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Advanced Battlespace and Cybermaneuver Concepts: Implications for Force XXI

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Force XXI has proven to be an ambitious and farsighted Army vision of future warfighting and a tribute to nowretired Chief of Staff General Gordon R. Sullivan. Because it is an institutional attempt at US Army reform, however, the changes being promoted are at times more evolutionary than revolutionary. Force XXI organizations-at brigade, division, and ultimately corps levels-will represent a synthesis of conventional military hardware with integrated digital communications. This experimental force will exist within and dominate the battlefield defined by the range of human senses; it is essentially the force and the concept of the battlefield with which the United States defeated Iraq in 1991.

This article argues that the traditional perception of the battlefield reveals the limiting assumptions upon which Force XXI is built, that it is constrained by its three dimensions, and that it is most likely outmoded. Paradoxically, it is the rise of nonWestern warfare and the proliferation of advanced weaponry that together have made current "spatial concepts" of the modern battlefield obsolete.[1] To be an effective military force into the 21st century, the US Army should start now to redefine the battlefield so that new operational concepts can evolve and produce the doctrine and materiel requirements that will lead to meaningful restructuring of all components of the land force. Without a new conceptual model, Force XXI will fail to take full advantage of the potential inherent in new and emerging technology, no matter how successful it is in developing technology appliquéés for its existing fleets of tanks, infantry fighting vehicles, artillery systems, and aircraft.

Modern Battlespace

The Army's Field Manual (FM) 1005, *Operations* (June 1993), defines the modern battlefield, or battlespace as it is called, as follows:

Battle space is a physical volume that expands or contracts in relation to the ability to acquire and engage the enemy.[2]

Components [are] determined by the maximum capabilities of a unit to acquire and dominate the enemy; [it] includes areas beyond the AO [area of operations]; it varies over time according to how the commander positions his assets.[3]

The above passages share a common liability: they ignore the electromagnetic spectrum.[4] Department of the Army Pamphlet (DA Pam) 5255, *Force XXI Operations*, a visionary document published in 1994 by the Army's Training and Doctrine Command (TRADOC), better defines battlespace:

Components of this space are determined by the maximum capabilities of friendly and enemy forces to acquire and dominate each other by fires and maneuver and in the electromagnetic spectrum.[5]

Current Army thought holds that battlespace is composed of separate, discrete physical and electromagnetic dimensions, each of which must be controlled if friendly operations are to be successful. Recent naval doctrinal publications share that perception.[6] Military forces are said to operate in the physical dimension, which represents the world in which humans and their machines move and fight. The boundaries of this specific "threedimensional battlespace" are, for the purposes of this article, defined by the limitations of humansensing capabilities. Conversely, information warfare is said to be conducted within the electromagnetic realm where there are no physical military forces.[7]

The Army's outmoded definition of battlespace has proven adequate for maneuver warfare in the threedimensional physical battlespace. Armored spearheads and amphibious thrusts seek to defeat opposing forces by exploiting weaknesses and vulnerabilities. Maneuver warfare with its encirclements, flanking operations, and disruption of the enemy's command and control processes works well within the constraints of a physical dimension where military forces and the human senses operate. It has, in fact, come to represent the dominant Western mode of warfare.

The concept of extended battlespace developed in Force XXI operations enlarges this concept of the physical threedimensional battlefield with an increase in depth, breadth, and height, but in no way fundamentally alters it. In fact, the attribute of extended battlespace that comes closest to challenging the linear assumptions that underpin current doctrine is the concept of the "empty battlefield." This concept, loosely described as the dispersal of forces for survival purposes, is significant because it most clearly depicts the breakdown of some of the fundamental assumptions-and hence principles-of warfare dominated for several centuries by Western philosophies.[8]

Future Battlespace

The reason for this breakdown of our Western mode of warfare is twofold. First, nontraditional adversaries and forms of conflict have evolved in the recent past that challenge the assumptions that underpin maneuver warfare. Various "grayarea phenomena," including terrorists, narcocartels, and forces based on clan and ethnic affiliations bring to conflict characteristics that are asymmetrical to conventional Western forms of warfare.[9] And since safety for such forces may be achieved by staying off of the conventional battlefield, they have no option but to leave the threedimensional battlespace acknowledged in US doctrine and disappear in accord with the maxim "if you can't see a force you can't kill it."

