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CONTENTS: The document(s) listed below are forwarded for accessioning into the DTIC DROLS Technical Reports database. Point of contact is the undersigned, DSN 680-2956, commercial (804) 727 2956.

TITLE	**NO. COPIES**
1. LOUISIANA MANEUVERS THE FIRST YEAR	2
2. ARMY LEADER'S GUIDE TO NEPA	2
3. FUTURE VISION	2
4. HISTORICAL REVIEW AND EVALUATION OF COMBINED ARMY DOCTRINE	2
5. AMERICA'S ARMY OF THE 21ST CENTURY	2
6. AMERICA'S ARMY IN TRANSITION	2
7. U.S. ARMY CADET COMMAND THE 10 YEAR HISTORY	2
8. AMERICAN ARMY DOCTRINE IN THE COLD WAR	1
9. TRADOC PRIMER	1
10. A SHORT HISTORY OF CAMP PICKETT	1
11. REFLECTIONS ON THE REVOLUTION IN MILITARY AFFAIRS	2

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REFLECTIONS ON THE REVOLUTION IN MILITARY AFFAIRS

by John J. Patrick

October 17, 1994

Searching for the Next Revolution

The apparent success of high-technology weaponry in the 1991 Gulf War, coupled with epochal developments like the collapse of the Soviet Union and the information explosion, has given rise to speculation that war itself may be undergoing a profound transformation. In the United States, this discussion centers on the application of advanced information technology to conventional combat. Proponents of high-tech weapons, sensors and communications claim that the introduction of systems now on the drawing boards will produce what they term a "revolution in military affairs," or RMA.[1]

Historians agree that war has undergone periods of revolutionary change in the past. Some of these transformations clearly resulted from new technology, such as iron weapons or firearms. Others, like the revival of infantry at the end of the Middle Ages or the advent of mass armies in the wake of the French Revolution, arose from social and economic developments and did not involve any significant change in technology.

Beyond these broad generalizations, historians can agree on very little. The question of precisely which changes qualify as genuine revolutions in warfare causes endless debate. So does the relative influence of technology versus social factors, especially in modern societies, where the two are closely intertwined. *Blitzkrieg*, for example, which many consider the most notable recent RMA, seems to have arisen from a combination of technological and organizational innovation, with neither the sole driving force.

Disputes such as these frequently boil down to what is meant by a "revolution in military affairs." When it comes to defining an RMA, the most that can probably be said is that, like any other revolution, it is a profound and striking transformation that thoroughly permeates the

institutions experiencing it. In extreme cases, it can sweep away entire military institutions, as the democratization of combat swept away knighthood at the close of the Middle Ages.

The historical record also suggests that revolutions in military affairs are not all equal, that some have more profound implications than others. The advent of modern mass warfare, for example, had a much greater cumulative effect on the military and society than the development of *Blitzkrieg*, which made itself felt primarily on the battlefield.

John F. Guilmartin, a professor of history at the Ohio State University, has suggested one characteristic that may distinguish the most transcendental revolutions in warfare. During a recent conference at the U.S. Army War College, Dr. Guilmartin noted in passing that a revolution in military affairs occurs when classes of people who have not previously played a significant role in war discover that they can do so.[2]

Dr. Guilmartin's observation does not seem to hold for many historical shifts that are generally — and probably rightly — considered revolutions in military affairs. It does, however, provide a convenient test of how profoundly a given historical transformation has affected the way people wage war. More importantly, it can serve as a helpful rule of thumb for judging the magnitude of the next revolution in warfare.

The Conventional Wisdom[3]

A single school of thought has begun to dominate the discussion of military trends, both within the American military establishment and among outside experts. This widely-shared conventional wisdom holds that a new revolution in military affairs has already begun, that it is essentially technical in nature, and that it first manifested itself in certain capabilities American forces brought to bear during the 1991 Gulf War. Among the most notable of these new capabilities were the Joint Surveillance and Targeting Radar System (JSTARS) and the Tomahawk Land Attack Missile (TLAM).

The driving force behind this high-tech RMA is information processing, the same dynamic technology powering the "information revolution" in today's civilian economy. The power of

information technology manifests itself in three key aspects of the RMA: information dominance, precision weaponry, and joint-service operations.

Information dominance promises to clear away the fog of war for friendly commanders and thicken it for the enemy. Dispersing the fog of war will permit warfare to become much more efficient, in sharp contrast to previous combat experience, in which reconnaissance has often been faulty, planning and execution have involved long delays, and destroying a single critical target could require huge amounts of ammunition.

In the conventional-wisdom version of the RMA, a variety of powerful sensor systems akin to JSTARS will search broad areas, gathering data across the electromagnetic spectrum and generating continuous, target-quality information on all significant enemy assets. Advanced command, control, and communications (C^3) will automatically collect and "fuse" this sensor data, adding intelligence information and digital reports from friendly units of all sizes. The result will be a single "near-perfect" picture of the combat situation available in real time to commanders at all levels.[4] The availability of such near-perfect information will enable higher headquarters to wage "information war," a highly coordinated, systematic effort to take control of the enemy's perceptions by disrupting or distorting his communications and blinding or deceiving his reconnaissance.

