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Since the end of the Cold War, the US Department of Defense has embarked on a series of studies and force planning efforts in an attempt to adjust its military strategies and force structure to an uncertain future. The most recent of these efforts have taken the form of the Quadrennial Defense Review (QDR) and its congressionally mandated corollary, the report of the National Defense Panel (NDP).[1] Despite congressional hopes that the QDR and NDP might produce alternative defense strategies and forces that could be compared side-by-side, that is not the way it turned out. The QDR took a relatively short-term look, expanded the scope of DOD's Bottom-Up Review (BUR), and kept major programs and budget projections essentially on track. The NDP adopted a longer-range view, called for additional funding to support a "transformation strategy" that would enable a "revolution in military affairs" (RMA), and questioned the future and rationale of certain major DOD programs.

Both studies note the tension between managing near-term threats and preparing to meet longer-term challenges, suggesting that there will be considerable pulling and hauling over the next few years as defense priorities and funding are manipulated to meet those competing needs. Both reports also recognize the importance of using wargames and experimentation to explore the military doctrines, operational concepts, and organizational arrangements needed to take advantage of the emerging RMA, as well as to develop and test "concepts and capabilities that will ensure the ability to transform for the future."[2] To assure Congress that his department had such work already under way, Secretary of Defense William Cohen, in a response to the NDP, described the number and variety of "transformation activities" that DOD has undertaken to improve understanding of the future security environment. In that response, he termed wargames a "critical tool for ensuring senior decisionmakers, joint force commanders, and their staffs are able to maximize 21st-century warfighting capabilities."[3]

As the nation embarks on a course of wargaming (defined in the 1999 Secretary of Defense's *Annual Report to the President and the Congress* as "carefully constructed simulations in which experienced civilian and military players . . . must make decisions regarding the use of force in the context of a future conflict scenario") and experimental exercises, it is important that those simulations seek basic truths about future military operations. But they must also reflect the realities of joint battlefields. All too often the outputs of wargames have been limited to their training value, or have been skewed because the players were allowed to take the future where they wanted it to go. Wargames frequently have been compressed into service-specific views and repertoires so that they validate, rather than challenge, current operational procedures and priorities. Our thesis is that wargaming will fail to meet the expectations of US defense planners unless the search for basic understanding of the future of war is coupled with the application and testing of these understandings in a joint arena.

The Basic and Applied Research of Wargaming

Wargaming is an established and time-honored mechanism through which proposed defense concepts, doctrine, and tactics are explored, and there is a rich literature that describes its uses and applications.[4] An attempt to develop a typology of wargaming would be quite complicated, however, and that is not our purpose here. Rather, if we categorize these efforts very generally, we note that one major use of wargaming is to examine what concepts, ideas, capabilities, or doctrines appear to have utility given a range of alternative futures, particularly for emerging or not-yet-fielded platforms and weapons. The best examples of these wargames may be the innovative games and chart maneuvers conducted at the Naval War College during the interwar period and, more recently, the Air Force series of Global

Engagement games in which airborne lasers, space planes, and space-based lasers were assumed to be operational in 2012.[5] A second use of wargaming is to explore how best to use the platforms and forces we plan to acquire in realistic future scenarios. Examples of this form of wargaming include the Navy's GLOBAL war games which developed new ways for naval forces to deter and defeat a Cold War adversary. Wargames have also been used, not always satisfactorily, to test the adequacy of current or planned forces in projected or official scenarios, such as those offered in support of the BUR and the QDR. Finally, of course, wargames can be used for other than analytical purposes, such as familiarizing key players with the capabilities of a specific armed service.

