This article suggests that the challenge for future US defense policy is as much intellectual as strategic and economic. Furthermore, wargaming can help us think through continuing challenges in military affairs, if not revolutions, much as it did during previous interwar periods. This reminder of those beneficial efforts, when coupled with a framework for current wargaming and related advanced warfighting experiments (along with the necessary caveat that assumptions we fail to verify can prove misleading if not dangerous) may provide a useful context for creative thinking about the future of conflict. Sir Michael Howard concluded his advice a quarter century ago with the observation,

> I am tempted indeed to declare dogmatically that whatever doctrine the Armed Forces are working on now, that they have got it wrong. I am also tempted to declare that it does not matter that they have got it wrong. What matters is their capacity to get it right quickly when the moment arrives.

If we are diligent and fortunate in our use of wargames, we may "get it right quickly" before this interwar period also draws to a close.

NOTES

1. Gordon R. Sullivan and Michael V. Harper, *Hope Is Not a Method* (New York: Random House, 1996.)

2. Ibid., pp. 32-38. This is also the approach adopted by the US Air Force in its recent long-range planning effort and by the National Defense Panel, created by Congress simultaneously with the QDR, to provide alternative defense strategies and force structures for the longer term. See "Transforming Defense--National Security in the 21st Century," Arlington, Va., December 1997. Although some were disappointed with the NDP's failure to provide alternative force postures, the panel's view of the future cannot be categorized as "business as usual." In calling for a "transformation strategy," the NDP questioned the enormous planned investment in short-range "tactical" aircraft at the expense of long-range stealthy platforms and precision munitions, challenged plans for future tank and aircraft carrier production, and suggested that the cancellation of the arsenal ship and the curtailment of the Joint STARS acquisition plan were steps away from a revolution in military affairs.

3. A. W. Marshall, "Some Thoughts on Military Revolutions," Office of Net Assessment (OSD/NA) Memorandum, 27 July 1993, p. 2. See also, Thomas E. Ricks, "How Wars are Fought Will Change Radically, Pentagon Planner Says,"

The Wall Street Journal, 15 July 1994, p. A1.

4. Peter P. Perla, *The Art of Wargaming* (Annapolis: Naval Institute Press, 1990), pp. 72-73.

5. Aviation was included in annual fleet maneuvers in 1921; the carrier USS *Langley* participated in the Fleet Problem V exercise in 1925; and in 1929 two modern carriers, the *Langley* and the *Saratoga*, were available, See Robin Higham, *Air Power--A Concise History* (New York: St. Martin's Press, 1972), p. 62.

6. A notable contributor was then Major George S. Patton, who, in several articles in *The Cavalry Journal* and other venues, proposed a small professional army that would be virtually totally mechanized. For example, see "Motorization and Mechanization in the Cavalry," *The Cavalry Journal*, 39 (July 1930), 331-48; and "Memorandum for the Assistant Commandant: The Army War College--Subject: The Probable Characteristics of the Next War and the Organization, Tactics, and Equipment Necessary to Meet Them," 29 February 1932, US Army Military History Institute (USAMHI) archives, Carlisle, Pa., File #387-52. An early co-conspirator in this effort was Dwight D. Eisenhower (see Captain D. D. Eisenhower, "A Tank Discussion," *The Infantry Journal*, 17 [November 1920]). When both were instructed to stop writing such nonsense, however, Eisenhower did and Patton didn't. Even then, Patton held the view that horses would still be needed for the bulk transport of supplies to the front, and for classical cavalry scouting functions.

7. For insight into mid-1930s views on this subject, see "Course at the Army War College, 1933-1934, Conduct of War (1st Part), Analytical Studies (1st Period), Report of Committee No. 2; Subject: Development of Weapons and Means of Communications, 27 January 1934, USAMHI archives, Carlisle, PA, File #406-2.

8. Eisenhower was informed that if his post-World War I articles on the employment of tanks stated anything incompatible with infantry doctrine he would be court-martialed. Dwight D. Eisenhower, *At Ease: Stories I Tell to Friends* (New York: Doubleday, 1967), p. 173.

9. Allan R. Millett, "Assault From the Sea," in *Military Innovation in the Inter-war Period*, ed. Williamson Murray and Allan Millett (New York: Cambridge Univ. Press, 1996), p. 58.

10. Barry Watts and Williamson Murray, "Military Innovation In Peacetime," in Murray and Millett, p. 414.

11. N. Friedman, "The Maritime Strategy and the Design of the U.S. Fleet," *Comparative Strategy*, 6 (1987), 416.

12. Douglas A. Macgregor, *Breaking the Phalanx* (Westport, Conn.: Praeger, 1997), p. 165.

13. Fred Kaplan describes these early nuclear war games in *The Wizards of Armageddon* (New York: Simon and Schuster, 1983), pp. 201-19. See also Thomas C. Schelling, "The Role of Wargames and Exercises," in *Managing Nuclear Operations*, ed. Ashton Carter, John Steinbruner, and Charles Zraket (Washington: Brookings, 1987), pp. 426-44.

14. See Thomas C. Hone, "Force Planning Cycles: the Modern Navy as an Illustrative Case of a Frustrating Trend," *Defense Analysis*, 9 (No. 1, 1993), 31-42.

15. Bud Hay and Bob Gile, *Global War Game* (Newport: Naval War College, 1993), p. vii.

16. Ibid. p. ix.

17. See the Institute for National Strategic Studies, *Strategic Assessment 1997* (Washington: GPO, 1997).

18. William A. Owens, "The Emerging System of Systems," *US Naval Institute Proceedings*, May 1995, pp. 36-39.

19. "Early Results Indicate Space-Based Assets, Info-Age Tools Key to AAN," *Defense Information and Electronics Report*, 21 February 1997, pp. 17-18.

20. The Japanese attack on Pearl Harbor was conducted with 183 aircraft launched from six carriers, and the US attack

at the Battle of Midway consisted of 153 aircraft from three carriers. In both cases, only a handful of aircraft were held back for self-defense.

21. For example, the Department of Defense Heavy Bomber Study, conducted ostensibly to determine the utility of additional B-2 aircraft in future conventional contingencies, made such favorable assumptions in the baseline scenario regarding warning time, base availability, and tactical fighter deployment that additional bombers added little to the large force already present in the theater. See "A Precisely Guided Analytical Bomb," Fairfax, Va.: National Security Research, Inc., 1996.

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