Precision weapons will serve as the primary tool for exploiting information dominance. With a near-perfect understanding of the situation, a high-level commander can determine precisely which assets are most important to the enemy at any given time. He can then order pin-point strikes — using the target-quality data provided by wide-area sensors — to destroy specific assets at the critical moment. Long-range "stand-off" weapons will play a particularly important role in this effort because they can strike from locations that are beyond the range of most hostile weapons and difficult for the enemy to reconnoiter.

A relatively small number of discrete weapons arriving precisely on the most critical targets can do far more damage to the enemy's fighting ability than indiscriminate saturation barrages and attacks by heavy maneuver units. By relying on intensive rather than extensive destruction, a

combination of information dominance and precision weaponry should, in theory, allow a comparatively small American expeditionary force to defeat much larger enemy formations. Proponents of the conventional-wisdom RMA envision small, agile maneuver units that help to coordinate the application of stand-off weapons and then administer the *coup de grâce* to heavier enemy forces while they are still reeling from the attack.

Jointness — the seamless coordination of assets from all services — is the final element of the conventional-wisdom RMA, contributing to the superior efficiency on which the entire concept is based. The more efficiently a commander can coordinate advanced sensor and weapon systems, the more effective they should be. The fact that a given system is land-based, sea-based or airborne, or that it belongs to the Army, Navy, Air Force, or Marines, must not interfere with this coordination. The RMA demands, at a minimum, that all services train and operate together to make sure their systems and procedures are compatible. It may eventually demand the joint *development* of systems and procedures.[5]

At present, the United States leads the world in applying information technology to warfare. Conventional wisdom maintains that this technical lead should give the U.S. military a significant and growing advantage over the forces of any potential adversary — with supremacy in the laboratory translating directly into supremacy in combat. Since no other country seems to be investing nearly as heavily in military technology, many RMA advocates predict that America will continue to enjoy this advantage for the foreseeable future. Others, however, urge the government to redouble its effort to field new technology, noting that the country with the shortest development cycle could gain a decisive military advantage over its adversaries.

The Fallacy of Technological Monopoly

The belief that the United States will be able maintain a decisive advantage in tomorrow's military technology is the most obvious flaw in conventional thinking about the RMA. In modern times, no technological leap has decided the outcome of a major war or given one country more than a fleeting military advantage over other leading industrial powers.

In World War I, the British blockade and American intervention doomed Germany to defeat, not the Allies' development of the tank. In World War II, jet aircraft and ballistic missiles failed to save Hitler, and it was the sheer volume of American war production, not the atomic bomb, that guaranteed the defeat of Japan. Throughout the ensuing Cold War, the United States held a commanding lead in military technology, but it never managed to achieve more than a military standoff with the less sophisticated forces of the Soviet Union. The eventual demise of the USSR resulted not from the general inferiority of Soviet military technology, but from the failure of communism as an economic system.

America's ability to maintain such a commanding technical lead for so many decades was itself highly unusual. The explanation lies in the unique circumstances of the post-war world. The critical military systems in the decades following World War II — including nuclear weapons, ballistic missiles, high-performance aircraft, and even advanced radars — depended to an extraordinary degree on technologies with few commercial applications. Staying on the leading edge of those technologies demanded massive government programs. America, an economic colossus largely untouched by the war, had the means to support such programs. The Soviet Union, its economy hobbled by communism, could never obtain the wherewithal to challenge America's lead. Europe and Japan might have matched America's investment in uniquely military technologies once they rebuilt their war-shattered economies. But they had no particular incentive to compete with American military power, which contributed to their own security.

Now, the era of unique military technology is drawing to a close. The rapidly advancing information technology that promises a revolution in military affairs is fundamentally commercial, not military. Its most important developments generally emerge from private firms seeking to anticipate or create demand in the marketplace. Any large country with a sophisticated economy will not only have access to state-of-the-art information technology but will probably be helping to create it. Converting that technology to military use will require no extraordinary commitment. Should the recent re-emergence of a multipolar world eventually stir up the great-power rivalries

that have caused so much trouble in the past, each major power will inevitably come equipped with the full panoply of the high-tech RMA.

A Clash between Two RMA Forces

What, then, if two First World forces equipped with what the conventional wisdom considers revolutionary military technology were to meet in battle? The result might indeed be a revolution in military affairs. However, that revolution would probably manifest itself in stalemate rather than the decisive victory for one side that RMA proponents envision.

As generally conceived, the RMA is essentially a revolution in firepower. Notional descriptions of a future RMA battlefield focus first and foremost on the use of fire-support systems to destroy enemy assets. Maneuver, when it appears at all, is clearly an afterthought. This vision of the RMA battlefield rather resembles the Western Front in World War I. There too, standoff weapons of unprecedented range and lethality — i.e., long-range, indirect-fire artillery — seemed to promise a crushing victory for the force that could wield them most efficiently. The actual result, however, was a bloody stalemate of unprecedented proportions.

Like today's theoretical RMA forces, the real armies that clashed in 1914-1919 had surveillance assets that could observe anything that showed itself on the traditional field of battle — what we might now call their "battle space." In other words, their forward artillery observers could observe any man, gun, or vehicle that attempted to move within their line of sight. As with the notional RMA, these surveillance assets could call in firepower from hidden sources far in the rear to kill whatever they saw.