Given these different uses of wargames, it is not evident just what kind of gaming might be most useful in helping DOD deal with the uncertainties of the post-Cold War era. Certainly service-specific games (often referred to as "Title 10 games" in reference to the legislation authorizing the services to conduct wargames in support of their "organize, train, and equip" functions) will continue to have relevance. However, as noted above, single-service wargames find it easy to avoid the tough choices likely to be generated in a joint environment. If, as former Chairman of the Joint Chiefs General John Shalikashvili observed, the future of modern warfare demands that we fight as a joint team, then we must look for increasing interservice play from our games, simulations, and experiments. Too much of our current wargaming lies within the bounds of the separate services, neither examining complementary joint capabilities nor raising such issues as trade-offs between land, naval, and air forces. Moreover, the official gaming in support of major DOD reviews has tended to confirm the adequacy of current plans and programs under favorable assumptions, rather than to stress the planned force with challenges such as surprise attack, denial of in-theater basing, or asymmetric threats.

Nevertheless, we know that wargaming has proved fruitful in the past, particularly in times such as these when the United States has been granted breathing space allowing for innovation and experimentation. But taking advantage of this strategic pause demands the right kind of wargaming. Unfortunately, not only is categorizing wargaming by use or purpose problematic, it is also not particularly helpful in suggesting the kind of gaming that needs to be done in the years ahead. As an alternative, therefore, we would like to borrow the long-standing dichotomy between basic and applied scientific research as a more practical way of categorizing wargames. This perspective will suggest a fresh analytical approach that can help us make better use of wargaming in thinking about and planning for an uncertain future.

Since the end of World War II, the United States has viewed scientific research in much the same way as Vannevar Bush described it in his enormously influential report to President Harry Truman, *Science, the Endless Frontier*. Bush, the head of the wartime Office of Scientific Research and Development, stressed the need to have an almost Jeffersonian "separation of church and state" approach toward the funding and support of *basic* versus *applied* research.[6] In this context, basic research is motivated solely by a desire to contribute to the existing store of general knowledge, while applied research is directed toward a well defined use for an expected product.[7]

Bush's paradigm can best be envisioned as a linear one, in which basic research lies at the left end of a one-dimensional spectrum and applied research at the right. The seminal influence of this model can be charted to this day in the Department of Defense, where both focus and funding remain compartmented in separate segments of a sequence leading from basic to applied research, then to engineering manufacturing development, and finally to production. This linear approach to research methodology presumes that fundamental inquiry drives but always remains separate from practical applications. Recent rethinking, however, has subjected this linear relationship to substantial revision, with implications for both the process and products of wargaming.

In his book reexamining the relationship between basic science and technological innovation,[8] Donald E. Stokes suggested a more imaginative way of illustrating the interaction of scientific inquiry and application. By adapting the linear model positing a straightforward progression from basic to applied science, Stokes produced instead a matrix with four quadrants that more accurately depicts how scientific research can be inspired by a desire for knowledge or for intended application. His model (Figure 1) illustrates that scientific research may be guided by a quest for pure understanding, by a drive for practical utility, or *by some combination of both*.[9]