Examples of this form of disappearance include the use of underground tunnel networks at Cu Chi and the integration of the Vietcong among the populace in Vietnam, the civilian clothing of a terrorist, and the blending of snipers into unarmed Somali mobs. Since these forces have left the humansensing dimension in which maneuver warfare dominates, maneuverbased doctrine is insufficient when applied against them.

Second, the breakdown in maneuver warfare can also be seen in the advent of advanced target detection and precision guided munitions.[10] Any military force, even those fielded by the West, which exists within the dimension of the human senses can now be acquired and killed. Since maneuver warfare doctrine was based on a synthesis of decadesold technology and ideas, it is not surprising that the advanced technologies now emerging negate the presumed benefits that justified this earlier synthesis. The only solution to this dilemma again requires leaving the humansensing dimension and disappearing-or seeming to do so. The stealth fighter and the submarine

both rely on this tactic as their primary form of defense.

Stealth capability has not yet been an applicable technical option for landbased and amphibious forces, so tactical and operational innovations have been developed by way of compensation. This has resulted in Western military forces increasingly turning their attention toward the development of advanced maneuver warfare concepts. Nonlinear operational concepts based on the absence of front lines or any recognizable rear area have been developing in Russia for a number of years and are extensively described in various publications.[11] Similar concepts existed in the midto late 1980s in TRADOC's Army 21 Interim Operational Concept, with its references to islands of conflict and deliberate noncontiguity on the battlefield.[12]

The value of stealth capability has, however, been recognized; it was given a priority one requirement in the May 1994 ARPA Report of the Senior Working Group on Military Operations Other Than War (OOTW). Termed "Invisible Soldier Image Avoidance and Signature Reduction," it called for a capability that would "make the individual soldier invisible, day or night, to the whole range of battlefield sensors across the electromagnetic spectrum." [13] As one outcome of this recognized need we may expect the United States to develop and use either active or metamorphic camouflage systems for defensive purposes.

Advanced Battlespace Concepts

As noted earlier, the implementation of Force XXI will likely be severely compromised unless an advanced definition of battlespace is created to support it. I propose that it should be based upon two spatial concepts-- humanspace and cyberspace--and two spatial transcendentals--stealth and data fusion (see Figure 1).[14]

Criteria	Definition
Humanspace	That aspect of battlespace composed of the traditional physical dimension of the human senses in which humans and their machines move and fight; the killing ground of future war.
Cyberspace	That aspect of battlespace composed of the electromagnetic spectrum and the non-human sensing dimension in which stealth-masked forces seek refuge from attack.
Stealth	The application of sensory defeating procedures and technologies which allow military forces to enter cyberspace.
Data fusion	The application of adaptive information processes to stealth-masked forces for target detection, identification, and location.

Figure 1. Advanced Battlespace Concepts

Humanspace represents the traditional physical dimension of the human senses within which military forces operate. This spatial concept has already been defined in *Force XXI Operations*, omitting the electromagnetic aspect. Cyberspace, on the other hand, represents not only the electromagnetic spectrum, but also that dimension in which military forces seek refuge for defensive purposes. Forces that enter this dimension are removed from the humansensingbased battlefield and are thus invulnerable to attack; at the same time, they retain the capacity to attack military forces that exist in humanspace. Any military force that has the capability of entering this nonhumansensing dimension, be it Western or nonWestern, must now be considered, respectively, either a highly advanced asset or a direct threat. Since emerging forms of nonWestern warfare and advanced technology applications appear to possess many of the same operational characteristics, this is not an unreasonable characterization.[15]

As an outcome of the development of the concepts of humanspace and cyberspace, a more precise definition of battlespace dominance in the 21st century may also be required. Cyberspace may be considered dominant over humanspace. For this reason, the goal of the Army in future war, beyond that of securing assigned politicomilitary objectives, will be that of total cyberspace dominance-not just digital battlespace dominance.[16] Army forces may ultimately look toward cyberspace as a place of refuge from attack while denying that refuge and capability to opposing forces.