The problem was that the enemy also had forward observers and long-range artillery. He too could observe the battle space and destroy whatever he saw. The only solution was not to be seen. Armies all along the Western Front hid from one another, digging in and fighting from the trenches. But the more the armies hid, the more trouble they had finding the enemy. And whenever they showed themselves, the enemy usually found them first.

One could easily envision a similarly indecisive war of attrition overtaking the RMA. While it may be possible, at least in theory, for one force to see and destroy every critical hostile target in the battle space, it is a logical absurdity to suppose that two opposing forces could do so. Were RMA forces to clash, each side's first priority would undoubtedly be to conceal itself from the unprecedented lethality of the other's weapons. Survival would naturally take precedence over attack, and the need to remain hidden would make it very difficult to locate and attack critical enemy assets. The slightest telltale movement or emission of energy could reveal the location of the would-be attackers and expose them to instant destruction.

RMA versus the Third World

The best prospect for achieving a decisive result with the conventional-wisdom RMA lies not in a struggle between armed forces of equal sophistication, but in a contest where an advanced military that has succeeded in harnessing RMA technology takes on an adversary still wedded to the mass firepower and mechanization of the industrial past. This situation is most likely to crop up when a First World country intervenes in the Third World.

However, the ability of an expeditionary force with RMA technology to defeat local mechanized forces of much greater size will not drastically alter the current military balance between the First and Third Worlds. First World expeditionary forces have consistently defeated Third World militaries for centuries, even in those cases where the more numerous locals enjoyed essentially equal or even superior technology. If the collapse of the Iraqi military in Desert Storm demonstrated anything, it is that advanced nations retain their traditional preeminence in formal conventional warfare. Israel's repeated victories over larger Arab militaries armed to the teeth with the latest Soviet equipment reinforces that conclusion.

First World preeminence in formal warfare has little to do with equipment. A Third World despotism like Iraq or Syria can organize and equip its forces like those of an advanced nation. It can even attempt to train them that way. But it cannot make them fight like a First World military.

The superiority of the advanced economic powers on the formal battlefield springs from the same cultural values that enable them to become advanced in the first place.

The value of RMA technology for military operations in the Third World consequently lies at the margin. The RMA is not necessary to perpetuate the superiority of First World expeditionary forces, but it could increase that superiority, enabling them to prevail more rapidly or against somewhat greater odds. Reliance on precision weapons also has the potential to reduce casualties, both friendly and enemy, and to limit collateral damage among civilians. Improvements of this sort, albeit at the margin, are by no means insignificant in an era when military budgets and force levels are declining in most advanced nations, and when aversion to casualties and humanitarian considerations can strongly affect domestic support for overseas operations.

Searching for an RMA Organization

The question then arises: how ready are the military services of the developed world, and particularly of the United States, to wield the new information technology that lies at the heart of the RMA? Wielding the new technology will require more than technical training. In the past, radical shifts in technology have tended to impose equally radical changes in the way combatants organize and interact on the battlefield. Countries that have discovered the organizational and behavioral implications of new technology and restructured their military institutions accordingly have tended to remain militarily strong during periods of revolutionary change. Those that have failed to do so have become vulnerable. In some cases, great powers with outdated military institutions have recognized their weakness and curtailed their commitments in time to avoid disaster. In other cases, they have suffered crushing defeats.

The transition process from one organizational paradigm to another is never easy. Leaders have large personal stakes in established ways of doing business, not the least of which is a sincere moral commitment to the existing order. Societies as a whole recoil from the dislocation and risk of drastic reform. The obstacles to reforming military institutions are especially daunting. The difficulty of discerning the war-fighting implications of new technology during peacetime tempts

the services to ignore the need for change until it is too late. Reforming the military also involves unusual risk, since the consequences of wrong decisions can be so dire.

In the case of the RMA, however, the fact that the critical technologies are basically civilian may help military institutions overcome their natural and understandable inertia. As the global information revolution transforms existing industrial societies, civilian institutions will probably have to change first. Private enterprise, which faces the daily test of the marketplace, will inevitably be in the forefront of this change, providing numerous examples of success and failure that the military can use to guide its own restructuring and minimize the inherent risk of reform. In fact, the information revolution is already affecting private enterprise, often in painful ways, and businesses are beginning to abandon their traditional organizational model and seek a new approach.

Business, of course, is not warfare. Combat will always remain a uniquely challenging environment, with its own special demands. Still, today's military institutions adhere to the same basic organizational model as most large corporations. Consequently, they will eventually encounter many of the same problems and find themselves in need of the same solutions.

The Industrial Model[6]

At present, most large businesses are still industrial organizations, following the production-oriented model that has prevailed ever since the dawn of the industrial revolution two centuries ago. Basically, industrial organizations are designed to create and perpetuate rational, steady-state environments with all the variables of the process carefully optimized for maximum production. The classic example of this rational, steady-state environment is the manufacturer's assembly line, but old-line transportation companies like the railroads and mass communication firms like the three broadcasting networks are organized along the same lines. The steady-state model absorbs even change itself, supplying detailed plans for updating both the product and the production line at regular intervals.

Process and control lie at the heart of the industrial organization. Central decision-making permits large-scale optimization. Elaborate hierarchy provides close oversight and ensures uniform standards. Large headquarters and numerous staff turn out plans and procedures to cover every contingency. Information tends to flow up the chain of command until it arrives at a high enough level to form a complete picture of the entire process, akin to the near-perfect picture conventional wisdom attributes to the RMA. High-level decision-makers then issue directions that flow back down the chain, growing more detailed at each level, systematically eliminating ambiguity and synchronizing the efforts of myriad individuals into a seamless process. Each group, and often each individual, has a rigid specialty, and the organization may even discourage direct communication among different specialties to avoid confusion and cross-purposes.