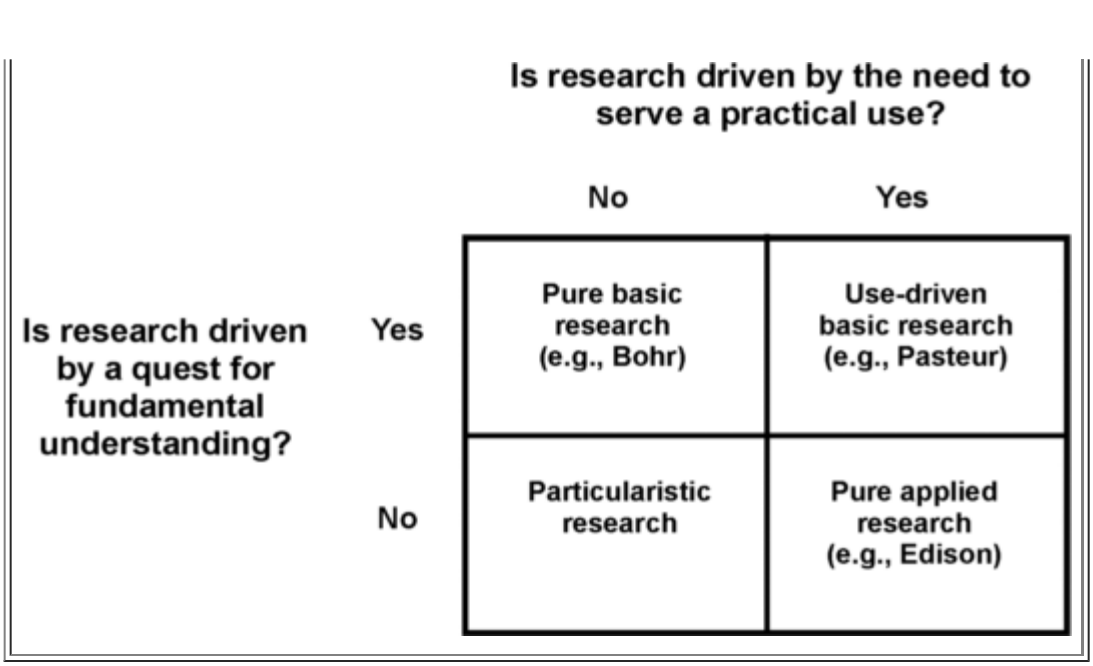

Figure 1. The Stokes Research Matrix.

Within this matrix, Stokes places Niels Bohr in the pure research quadrant: in concentrating on basic research, Bohr displayed little interest in any practical application of his model of the atom. He simply sought fundamental knowledge. Thomas Edison, by contrast, is placed in the pure applied research quadrant, suggesting that he cared little about the theory of electrons as long as he could get a light bulb to glow brightly for some usable length of time. Stokes's model also has a quadrant for Louis Pasteur, a man driven not only by the desire to understand the whys and hows of disease transmission, but also by a wish to protect people from milk-borne tuberculosis. If we accept this framework as a more faithful depiction of the relationship between basic research and applied knowledge, what are its implications for future wargaming?

Wargaming Quadrants

A quick application of this quadrant framework to the process and products of wargaming suggests the following. Bohr's quadrant of pure research has been left largely to academics, who have speculated on the evolution of aggression in human nature, man's proclivity for violence, and how the world's population might avoid Armageddon in spite of itself. Public and privately funded think tanks have occupied Bohr's quadrant for the purpose of predicting future international conflicts and examining how those conflicts might be deterred. RMA games, such as those conducted by the Air Force and the Navy to explore the varied concepts of operations and requirements generated by those alternative futures, also fit in this box.

However, for most of the last half century the armed services of the United States have necessarily been focused on application-inspired research, housed in Edison's quadrant. This has entailed conducting wargames involving a well-defined enemy--the former Soviet Union--with established intelligence-projected intentions and existing or planned military capabilities. The principal question of the applied wargaming effort was, given the services' existing force structures and the presumption that deterrence has failed, who would win, by how much, and what could be done to improve those forces to reduce any unfavorable consequences or outcomes.

Naturally, insights into basic issues happen along the way of practical application, and gaming efforts such as the Naval War College's GLOBAL exercises provided such a perspective.[10] But these insights generally have proved to be the exception. The Air Force's Global Engagement series of games also probably lies in Edison's quadrant, given its purpose of helping combatant command staffs incorporate air and space capabilities into their near-term planning. Unfortunately, according to some participants, this focus is occasionally obscured through the insertion of parochial agendas by agencies seeking to gain support for particular plans or programs. In the worst of cases, some gaming efforts are contrived to underwrite the need for certain numbers of platforms or weapon systems in a disingenuous bending of wargaming rules to support objectives previously prioritized by bureaucratic and organizational imperatives.

There is, of course, a continuing need for good, service-specific gaming in Edison's quadrant. However, as we seek to balance the nation's military capabilities under growing commitments and constrained resources, there will be a growing requirement for wargames to present issues of force structure trade-offs. Current thinking around single-service-dominated game tables rejects the proposition that the services could ever agree on a common scenario to test joint warfighting and to explore such trades. Surely that concern is overdrawn; the speculative nature of wargames precludes their outcomes from providing anything close to final resolution of such thorny issues as budget shares or debates over roles and missions. However, insights into the relative merits of alternative forces--unlikely to be generated by any other artifice--can be derived from the wargaming of well-structured joint scenarios.