The means of entering this refuge will be based upon the application of stealth technology and processes.[17] In hindsight, it can be said that when Mao Zedong referred to guerrillas as fish in a sea of surrounding population he was inadvertently stating early principles of what we would now term stealth and cyberspace.[18] Advanced weaponry, beyond that of the submarine, bomber (B2), and fighter (F117), is now being configured for the very purpose of exploiting the recognized defensive potential stealth offers. Followon programs to the 21st Century Land Warrior project seek to incorporate chameleonlike camouflage composed of biomaterials into the modular Soldier Integrated Protection Ensemble (SIPE) system.[19] Cruise missile successors to the canceled AGM137A TriService Standoff Attack Missile (TSSAM), as well as the recently unveiled Army RAH66 Comanche scout/light attack helicopter, are also now stealthbased.

The counter to stealthmasked forces will be based upon the spatial transcendent of data fusion.[20] Just as stealth allows a military force to leave humanspace and enter cyberspace, data fusion will negate the protection stealth provides. Data fusion describes the concept of using information gathered across the electromagnetic spectrum to locate stealthmasked military forces in space and time.[21] In future operations, opposing forces that appear invisible to conventional means of detection and identification will be identifiable via superior data fusion systems and procedures so that they can be immediately neutralized or destroyed. The urgency here acknowledges that each of the opposing forces will be operating within its own data acquisition and informationprocessing cycles.[22] Differences in response times measured in seconds will separate the quick and the dead.

Based upon this tension between stealth and data fusion, the "humansensing dimensional barrier" separating humanspace and cyberspace will represent a dynamic and contested frontier, a transdimensional forward edge of the battle area (FEBA) between opposing forces.[23] As a result, new spatial premises of offense and defense may develop based on two basic formulas. Whenever individuals, organizations, and materiel can avoid or counter efforts at data fusion, those entities can be said to be operating in cyberspace. Conversely, when efforts to counter data fusion fail, the entities will be considered to be operating within humanspace, vulnerable to attacks by an adversary, whether a stealthy cruise missile or a sniper heretofore concealed in the midst of a crowd. The two concepts can be expressed as follows:

Defensive Premise: Stealth \supset Data Fusion = Cyberspace
Offensive Premise: Stealth \subseteq Data Fusion = Humanspace

These spatial premises of advanced battlespace can be viewed in Figure 2, which portrays a threedimensional volume of battlespace bisected by a humansensing fourth dimensional barrier. (Were time to be included in this concept of battlespace, it would represent a fifth dimensional attribute.) The figure is misleading-humanspace and cyberspace actually coexist in a given volume of battlespace-but it will have to suffice until conventions for expressing these concepts have become commonplace. Because stealth masked forces are inherently "invisible" to normal military forces, they can maneuver with relative impunity in cyberspace. Hence, the "battlefield" addressed in this essay, and portrayed crudely in Figure 2, appears to have twice the potential volume of the

battlespace currently defined in FM 1005 and being applied to develop Force XXI theory.