Emphasis on steady-state process has inevitably carried over to the social arrangements that sustain large industrial concerns. Until recently, lifetime employment and generous pensions have been the norm. The steady-state mentality has also affected attitudes. Management and labor have tended to take the closed production environment for granted, to insist upon its rigid but reassuring rules, and to assume it would perpetuate itself forever. But as the information age dawns, the old-line organizations that epitomize the industrial model are increasingly falling prey to hostile takeovers, downsizing, restructuring, reorganization, and outright bankruptcy.

The Industrial Military [7]

Despite their technical sophistication, today's advanced militaries are, with very few exceptions,[8] quintessentially industrial organizations. They stress process and control. They have elaborate hierarchy, large headquarters, and numerous staff to support centralized decision-making. Centralized direction and planning are their life blood, to the extent that their leadership blithely attempts to translate the deliberately vague objectives of national strategy into precise quantitative requirements, and officers at all levels commonly begin written discussions of even minute technical questions with a ritual bow to the reigning service plan. Specialization is so rigid

that each service wears distinct clothing. Within the services, permanent groups consisting mostly of lifetime members wear distinctive badges and focus on specific types of weapons or platforms.

The social attributes of an industrial organization are present in spades. Even among management — the officer corps — rank correlates more closely to seniority than to any other factor. Lifetime employment has been taken so much for granted that officers still perceive even mandatory early retirement as a devastating blow, and the government attempts to guarantee military pensions not merely at their face value, but at a constant *real* value, sustained by cost-of-living increases.[9]

Like their industrial-age counterparts in the civilian world, almost all of today's military organizations instinctively seek a steady-state environment where they can ensure the desired result by controlling as many variables as possible. They tend to conceive of the ideal battle as one that goes according to plan. They favor synchronization and standard procedures. They are devotees of target lists, phase lines, geographical objectives, areas of influence, areas of interest. Above all, they are output-oriented. This is why modern military organizations naturally gravitate to firepower. Firepower is classic industrial output. It demands elaborate planning and logistics. It can be quantified and controlled at every step. Its goals are volume and precision.

Not surprisingly, militaries organized along industrial lines appear to have difficulty when the focus changes from dealing with material to handling information for its own sake. Information easily overwhelms them. Israeli military historian Martin Van Creveld refers to this phenomenon as "information pathology."

Van Creveld points out that in Vietnam burgeoning message traffic rapidly clogged the military communication system, notwithstanding its unprecedented capacity. High-priority operational messages were chronically late. The Joint Chiefs of Staff were obliged to create a new "Superflash" message category just to guarantee that the most urgent communications got through.[10] Other sources indicate that the same thing happened in the Gulf War, despite what was once again an unprecedented level of communications "connectivity" in the theater. During the

first 30 hours of Operation Desert Storm, a glut of 1.3 million electronic messages did more to impede informed decision-making than to support it.[11]

The daily Air Tasking Order (ATO) produced by coalition headquarters in Riyadh was a prime example of how ineffectually the industrial model deals with large masses of information. Once computers made it possible to keep track of plans for every friendly flight in a theater of operations, no industrial-era organization could resist the temptation to pull all the information up to the highest headquarters, have the staff assemble it into a single, complete picture, and use that picture to generate detailed plans and instructions for the edification of subordinates. The resulting ATO was a typical industrial production plan: highly detailed, static, and at least one day old by the time it was issued.

In the information age, a comprehensive plan of this sort seldom relates to anything for very long. War, which is inherently chaotic, compounds the problem. Although the Iraqis did very little to upset the elaborate plans of coalition headquarters, many airplanes naturally failed to follow the script and popped up where the ATO said they could not possibly be. Meanwhile, transmitting and attempting to use a plan of that magnitude generated the usual friction and distraction further down the chain of command. U.S. naval officers, for example, wasted untold hours getting the ATO aboard ships in the Gulf and attempting to make sense of it.

The Open Organization[12]

The information revolution calls for an organizational model designed to deal with information *for its own sake.* The old industrial model was essentially logistical; it employed information primarily to handle material. It produced good results when the competitive advantage lay in maximizing physical output, but it has serious shortcomings when the competitive advantage shifts to information itself.

Any organization that depends upon its leaders having a complete picture of the situation — much less a "near-perfect" picture — is going to have problems in the information age. Information is inherently ambiguous and incomplete. "Perfect information" is a contradiction in

terms. The more information one tries to absorb, the more uncertainty one has to deal with.[13] It is interesting that as the amount of information has increased, physicists and philosophers have turned to approaches that offer not certainty, but elegant ways to make use of ambiguity. It is not coincidental that the recent vogue for chaos theory coincides with the need to process more and more information.

It is not surprising, then, that the "open" model of commercial organization associated with the new information economy differs sharply from the industrial model. An open organization seeks competitive advantage not in maximizing the efficiency of the internal process and the volume of output, but in reacting to outside change faster than its competitors. Productivity is still important, but the new information technology makes efficient production comparatively easy. The challenge for leading-edge companies is tailoring production to meet increasingly unstable demand.