But if we are to apply Pasteur's method of research to the friction-filled future of war successfully, the first step must be to better define the problem. Pasteur's quadrant, which seeks both basic knowledge *and* its application, requires the questioning of elemental assumptions as well as a comprehensive survey of plausible solutions. Recall that even such an enthusiastic advocate of mechanized warfare as George S. Patton maintained that lots of horses would still be required to haul supplies to his fast-moving motorized forces.[11] Our future Pattons must be encouraged both to seek an understanding of the future of warfare, and to consider and weigh the winning elements in military practice. As Stokes points out, "Pasteur wanted to understand *and to control* the micro-biological processes he discovered," just as the scientists and generals leading the Manhattan Project wanted to "understand *and to harness* nuclear fission."[12] If future warfighters are to understand *and to manipulate* the instruments of modern warfare, the contemporary wargaming process must include conceptual thinking at a *joint* level, rather than only at a service-specific level. Obviously, service-derived insights into the unique capabilities brought by each combat arm must be credibly represented in these simulations. But those views should be seen as adding value owing to their understanding of unique capabilities, not by their singular dedication to service programs and priorities.

The recent Army After Next (AAN) wargames conducted by the Army Training and Doctrine Command seem to be moving in the right direction. Deliberately set out beyond the Army's near-term budget projections, the AAN games test increased mobility, enhanced firepower, and reduced logistic requirements without dictating how much an armored fighting vehicle should weigh, nor defining precisely how many troops are in a "Battle Force."[13] When these theoretical concepts are coupled with practical applications--for example, testing the rapid deployment of lighter ground forces against the availability of supporting fires from joint, relatively long-range assets--the value of gaming the entire process through is revealed.

Of course, wargaming in Pasteur's quadrant is not entirely new. During the mid-1930s, Marines at Quantico perceived that the Navy and Army Air Corps would require advanced island bases to project military power across the Pacific, and that these prospective island bases would be heavily defended by Japanese forces.[14] However, as a result of the British debacle at Gallipoli during World War I, conventional military wisdom dictated that no amphibious assault could be successfully conducted in the face of modern weaponry. Hence, there were no programs to design and build amphibious assault vessels, large or small. In spite of this formidable ideological barrier, the Marines gamed these contingencies, developing the strategy and tactics to execute a successful beach landing despite armed opposition, and speculated on the types of platforms that would support such an operation. This innovation, given the joint requirement driving it, was certainly an early form of gaming in Pasteur's quadrant.

We'd like to push this analogy between research and wargaming just a bit further. Let us posit, based on this framework for analysis, that the QDR lies in Edison's quadrant (pure applied research) and the NDP resides in Bohr's (pure basic research). In other words, the QDR speaks about what we could do with the service-specific *forces and platforms* we plan to have, and how many more or less of them we need. The NDP, on the other hand, addresses what *concepts* appear to have future utility, and calls for increased joint operations in the future, but carefully avoids those pesky and politically unpopular force trade-off issues. If we plan to conduct meaningful wargames supporting these study efforts, what would a gaming analogue to Pasteur's quadrant of use-inspired basic research look like? Is *jointness* a necessary ingredient in wargaming designed to effectively unite theories about the future of conflict with practical prescriptions for deterrence and defense? The answer is yes.

Joint Wargaming in Pasteur's Quadrant

Joint wargaming in Pasteur's quadrant should combine the QDR's programmatic thinking with the experimentation

called for in the NDP. Such an approach could inquire into the feasibility and desirability of the RMA while suggesting acceptable and affordable paths to transition to it. Admittedly, given the separate services' need to support their near-term priorities, it is difficult for them to structure wargames that might question programs high on the combatant commanders' Integrated Priority Lists. And the far term--2020 and beyond--clearly remains the province of the services' long-range visions. However, there may be a time span just beyond the Future Years Defense Program, but not far in the future, that could profit from joint wargaming in Pasteur's quadrant.