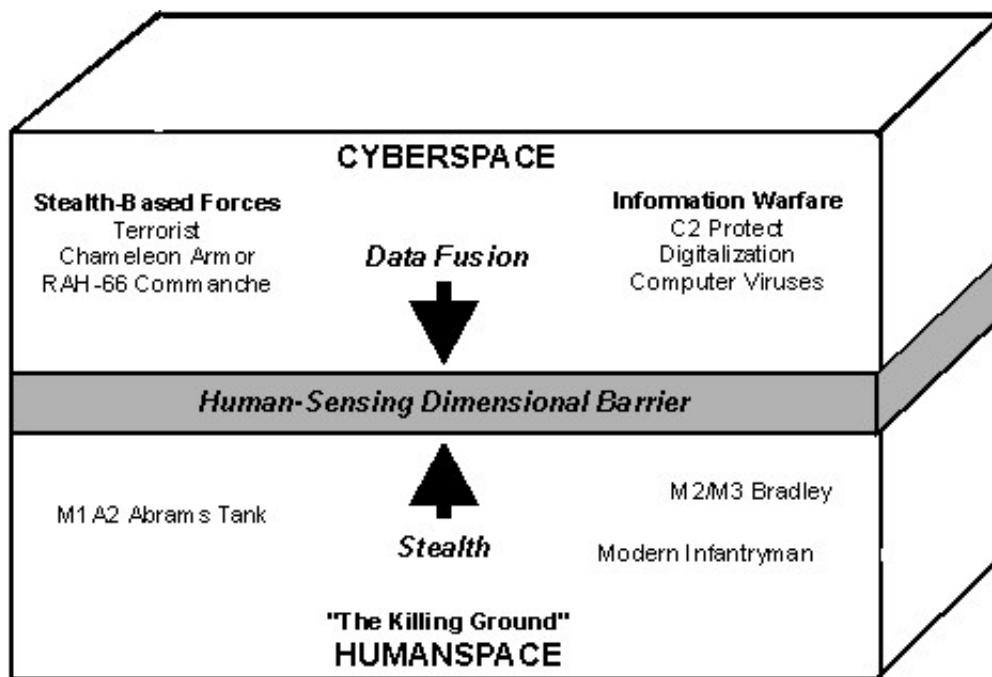


Figure 2. Spatial Premises of Advanced Battlespace

Army forces will rely upon the "maneuver force protection" envisioned in *Force XXI Operations* to extend their ability to conduct operations.[24] Within a few decades, however, nonstealthmasked Army forces will have become highly vulnerable-even with the development of high technology proactive armor and point defense systems.[25] For this reason, the initial digitalization of Army mechanized and armor forces which rely upon maneuver as the basis of their operational art, while a bold move, can still only be viewed as an incremental step into future warfare.

This redefinition of battlespace suggests that our traditional concepts of maneuver warfare may be made obsolete because forces that conduct maneuver warfare operate in humanspace, and humanspace represents the killing ground of future war. One can only speculate when-or if-this style of warfighting might be replaced by dispersed land forces engaging in cybermaneuver as a complement to precisionstrike operations conducted by stealthcloaked missiles and aircraft.[26]

Cybermaneuver Concepts

With this redefinition of the battlefield based upon principles of dualdimensional space, early concepts of cybermaneuver may now find their way into future editions of *Force XXI Operations*. The potential need for the development of such a new form of doctrine was recognized in 1992 by John Arquilla and David Ronfeldt in a RAND paper entitled *Cyberwar is Coming!*[27]

For an example of what cybermaneuver warfare may look like, consider two opposing helicopters in a meeting engagement. Initially, each helicopter will rely upon stealth technologies to keep itself off the other's battlefield. Both will be using data fusion and informationcycle processing technologies in an effort to acquire, identify, and engage the other. One belligerent will momentarily gain the initiative by using data fusion to force the other out of cyberspace and into humanspace. Finally, the "uncloaked" helicopter will be engaged by the other, whose intent will be to neutralize or destroy it before it can take offensive action itself or escape back into a "cyberspace" mode of operation by using countermeasures to defeat data fusion activities. Early, primitive applications of this

concept include the firing of flares by aircraft to confuse heatseeking missiles, or technology applied to helicopters to mask their infrared signature for the same purpose.

Similar concepts of battlespace underlay the functional basis of countersniper systems. Snipers, it can be argued, use cyberspace as their principle form of defense. They deftly stalk their intended targets by using disciplined body motions and breathing control to reach a suitable firing position without detection. After neutralizing their intended target, they fade back into cyberspace and either vanish forever or wait minutes, maybe hours, before momentarily letting their presence again be known with another kill. The danger of snipers for Army forces deployed overseas is growing in proportion to increasing urbanization.[28] That insurgents operating in these environments are likely to be dispersed among innocent noncombatants and have access to precisionguided munitions (PGMs) is a more ominous concern.[29]

To deal with the sniper threat, a new defensive system called Lifeguard has been developed at the US Lawrence Livermore National Laboratories. Based on stateoftheart commercial technologies, it can locate the point of origin of a bullet in flight within hundredths of a second. While Lifeguard is unable to return fire, a combat version with this capability, known as Deadeye, is under development.[30] In essence, this countersniper system, like the helicopter used in the first example, takes a cyberspacebased force, in this instance a sniper, and strips it of its invulnerability to attack by bringing it into humanspace by means of data fusion. A sniper faced with this new technology has a range of choices, none of which is particularly appealing: decline to fire his weapon, target the countersniper system initially in hopes of disabling it (first the sniper must locate it, of course), or be equipped with innovative means for circumventing such technology.