This is why the new organizations focus first and foremost on the customer.[14] Early in the 20th century, the Ford Motor Company became so much more efficient by streamlining the production process that customers flocked to buy its cheaper, highly reliable Model Ts, even though they came in only one color: black. But as the century draws to a close, any number of efficient producers can supply cheap, reliable products. The problem is keeping up with an information-driven demand. New products are constantly appearing. Niche markets proliferate. To prosper, a commercial firm must be agile and flexible enough to deliver the right product at the right time.[15]

The goal of an open organization is not synchronization, or even coordination from above. Its goal is effective *cooperation* to ensure prompt and effective action. It therefore minimizes hierarchy and centralized decision-making. It shortens the chain of command to make leadership accessible and delegates authority widely to permit on-the-spot decisions. Headquarters and staff are relatively small. An open organization also encourages groups and individuals to talk directly to one another rather than passing information to a common superior. New forms of

communication, such as E-mail, encourage the creation of *ad hoc* networks defined by common interests.[16]

Higher authority provides only essential direction, so as not to preclude more informed decisions at a lower level. Plans include only the main objectives and say little about how to meet them. Greater detail would merely fail to address an ambiguous and rapidly shifting situation. Rather than providing direction, corporate leadership attempts to instill in its employees a common understanding of the organization's goals and common ways of thinking about the types of problems they are apt to encounter.

To thrive in volatile markets, the new organizations are also demanding more personal flexibility from management and employees. Job descriptions are less precise, and there are fewer work rules. People move among established groups. Other groups form and dissolve in response to specific needs. Incentive plans are proliferating for both individuals and groups.

Meanwhile, deep-rooted social arrangements from the industrial age languish. Seniority is becoming less important. Guaranteed pensions have vanished from entire industries, replaced by combinations of incentives and employee savings plans. "Virtual corporations" now emerging in the computer industry may herald a new era of organizations that have few permanent facilities and contract for most of what they need when they need it.[17] Such organizations will bring in workers — including specialists and professionals — only when they are needed and let them go again as soon as the workload diminishes.[18]

In virtually every respect, open organizations are a far cry from the conventional view of how to organize for the revolution in military affairs. If the open organization is the most appropriate model for the information age, then conventional wisdom has produced a hermaphrodite, a strange marriage of mutually exclusive characteristics. The standard vision of the RMA ignores the organizational implications of leading-edge information technology and consequently seeks to graft it directly onto military institutions still attuned to the industrial past.

An Open Model from Military History[19]

Militaries are not necessarily wedded to the industrial model, however. Over the centuries they have taken on any number of organizational forms. Nearly 80 years ago, one of the world's leading military services developed a combat organization that had many of the same characteristics as the open commercial organizations now cropping up in response to the information revolution. This revolutionary experiment proved highly successful at the tactical level in World War I and laid the groundwork for famous operational successes in World War II.

The Imperial German Army developed the new combat organization during World War I in response to what is arguably the central problem of modern warfare: the tendency of the industrial model, with its highly efficient production of firepower, to produce stalemate rather than victory. This tendency manifested itself as early as the American Civil War, when the industrial revolution and the art of war had only recently begun to converge. The protracted trench warfare near Richmond, Virginia, in 1864-65 was merely a foretaste of the much longer and bloodier stalemate half a century later on the Western Front in World War I. The steady-state application of firepower seemed merely to produce a steady-state outcome.

The heart of the problem on the battlefield was analogous to the key difficulty many industrial organizations now have in supplying an information-driven marketplace. Focused on optimizing the placement of firepower on "targets" — i.e., on the production process — an industrial-model organization could easily fail to address the combat equivalent of the customer — *the enemy*. The industrial approach to war regarded the enemy merely as a factor in the process, never as a human being with an independent will. For all the destruction it wrought, firepower applied along industrial lines seldom destroyed — or even attacked — the most important target: the enemy's will to resist.

In contrast, the innovative model of combat organization that eventually restored decisiveness to the early 20th-century battlefield was decentralized and enemy-oriented. It recognized that combat, at least the dispersed, stealthy combat of the modern battlefield, is the opposite of a steady-state environment. Combat is inherently ambiguous and unstable. It is "non-

linear."[20] It therefore calls for flexibility and on-the-spot initiative to anticipate its rapidly changing demands and exploit its fleeting opportunities.

To meet those demands, the German Army developed a much more open combat organization beginning at the lowest tactical level. It invented small, self-sufficient combined-arms units of the sort we now refer to as squads or fire teams. These small units carried diverse, mutually supporting weapons that permitted them to operate independently. Their goal was to infiltrate, disrupt, and break down larger but less flexible enemy formations while offering few targets for the enemy's massed firepower.

The Germans selected capable, motivated troops and trained them rigorously in how to solve the problems of combat. Their training laid particular emphasis on individual initiative and independent action in pursuit of common, general goals. Once the new units were thoroughly trained and equipped to exploit every fleeting opportunity, higher-level commanders turned them loose to fight the enemy according to their own best judgment.

Senior officers did not attempt to provide detailed direction. Instead of insisting on rigid synchronization, they tried to support whatever form of cooperation seemed to work best in each situation. Rather than imposing fixed objectives, they encouraged attacking units to get as deeply as possible into the enemy's rear and defending units to initiate immediate local counterattacks on their own initiative. Although this new approach required thorough preparation, it did not try to make the battle follow any fixed plan. Instead, it fostered myriad individual actions that out-paced the enemy's attempts to respond and convinced him that further resistance was futile.