If we adopted such a research method, what are the key concepts waiting to be tested in a Pasteur's quadrant joint wargame? Some, certainly, are contained within QDR recommendations and *Joint Vision 2010*, while the ambitious agenda set by the NDP can provide another course of action. In addition, there are several functional areas getting a lot of attention in wargames these days that, from our perspective, seem particularly ripe for joint exploration. They include stealth, long-range precision strike, reduced logistic footprints, and command and control.

Stealth

Some joint commanders may not be sure of what "stealth" is, but they want more of it. The earliest concepts of combat stealth were developed in the submarine, then incorporated in aircraft, but now are being extended into other platforms and media. Stealth, from the beginning, enabled the submarine to engage at will. Until nuclear power provided its propulsion, however, the submarine could not always *disengage* at will.[15] Within the AAN wargaming effort, there has been an examination of the ability of an engaged army, if not to be stealthy, at least to be able to disengage at will--a characteristic never before possessed by any but the smallest of ground warfare units.[16]

Although air power advocates argue that air forces can also disengage at will, even without stealth, the increasing dedication of Air Force resources and platforms to the support of ground forces (unless a more independent role for air power is pursued, post-Kosovo) challenges this assertion. The vulnerability of highly visible aircraft such as transports, tankers, air-breathing surveillance vehicles (both manned and unmanned), and airborne lasers suggests that measures are needed to increase the survivability of these platforms. Certainly examining these mission requirements in a joint wargame could contribute to understanding the theoretical and practical applications of low observability, and to comparing alternative means to achieve joint objectives.

Long-range Precision Strike

The dilemmas of extended-range operations have been examined in a number of service-specific wargames in which the United States military is tasked to reach into vital areas when denied its traditional power projection advantages of access within the region. While this scenario most often has been used to strain the predominantly short-range assumptions in Air Force modernization plans, and to argue for the consideration of added investments in long-range aircraft, such research into theory and practice could clearly profit from a joint perspective. For example, because a sudden enemy land grab in a faraway region could rapidly harden into a fait accompli, additional thought (and practice) should be given to the pre-hostilities phase of a distant contingency.

How to use joint forces as a tool of coercive diplomacy should be addressed, not only to identify important concepts of conventional deterrence and flexible deterrent options, but also to generate joint options to support preemptive and preventive measures such as no-fly or no-drive zones, mining, blockades, and shows of force. Although game players are often reluctant to edge up to thresholds for the use of weapons of mass destruction, the consideration of long-range conventional ballistic missiles launched from submarines can add an important element combining both stealth and precision strike. But that option is likely to be quickly rejected if the wargaming of extended-range operations seeks only Air Force-oriented solutions.[17]

Reduced Logistics Footprint

From *Joint Vision 2010*, to the QDR, to the NDP, there is unanimous agreement on the need to tailor logistics to support the rapid deployment of joint forces, and to diminish the size of the logistics footprint in forward areas. Moreover, while the focus of service-specific wargames frequently remains on single-service-dominated combat operations, there is considerable agreement that the logistics in support of these operations will increasingly depend on joint resources, organizations, and management. For example, a logistics cell at a recent wargame of extended-range

operations was very willing to follow the NDP's recommendations for a joint logistics command that would integrate the functions of Transportation Command and the Defense Logistics Agency. That group also stressed the growing importance of the Civil Reserve Air Fleet to future joint deployments, along with the relative advantages of air transport over sealift as forces get lighter, distances greater, and time-lines shorter.

In future wargames these trends must be weighed against Army and Marine Corps reliance on organic artillery that might compose as much as 75 percent of an engaged unit's logistic tail. As these packages are downsized, those units will increasingly require naval surface fire support and air power to supply combat fires when and where needed. These are issues already under study by the AAN effort, but they clearly require joint investigation and experimentation.