These two examples bring up the most significant challenge that will probably face forces operating in cyberspace. Whenever they actively acquire an adversary in cyberspace, thereby moving it into humanspace, even if only for a few seconds, they will likely betray their own position in space and time. At that point, both the attacker and the intended victim can be engaged directly by other killing forces, be engaged by other allied forces via shared informational awareness, or launch strikes against opposing forces in humanspace. This window of vulnerability will likely be one of the primary features of the sort of information dominance that must be readily available to Force XXI and denied to opposition forces.[31]

As a result of technology evolution, future Army commanders may view the battlefield by means of realtime holographic displays. All friendly forces can be made to appear on these displays; technically sophisticated opposition forces will appear and disappear from these displays as they are acquired and escape detection, literally "popping" out of and back into cyberspace. Forces in such a scenario would probably become quickly intermingled, resulting in a blurring of our traditional concepts of front lines and the tactical, operational, and strategic continuum.[32] In fact, older military forces and those forces of less advanced national and nonnational entities which exist and function in humanspace can expect to be engaged simultaneously across the physical continuum by precision fires in the opening stages of a conflict.[33] The concept of safe rear areas would conceivably no longer exist because the entire humansensing dimension would indeed become the battlefield. Within this context, safety would be gained only by means of the "cyberspace shifting" of forces and other national security assets outside the boundaries of traditional humanspace.

Such a perspective on the future battlefield reinforces the need for digital interoperability standards, the seamless tracking and engagement of enemy targets, and a future Army force structure primarily configured around stealthbased forces.[34] Based on these perceptions, a failure to explore cybermaneuver as an emerging warfighting style potentially risks setting up the Force XXI Army for a catastrophe much like that which befell

France in the spring of 1940 when it eschewed both the new German operational art which had developed and the expanded concept of the battlefield underlying it.

Conclusion

The concepts developed in this essay represent an initial attempt to give substance to the meaning of "asymmetry" in force-on-force relationships. It has been proposed that advanced forces gain an asymmetrical battlefield advantage over traditional forces by means of techniques and processes such as cloaking, blending into civilian populations, concealment, and deception—all of which allow them to avoid detection by entering a realm which is frequently called cyberspace. At the same time, traditional forces, which remain in humanspace, are subject to detection and attack by these now-stealthy systems. Current and emerging precision strike capabilities support this perception. When one force can attack another force and in the process not be attacked in return, a clear battlefield advantage exists.

Our traditional concepts of three-dimensional battlespace are unable to explain such a military revolution because increases in the physical dimensions of a battlefield cannot account for it. Rather, a new concept of range is required, one that is defined by a "humansensing dimensional barrier" which separates humanspace from cyberspace. Given this perceptual lens, a terrorist in civilian garb who is standing five meters from a US soldier and whom the US soldier views as a noncombatant is at a much greater battlefield range from that soldier than a hostile tank that is visible 1000 meters away—and yet is potentially far more dangerous to the soldier than is the tank. To counter such forces, we will most likely be required to rely upon principles of data fusion which can provide us with the capability to bring such cloaked entities out into the open where they can be neutralized or destroyed. A number of implications can be derived from the development of such a technically advanced battlespace that bear directly on the Army's conduct of war in the future:

- The US Army should explore the development of cybermaneuver doctrine in support of Force XXI. It is proposed that such doctrine could better exploit the advanced battlespace which is developing than more traditionally based warfighting concepts such as maneuver or maneuver force protection as described in FM 1005 and DA Pam 5255 respectively. Cybermaneuver doctrine would be a natural complement to maturing precision strike concepts which are focused upon the neutralization or destruction of opposing humanspace-residing forces. Implicit in this doctrine would be the development of a capability to defeat opposing stealth-masked forces.
- Lighter forces may possess more of a defensive advantage than heavier forces because lighter forces can more easily seek the defensive advantages that cyberspace offers. This could mean that defense would no longer be measured by such traditional concepts as heavier armor or even speed, but rather by the ability of a force to make itself "invisible" to detection.
- A further blurring of the distinction between soldier and civilian may likely result. War in the Western world has been conducted from the time of Frederick the Great by armies wearing distinctive uniforms which have distinguished combatants from noncombatants and one opposing army from another. Our modern camouflaged battle dress uniforms are based upon this evolutionary pattern of uniform development. These uniforms are not worn by many soldiers representing non-Western cultures because behavioral norms and ethical systems to which these soldiers subscribe allow them to discard the symbols of the soldier in order to obtain the defensive benefits that cyberspace provides. We may expect this trend to intensify as American dominance of the humanspace battlefield increases.
- The perceptual abilities of US soldiers will likely be enhanced to provide them with "extrahumansensing capabilities" which will allow them to peer into cyberspace for the purposes of identifying threat forces.