Like today's open business organizations, the German combat organization drastically reduced hierarchy. A German division entered World War I with five levels of combat command: division, brigade, regiment, battalion, and company. By the end of the war, it had two: division and battalion. The other levels became purely administrative. The Germans not only decentralized decision-making to ensure on-the-spot decisions, they expressly subordinated senior officers to juniors who were closer to events and thus better able to grasp fleeting opportunities. For example, in a regiment's defensive sector, whoever commanded the battalion stationed closest to

the enemy automatically took command of all other battalions in the regiment, as well as any reinforcements sent into the forward area — up to and including an entire brigade!

In the great German offensives of 1918, the new open approach worked splendidly at the tactical level, splitting the previously impenetrable allied defenses and advancing to unheard-of depth. But at the broader, operational level the Germans failed to make a decisive breakthrough. The Allies managed to restore the line, and American reinforcements eventually tipped the strategic balance decisively against Imperial Germany. The open organization failed to achieve victory because no World War I army had the specific technologies needed to achieve deep operational penetrations: namely, reliable armored vehicles and mobile radios. In World War II, when those technologies were widely available, the same organization principles produced the *Blitzkrieg*, a revolution in military affairs that once again allowed armies to move and achieve decisive results in the face of coordinated industrial firepower.

The striking tactical and operational successes of the open combat organization inspired other major powers to mimic specific elements of the German organization, and many of those isolated organizational structures and procedures persist to this very day. However, no major power succeeded in reproducing the intellectual framework that gave those elements meaning and made them part of a successful whole. Thus, while some of the outward manifestations of *Blitzkrieg* have persisted, the spirit of openness, which made all the difference, has been allowed to wither in the military that first nurtured it and has never really taken root in most other military services.[21]

Consequently, few of today's military professionals have the historical perspective to recognize the striking parallels between innovative business organizations now emerging to deal with the information explosion and the revolutionary combat organization that first enabled armies to break the deadlock of modern industrial firepower. Fewer still are sufficiently imbued with the open spirit that created *Blitzkrieg* to begin creating the new tactics and organizations that will be needed to deal *simultaneously* with the chaos of modern combat and the chaos of the information explosion.[22]

Organizing for the RMA

What sort of organization can make the best use of state-of-the art information technology in conventional combat? First, we should recognize that it is useless and even dangerous to be too specific at the outset. A military organization must focus as closely as possible on the changing demands of actual combat. It can rely on theory only for the essential guiding principles. It must rely on experience — whenever possible, combat experience — to reveal the specifics. The study of actual combat information from whatever source it can be obtained, without regard to persons or reputations, is an essential tool for developing an effective combat organization. In peacetime, organizational development must focus on frequent exercises, with maximum free play to simulate the intellectual challenges of war.

At this early stage in the information revolution, we can only infer some general principles of organization that we can then begin to test. First, future combat will require an open organization.[23] Grafting advanced information technology onto a traditional industrial structure will not work. Experience in Vietnam and the Gulf War have already exposed critical weaknesses in that hermaphrodite approach. Industrial organization cannot deal effectively with uncertainty and ambiguity, which are intrinsic characteristics both of the information explosion and of modern combat. The industrial approach will fail to achieve decisive results because it will miss fleeting opportunities in an environment increasingly prone to sudden, drastic change.

The RMA, which adds the demands of highly automated information to those of combat, should call for an organization more open than any that has gone before. Organizational analysis should therefore focus on questions such as how to reduce hierarchy and speed up decision-making, how to communicate goals with the least restriction on the way subordinates achieve them, and how to focus the organization's effort sharply without sacrificing the ability to sense rapid change and shift focus with equal swiftness. The analysis should seek to determine which commanders have the best opportunity to exploit fleeting information at any given time, how the organization can give them the authority to make the most of those opportunities, and how it can

help them to reach out across the organization and draw on other command echelons without regard to fixed command relationships.

Finally, the German experience in World War I indicates that an open organization requires, above all, leaders who are decisive, intelligent, independent, and highly skilled at creative solutions to ambiguous problems. It requires such leaders down to the lowest possible level of command. (Current experiments in the world of business will probably indicate much the same thing.) Strict selection and rigorous training for independent action are both essential. The training of leaders should never be by rote, but should focus constantly on solving realistic problems. Above all, the future military institution will need a "corporate culture" that consistently rewards independence, so long as it is not arbitrary but focused on the general goals set by superiors. In a corporate culture of that type, no superior would ever feel entitled to assert his authority for its own sake, an all-too-common failing in military organizations still wedded to traditionally hierarchy.

A Few Real-Life Examples

How would this approach seek to change the U.S. military's current way of doing business? A few examples from recent experience suggest the sort of questions future experiments and analysis should pose.

The Air Tasking Order (ATO) developed by the U.S. Air Force is a case in point. Conventional wisdom considers the ATO part and parcel of the revolution in military affairs. It holds that the U.S. naval aviation might have played a more effective role in the Gulf War air campaign if aircraft carriers had been equipped to receive and instantly display the ATO and if naval officers had been trained to use it. Unfortunately, the ATO seems to be precisely the wrong sort of tool for the information age. It is headquarters' idea from last night, at the latest, of what friendly aircraft ought to be doing today. It may have some value as a reference document, provided it does not get in the way, but it is not the sort of thing a combat organization — or any up-do-date information organization — can rely on once the action begins.