Command and Control

Unfortunately, the traditional concept of "command and control" is often subsumed in large wargames under the broader, almost all-encompassing acronym "C4ISR"--command, control, communications, computers, intelligence, surveillance, and reconnaissance--which in the aggregate provide the basis for "information dominance" or "information superiority." While the interactions of all these elements are surely of importance on future joint battlefields, attempting to lump them all under one grand overarching concept may be too much to grasp, even for wargames confined to single services. Put another way, it is important for the separate services to understand and appreciate each other's command and control capabilities so that the result is enhanced operations in joint areas of responsibility. For example, in a recent wargame in which USAF forces were crying out for defense against low-observable cruise missiles, few players understood the Navy's Cooperative Engagement Capability (an integrated, sensor-based fleet air defense system), nor did they appreciate the contributions that an enhanced E-2C Hawkeye (the Navy and Marine Corps airborne surveillance and command and control platform) could bring to an air battle far from the littoral in the year 2005. Similarly, there has been a lack of joint understanding and appreciation regarding the battle management potential of the Joint Surveillance and Target Attack Radar System (Joint STARS): the Army and Air Force do not always agree about the platform's role in collecting and disseminating information for air-land battle operations; the Navy is just beginning to investigate how to capitalize on maritime forces through Joint STARS connectivity.

Now and in the future, battle management is much more than searching sensor data to pass to weapon delivery platforms along service-specific lines. It includes the tasking and control of sensor operations, interpreting sensor data in terms of the "Blue" commander's operational concept and intent, matching platforms and weapons to targets--not through some automatic space-based link, but through the active engagement of a joint decision architecture--and near-real-time battle damage assessment. Given the considerable reliance expected to be placed on commercial communication systems to expand bandwidth and enhance situational awareness in the future, joint, networked command and control is just the start of the "system of systems" required to manage future combat operations. Joint wargaming can help piece together these nascent, and presently far-from-seamless, system architectures.

Conclusion

Given these areas of common interest, how and where should joint wargaming proceed? Bohr's quadrant gaming will continue to be supported by the work done in think tanks across the country. Their work will be an important source of both political and technical projections upon which applied research and gaming will feed. Similarly, games in Edison's quadrant will remain the mainstay for generating and testing service-specific operational doctrine and tactics within the realm of existing and planned platforms, weapons, and systems. Using inputs from both the Bohr and Edison quadrants, the games in Pasteur's quadrant, directed and played in the joint arena, would generate, refine, and test issues similar to those suggested above, look to the mid-term, and seek to combine theory and practice, concepts and programs. Figure 2, building on Stokes's concept of research, suggests what a model approach to joint wargaming looks like, in terms of who might be doing what.