Two methods may be employed. The first is by technical means such as the Land Warrior program, which provides night vision capability. The second is by better exploiting the organic capabilities of our troops by training them to be aware of the different smells, habits, and behaviors of warriors in specific cultures or ethnic groups with which we may find ourselves in conflict.

- If our traditional concept of front lines-linearity-becomes blurred because of the effects of the "humansensing dimensional barrier" separating cyberspace from humanspace, we may expect that the tactical, operational, and strategic continuum as we now understand it will be reexamined and possibly redefined. The threedimensional quality of that traditional continuum cannot be expected to define the reality of a fourthdimensional battlespace where rear areas and flanks may no longer exist, and where what was in earlier times known as the "Zone of the Interior" (the continental United States) is part of the region of conflict.

Implications such as these could prove difficult for an Army victorious in the Gulf War to consider, much less accept, because they challenge both the core of its doctrinal sensibilities and its traditional force structure preferences. Yet the value of informed challenges was recognized by General Sullivan, writing as Chief of Staff, along with Lieutenant Colonel Anthony M. Coroalles:

Ideas that have the potential to overturn longestablished, bureaucratically entrenched methods of operation are not welcomed by the average man. When the paradigm shifts, most cannot grasp the full potential of new ideas. New technologies and processes can frighten those who are comfortable with the routines established to accommodate the old technologies. Furthermore, vested interests within the organization and within its bureaucracy-usually for what to them are good and logical reasons-will resist ideas that threaten the status quo. Bureaucracies flourish on procedures instituted to ensure efficiency. Innovation is the enemy of efficiency because it threatens established procedures. This is a mindset that we cannot afford in Force XXI. While military professionals must hold the security of the nation as something with which they dare not gamble, they cannot afford to discourage the kind of imagination and innovation that is needed to meet the varied challenges that will arise in the 21st century.[35]

To be a relevant military force in the next century, the Army must learn to adapt itself like an entrepreneurial organization to the social, political, economic, and military changes which are now upon us. While Army traditions based upon individual integrity, honor, and service to country must be retained, those based on discredited perceptions of the battlefield and of warfighting itself will be left where they belong-in the twilight of the 20th century.

NOTES

The advanced concepts contained within this essay represent an attribute of Fourth Epoch War theory. For dissemination purposes, I have refrained from linking them to the larger theoretical paradigm within which they exist. This essay was initially prepared for US Army TRADOC as NSSP Report 952. National Security Studies program, California State University, San Bernardino, July 1995. It was presented at US Army TECOM "Visions of Future Conflict Test Technology Drivers" TTS '96 Symposium at Johns Hopkins University, Applied Physics Laboratory, 4 June 1996. I wish to thank Professor Douglas C. Lovelace, Jr., Charles F. Swett, Lieutenant Colonel Matthew Begert, USMC, CWO5 Charles "Sid" Heal, USMCR, and Dr. T. Lindsay Moore for their comments on an earlier draft of this paper, and the US Army Command and General Staff College for

its research support.