What might the wizardry of the information revolution attempt to do instead? Information technology should, if possible, help to communicate the *essence* of a commander's plan — his intent, what he wants to achieve. This is best done face-to-face, because meeting face-to-face conveys a wealth of nuance that is lost in other formats.[24] Among other things, it permits the commander to judge critical factors like the subordinate's mental state and attitude toward the mission. Can some future form of teleconferencing provide anything like a comparable experience? Can it do so reliably? In combat? If not, can information technology encourage face-to-face contact by automating other, less critical parts of a commander's workload?

Once subordinate units understand the commander's intent, information technology should give them the ability to carry it out in whatever manner best meets the demands of a rapidly changing combat situation. This is the very opposite of rigid, preplanned air operations in the style of World War II bomber missions. Instead, it would seek to place technology at the service of individual initiative at the lowest feasible level. It would enable aircraft units to cooperate with one another, with units on the ground, and with friendly surveillance assets so that they could determine for themselves — in real time — how best to support the overall effort. Its goal would be to endow every aircraft mission from "strategic" strikes to airborne surveillance with the same responsiveness and flexibility as the very best close air support.

The application of technology should pay close attention to the information needs of individual combat decision-makers. For example, why was it important that cruisers as well as aircraft carriers have instant access to the ATO? Was it to prevent them from inadvertently shooting down friendly aircraft? If so, having instant access to the ATO might have given them a useful reference, but it would not have offered any panacea, since the chaotic nature of combat ensured that a good many friendly aircraft would fail to follow the plan. For officers in ships making instant combat decisions, reliable technology for identifying aircraft in real time might have proven more useful. Was the ATO needed to assist the ship in controlling friendly aircraft? If so, would it have been more useful to broaden communication between the cognizant shipboard officers and the commanders of specific aircraft units? Obviously, if it comes to a choice between

training officers to seek direct communication across the organization as a matter of course and training them to use a set plan like the ATO, the former should have priority.

On a broader plane, the current drive for jointness might also benefit from rigorous questioning. Common wisdom, with or without the RMA, considers joint operations good *per se*. Jointness, we are told, exploits synergism among the services, makes each service more effective and efficient, and is essential for all forward operations. But is jointness really good in and of itself? How has our experience with it measured up to the principles of open organization? True, jointness has provided some opportunities for direct communication across the defense organization, but has it reduced hierarchy or added levels of command and approval? Has it encouraged only essential planning, or have plans proliferated? In preparing for combat, does it focus more often on the enemy or on the defense establishment's own institutional agendas?

Operational jointness has value only insofar as it thwarts the intentions of the enemy and imposes our will on him. To form a useful joint force, one must ask: What is the enemy trying to do to us? What do we need to do to him? How does each unit we select contribute to what we are trying to do? For some operations, we may want units from every service. For others, we may want only one service, or only one type of unit, or an entirely new unit created on the spot. Neither jointness nor the lack thereof is inherently better. What is better is whatever succeeds in rigorous exercises and, ultimately, in combat.

How Important Is This High-Tech RMA?

If questions of this sort spark organizational changes on the same scale we are now beginning to see in private business, they will indeed bring about a revolution in military affairs. They will permit the U.S. military to progress beyond stale forms and rote procedures. They will help members of the armed forces internalize the open way of thinking and thus enable them to begin creating new tactical and operational forms suitable for conventional combat in the information age.

As revolutions go, however, this will be a fairly minor one. It will not cause any major shift in the strategic balance of power. Moreover, its effect, like the effect of *Blitzkrieg*, will be limited to the formal battlefield. In other words, the high-tech RMA may be a new style of warfare, but it certainly does not constitute a new form of war.

To appreciate this distinction, it is useful to recall Professor Guilmartin's observation that a fundamental revolution in military affairs take place when people who have not previously played a major role in war discover that they can do so. The technology-driven RMA we have discussed up to now does not expand the class of people considered warfighters, much less shift that distinction from one group to another. On the contrary, current theorizing about the RMA concludes that it will shrink the category of warfighter to a relatively small number of highly-trained, full-time military professionals, a class that constitutes only one element of today's mass militaries. In other words, many people who *have* played a significant role in war up to now will discover that they can no longer do so.

There is some evidence, however, that a much more profound revolution in military affairs is afoot. Unlike the high-tech RMA, this deeper transformation does seem to be changing the balance of military power. And its impact goes well beyond the formal battlefield. Indeed, it is shifting the main focus of war away from the formal battlefield altogether. Most important, it is introducing a new class of warfighters who are not professional military men and may not even possess formal military training.

The Shifting Balance of Military Power

What evidence do we have that such a transformation is indeed taking place? As with many new phenomena, some of the earliest evidence of its existence has been indirect: namely, a striking reversal in the military balance of power that no current theory can adequately explain. Current military thinking would lead us to believe that the warfighting advantage the developed world has so long enjoyed over less developed regions should be growing stronger than ever. With the exception of a few rapidly developing countries like Korea, and perhaps China, the developed

world continues to have a virtual monopoly on the cultural attitudes that breed success on the formal battlefield. On top of that, it has a growing lead in information technology, the technology of the future battlefield.