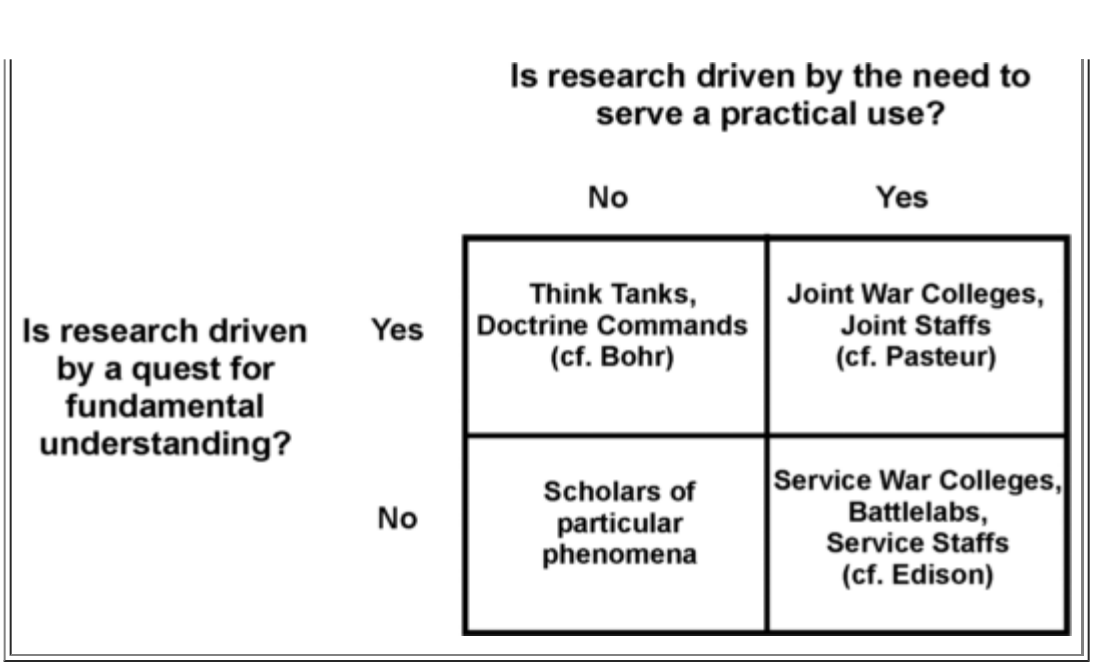

Figure 2. The Stokes Matrix Applied to Wargaming.

We conclude that Pasteur's model should be emulated as wargames are developed, played, and evaluated to help prepare the nation's military forces to face an uncertain future--together. In reaching that conclusion we've deliberately stretched some analytical frameworks and extended some applications of wargaming. For example, with regard to the Bohr quadrant in Figure 2, service think tanks and doctrine commands obviously have a "practical use." But such use is indirect and lies outside the immediate operational domain. Clearly, more work needs to be done to apply these frameworks and to fill in the conceptual and practical gaps that we have left uncovered.[18]

If it is difficult to deny the imperative of joint operations, it becomes equally hard to ignore the dividends of joint wargaming. Writing in the Winter 1996-97 *Joint Force Quarterly*, Chief of Naval Operations Admiral Jay L. Johnson stated that adopting a joint vision equates to changing the way the Navy thinks and operates:

> It is about a new kind of joint warfare which will enable us to optimize the capabilities of every ship, submarine, and aircraft, . . . putting them in a joint context where they support and are supported by the Army, Air Force, and Marine Corps to maximize the full range of military power.[19]

If the services are ready to change the way they think and operate, we believe that a generous amount of joint wargaming combining both theory and practice could help facilitate that change. And it occurs to us that those presently best postured to help initiate that change are those experienced wargamers who are currently sporting purple suits.

NOTES

1. William S. Cohen, *Report of the Quadrennial Defense Review* (Washington: Department of Defense, May 1997); and National Defense Panel, *Transforming Defense--National Security in the 21st Century* (Arlington, Va.: National Defense Panel, December 1997).

2. Cohen, *Report of the Quadrennial Defense Review*, p. 41.

3. News Release, "Secretary of Defense Response to Congress on `Transforming Defense,'" Office of Assistant Secretary of Defense (Public Affairs), Washington, D.C., 15 December 1997, p. 2.

4. See, for example, Peter P. Perla, *The Art of Wargaming* (Annapolis, Md.: Naval Institute Press, 1990); Bud Hay and Bob Gile, *Global War Game* (Newport, R.I.: Naval War College, 1993); Edward A. Smith, Jr., "The Navy RMA War Game Series: April 1995-November 1996," *Naval War College Review*, 50 (Autumn 1997), 17-31; and Robert P. Haffa, Jr., and James H. Patton, Jr., "Gaming the `System of Systems,'" *Parameters*, 28 (Spring 1998), 110-21. For an

update of current service efforts, see the section on wargaming in *Aviation Week and Space Technology*, 2 November 1998, pp. 56-65.

5. "Wargame Shows Impact of Air/Space Action," *Aviation Week and Space Technology*, 8 December 1997, pp. 26-27. In its futuristic wargames, the Air Force has employed a reusable space operations vehicle to put up new satellites, refuel space-based lasers, and put weapons into orbit.

6. Bush felt that if basic and applied research were not kept separated, the profit motivation of democratic, capitalistic society would preclude any basic research, and there would be no continually replenished "seed corn" from which future developments could be generated toward the best interests of that society.