1. For background on the rise of nonWestern and advanced technology warfare, see Robert J. Bunker, "The Transition to Fourth Epoch War," *Marine Corps Gazette*, September 1994, pp. 2032.
2. US Army, Field Manual 1005, Operations (Washington: Department of the Army, June 1993), p. 612.
3. *Ibid.*, p. Glossary1.
4. *Ibid.*, p. 224. Mention of EW against enemy C2 is as a capability that contributes to the effectiveness of combined arms operations.
5. US Army, Pamphlet 5255, *Force XXI Operations* (Fort Monroe, Va.: US Army Training and Doctrine Command, 1 August 1994), p. Glossary1. It should be noted that this pamphlet has defined the general tenets upon which the next version of FM 1005 will be based. Of equal interest is the separation of the electromagnetic spectrum from the realm where engagements occur. It is among the premises of this article that engagements will occur with increasing frequency within the electromagnetic sphere, and that the conventional threedimensional battlespace will become a killing ground for those forces that cannot use fourth dimensional assets to conceal themselves from attack.
6. Naval Doctrine Command, NDP1, *Naval Warfare* (Washington: GPO, 1994), p. 72.
7. Discrete from the "bioelectric realm" of minds where psychological operations are waged. Some question also exists if a "computer virus" shouldn't be considered a new form of military force.
8. DA Pam 5255, *Force XXI Operations*, p. 29.
9. Concern has been raised over my use of the term "nonWestern warfare" because of its ethnocentric implications and the collapsing together of all forms of warfare other than that waged by the West. I would argue that Western civilization as we define it wages war collectively in a similar manner. Further, this civilization has dominated much of the global system since the 16th century. NonWestern warfare is an attempt by nonWestern cultures to break this monopoly on warfare. Categorizing all forms of nonWestern warfare as one general type is indeed inaccurate since the various forms of nonnation forces, security forces, and armies that exist in the world today will wage war differently. However, until a concept similar to that of "nonWestern warfare" replaces the flawed operations other than war (OOTW) concept, I see little utility in exploring the true variations in nonWestern modes of warfare. See Robert J. Bunker, "Rethinking OOTW," *Military Review*, 75 (NovemberDecember 1995), 3441.
10. For a synopsis of ARDEC's smart munitions strategic plan, see Scott R. Gourley. "Smart Munitions," *Army*, July 1995, pp. 4144. For other articles of interest see Glenn W. Goodman, Jr., "Fire and Forget: Terminally Guided Antitank Submunitions Reach Fruition," *Armed Forces Journal*, August 1994, pp. 36, 39; Robert Holzer, "U.S. Navy Study Promotes Precision Munitions," *Defense News*, 27 February 5 March 1995, p. 30; Pat Cooper, "USAF Considers Smaller, More Lethal Bombs," *Defense News*, 2723 April 1995, p. 6; Glen W. Goodman, Jr., "Fired, Forgotten, and Finished," *Armed Forces Journal*, December 1995, pp. 36, 3839.
11. See principally the writings of Mary C. Fitzgerald: "The Soviet Image of Future War: `Through the Prism of the Persian Gulf,'" *Comparative Strategy*, 10 (OctoberDecember 1991), 393435; "Russia's New Military Doctrine," *Naval War College Review*, 46 (Spring 1993), 2444; "The Russian Military's Strategy for `Sixth

Generation' Warfare," *Orbis*, 38 (Summer 1994), 45776; "The Russian Image of Future War," *Comparative Strategy*, 13 (April/June 1994), 16780.

12. US Army, *Army 21, A Concept for the Future: Umbrella Concept* (Fort Monroe, Va.: US Army Training and Doctrine Command, December 1988).

13. Advanced Research Projects Agency, *Report of the Senior Working Group on Military Operations Other Than War (OOTW)*, May 1994, p. 24. Available on the Internet.

14. This will require a paradigm shift in our view of the battlefield and the military's place in it. For an example of what this type of shift will mean, see Alan G. R. Smith, *Science and Society in the Sixteenth and Seventeenth Centuries* (Norwich, Conn.: Harcourt Brace Jovanovich, 1972), pp. 927.

15. Western concepts of information warfare are mimicked by terrorism; hightechnology stealth coatings for our aircraft are mimicked by soldiers wearing civilian clothing or hiding out in mobs of women and children; precision strike weaponry is mimicked by driving a vehicle laden with explosives into a military installation.

16. It is assumed digital battlespace dominance would represent mastery of the electromagnetic spectrum and the physical battlefield. This form of battlespace dominance is inferior to cyberspace dominance because one's military forces would remain within the humansensing battlefield (i.e., humanspace).

17. Stealth has been written about extensively in military publications but no attempt has been made to link it directly to a fundamentally new concept of battlespace. For background on this subject, see James H. Patton, Jr., "Stealth Is a ZeroSum Game: A Submariner's View of the Advanced Tactical Fighter," *Airpower Journal*, 5 (Spring 1991), 417; and "Stealth, Sea Control, and Air Superiority," *Airpower Journal*, 7 (Spring 1993), 5262; John W. McGillvray, Jr., "Stealth Technology in Surface Warships," *Naval War College Review*, 47 (Winter 1994), 2839; James HeitzJackson, "Stealth: Potential vs. the Purse," *Defence Yearbook, 1992* (London: Brassey's, 1992), pp. 26169.

18. Not only do fish live in the sea-its great volume protects them from detection. See Mao TseTung, *On Guerrilla Warfare*, trans. Samuel B. Griffith (New York: Praeger, 1961), pp. 9293.