7. Contrary to conventional wisdom, Bush's most universally claimed World War II success--the Manhattan Project that produced the atomic bomb--was not attributable to expediting basic research (the elemental physics of uranium and fission had been well known for more than a decade), but rather to funding the applied research of a war-winning technology.

8. Donald E. Stokes, *Pasteur's Quadrant* (Washington: Brookings Institution, 1997).

9. Stokes argues that the lower left quadrant, representing research conducted neither for understanding nor use, is not unpopulated, but represents research that systematically explores particular phenomena. The meticulous classification of weapon characteristics and effects, upon which many wargames rely in their quantitative calculations, might fit here. See Stokes, p. 73.

10. The history of the GLOBAL-series games is far too extensive to be recounted here, but in 15 consecutive years of participation since 1984, one of the authors can attest to the extensive effects the series has had not only on US Cold War military strategies, but in the prediction of such post-Cold War events as the disintegration of the former Yugoslavia.

11. Then-Major George S. Patton, in several articles in *Cavalry Journal* and other venues, proposed a small professional army that was completely mechanized. For example, see "Motorization and Mechanization in the Cavalry," *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 Archives, Carlisle, Pa., File #387-52.

12. Stokes, pp. 79-80. Emphasis in the original.

13. The NDP's view on the 21st-century tank was that it should depend on speed, agility, and hyper-velocity gun technologies and weigh less than half (30-35 tons) of the present M1A1.

14. As discussed by Lieutenant General Paul K. Van Riper, USMC Ret., during a conference presentation. ("Precision Strike from the Sea: New Missions for a New Navy," Cambridge, Mass., 8-9 December 1997.)

15. There were a few pre-World War II advocates of using remaining stored energy to depart after the attack at a high submerged speed, but in a harsh combat arena characterized by Darwinian dictums, fewer and fewer of these advocates returned from patrol.

16. Of course, the cavalry sought this property. The naval equivalent of the cavalry is the attack submarine, and the air superiority fighter should also be able to depart the fight at will.

17. There is no more dramatic example of long-range precision strike, in terms of range, timeliness, and accuracy, than an ICBM. The barriers to employing a mixed load of nuclear and conventional warheads along with satellite/anti-satellite launch vehicles on future Tridents, as long as we are willing to count them as nuclear systems under START, can be exaggerated. The precedent for dual-capable systems exists in theater tactical air support, in nuclear and conventional Tomahawks launched from attack submarines, and in conventional air-launched cruise missiles carried by B-52s. The accuracy and destructive power (tens of thousands of pounds of high-explosive equivalent even when

relying only on kinetic effects) of a submarine-launched ballistic missile provide enormous capability, particularly against deeply buried targets. See Robert Gibson, "Conventionally Armed ICBMs," *Airpower Journal*, 11 (Fall 1997), 119-23; National Research Council, *Technology for the United States Navy and Marine Corps, 2000-2035* (Washington: National Academy Press, 1997), I, 67; and James H. Patton, Jr., "Trident Can Fire More than Nukes," *Proceedings*, 124 (August 1998), 36-38.

18. There are some promising joint efforts. The Joint Land, Aerospace, and Sea Simulation (JLASS) wargame conducted in April 1998 involved students from the various service and joint war colleges. However, objectives assigned to the teams by the service school faculties and the allocation of senior service school teams to represent and defend their own service roles and missions helped retain the Title 10 flavor. US Atlantic Command's designation as the executive agent for joint concept development and experimentation, and the annual publication of its Joint Experimentation Campaign Plan, may also turn out to be important steps. However, these nascent joint endeavors pale in comparison with the separate service wargames, visions of future warfare, and operational concepts described in the most recent Secretary of Defense "posture statement." See William S. Cohen, *Annual Report to the President and the Congress, 1999*, pp. 125-33.

19. Jay L. Johnson, "The Navy in 2010: A Joint Vision," *Joint Force Quarterly*, No. 14 (Winter 1996-97), p. 18.

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