19. For background on SIPE, refer to the series of articles written over the last six years in *Army RD&A*. For a current perspective, see John G. Roos, "The 21st Century Land Warrior: The Army Becomes the Dominant Gene in Soldier Evolution," *Armed Forces Journal*, February 1995, pp. 1823; Mark Hewish and Rupert Pengelley, "New Age Soldiering," *International Defense Review*, 27 (January 1994), 2633; "Land Warrior program consolidated," *Washington Update*, AUSA Institute of Land Warfare, Washington, May 1996, p. 2.

20. My use of the term data fusion and the concepts behind it have been simplified. My understanding of data fusion derives from presentations given by Edward Waltz, "Image and Spatial Data Fusion-Combining Data to Understand the Battlefield," and Dr. James Llinas, "Fusion in Information Warfare," at the TMSA Information Warfare Conference held in Los Angeles 56 June 1995. For more on this subject, see SPACECAST 2020, "Leveraging the Infosphere: Surveillance and Reconnaissance in 2020," *Airpower Journal*, 9 (Summer 1995), 825; Marvin G. Metcalf, "Acoustics on the 21st Century Battlefield," *Joint Force Quarterly*, No. 10 (Winter 1995/96), 4447.

21. Facial and subdermal recognition technologies have immense potential in combating insurgency and terrorism

- as well as in law enforcement. For onthespot identification of known suspects in Haiti, see Gordon R. Sullivan, "A Vision for the Future," *Military Review*, 75 (May/June 1995), 8.
22. Better known as the OODA (Observe/Orient/Decide/Act) loop. See John R. Boyd, *Lecture on A Discourse on Winning and Losing* (Maxwell AFB, Ala.: August 1987).
23. It is proposed that this informational barrier is composed of either "noise" or "static" to the human senses and to lesser forms of technology. When a military force takes refuge in cyberspace, it becomes lost in the surrounding medium-human, organic, electromagnetic, et al.-and as a result is not subject to detection or target acquisition.
24. DA Pam 5255, *Force XXI Operations*, p. 310.
25. "Advanced Armor Keeps New Ordnance at Bay," *National Defense*, 79 (May/June 1995), 1617; "US Army to Test AFV Selfdefense Suite," *International Defense Review*, 28 (June 1995), 12.
26. Attrition warfare is also becoming obsolete. See Memorandum for Vice Chairman, Joint Chiefs of Staff, Under Secretaries of Defense, Director, Net Assessment, "Terms of Reference for Strategic Studies Group I," Memo from The Deputy Secretary of Defense, 6 September 1995; "Kellogg: We don't play attrition warfare anymore," *AUSA News*, July 1996, pp. 1112.
27. John Arquilla and David Ronfeldt, *Cyberwar is Coming!* (Santa Monica: RAND, P7791, 1992), p. 7; see also "The Transition to Fourth Epoch War," p. 29.
28. Jennifer Morrison Taw and Bruce Hoffman, *The Urbanization of Insurgency: The Potential Challenge to U.S. Army Operations* (Santa Monica: RAND, MR398, 1994), pp. 145.
29. Marvin B. Schaffer, *Concerns About Terrorists with PGMs* (Santa Monica: RAND, P7774, 1992), pp. 18.
30. Scott R. Gourley, "The sniper's latest nightmare," *International Defense Review*, 28 (April 1995), 66.
31. The other aspect of cyberspace, that which represents the information infrastructure of our society, represents another feature to be dominated. Robert L. Ayers, Chief, Information Warfare Division, Defense Information Systems Agency, "DISA and Information Warfare," at the TMSA Information Warfare Conference, Los Angeles, 56 June 1995.
32. See the concept of simultaneity. DA Pam 5255, *Force XXI Operations*, p. 29.
33. For the initial airspace offensive, see the interview with Defense Minister Pavel Grachev, "General Grachev on the Army and on the Soldier," *Argumenty i fakty*, February 1993, pp. 12, quoted in "The Russian Military's Strategy For 'Sixth Generation' Warfare," p. 2.
34. The Composite Armored Vehicle Advanced Technology Demonstrator (CAVATD) which seeks to reduce vehicular weight and active and passive signatures is viewed as a step in the right direction. Rupert Pengelley, "Towards the Plastic Tank," *International Defense Review*, 28 (July 1995), 61.
35. Gordon R. Sullivan and Anthony M. Coroalles, *The Army in the Information Age* (Carlisle Barracks, Pa.:

US Army War College, Strategic Studies Institute, 31 March 1995), pp. 1819.

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