Moreover, actual combat results confirm the continued battlefield superiority of the developed world. In the early 1950s, the United States and its allies rolled back the armies of North Korea and fought a huge Chinese invasion force to a standstill. It has been said that during the United States' later involvement in Southeast Asia, North Vietnam never managed to defeat an American unit of any significant size, although U.S. field forces were often heavily outnumbered.[25] In the 1991 Gulf War, a U.S.-led coalition crushed one of the Third World's largest and best-equipped armies virtually without a fight. The later destruction of Iraq's intelligence headquarters in Baghdad by Tomahawk cruise missiles demonstrated that U.S. precision weapons can strike virtually any Third World target with impunity.

But while the developed countries have continued to dominate the formal battlefield, the actual outcome of conflicts in the Third World has increasingly favored their less sophisticated opponents. Time after time, the best efforts of powerful, well-equipped expeditionary forces have come to naught, and local forces of various sorts have achieved victory in the final settlement, where it really counts.

The trend is clear. As late as World War II, the developed nations dismissed the military potential of so-called "backward" countries out of hand. After all, the European powers had colonized the bulk what is now called the Third World with relatively little military effort, and technical advances were rapidly increasing their military superiority. The indigenous peoples were at most a colorful backdrop to the struggles of the great powers. To this day, most accounts of World War II campaigns in North Africa — where the fighting surged back and forth across Egypt, Libya, Algeria, Tunisia, and Morocco — barely mention the inhabitants.

Half a century later, the United States, the world's greatest military power — with perhaps half the world's total military expenditure — joined France and Britain in demanding the punishment of Libyan intelligence officials who had arranged to plant bombs aboard civilian

airliners, including the Pan American flight that exploded over Lockerbie, Scotland. Libya blandly denied any responsibility and refused to turn over the officials for trial. No military action ensued.

That the world's leading nations are so reluctant to intervene militarily in the Third World is not surprising given the number of times they have suffered defeat at the hands of seemingly weaker adversaries. In the first two decades after the war, Europe's traditional imperial powers withdrew or were expelled from all but a few of their colonies. Vietnam, an agrarian nation with about the same population as France, defeated its French overlords and went on to defeat the United States as well. Afghanistan, an impoverished, faction-ridden country with about 20 million inhabitants, subsequently defeated the Soviet Union, a country with at least pretensions to modernity and a population of 250 million people.

In 1993, U.S. and allied forces reluctantly intervened in Somalia to put an end to endemic bloodshed and starvation. The U.S. contingent soon became embroiled in fighting with a Somali clan led by General Mohammed Aidid. American troops repeatedly entered Aidid's territory to capture or kill the general. Aidid's forces suffered far greater losses than American units in the resulting combat. Yet Aidid remained at large, and in a striking policy reversal following the death of 18 American Rangers in October of 1993, the United States not only recognized the Somali clan leader's local political role, but went so far as to place U.S. transport aircraft at his disposal.

Why is it that the advanced countries, even in concert and in a good cause, find it increasingly difficult to wage conventional war in less developed countries?[26] One reason is that today's great powers generally recognize that they can obtain no advantage from dominating others by military force. Before the industrial revolution, military invasions could pay off handsomely. Poor nomads like the Mongols, for example, could become fabulously rich by conquering productive agricultural regions like China and the Fertile Crescent. With industrialization, the road to wealth no longer led abroad. Initially, it seemed that the possession of resource-rich colonies might still confer some advantage, but by the late nineteenth century, Germany and the United States, both negligible colonial powers, were already surpassing the economic power of Britain and France, with their global empires.

It is more and more apparent that resources in the modern world flow naturally to those who can make the best use of them. Japan, South Korea, Taiwan, Hong Kong, and Singapore all prove the point. Global market forces have become remarkably resistant to political control, as the virtual collapse of the Organization of Petroleum Exporting Countries (OPEC) and the actual collapse of the Soviet economy have amply demonstrated. The leaders and people of the First World are increasingly aware that their strongest interests lie at home. This realization makes them less inclined than ever to support any overseas operation that demands serious sacrifice, which serious wars invariably do.

Nonetheless, the lack of economic incentives for intervening in the Third World does not, by itself, provide a sufficient explanation for the drastic reversal of the "north-south" military balance. Third World countries have succeeded in defeating military interventions by developed countries even when the intervening forces enjoyed widespread support at home, at least at the outset. For example, the people of France and the United States supported their countries' respective involvements in Indochina sufficiently for their governments to dispatch powerful expeditionary forces and support them for years on end. Yet the Vietnamese communist leadership achieved its objectives, if not in battle, then in the peace settlements, which is where victory really counts.

The Disappearing Enemy

Third World entities ranging from coherent nations to scattered clans have succeeded in defeating First World military interventions because they have evolved a new form of war that renders the developed power's superiority in formal combat irrelevant. It is not surprising that the Third World has come up with an answer to First World military power. After all, many of today's developed nations have been waging conventional war in what is now called the Third World for centuries. Like an organism repeatedly attacked by the same disease, the Third World has finally developed a resistance to conventional military force, a resistance that appears to be growing stronger with each new encounter.

This revolutionary form of war makes no attempt to match the firepower and sophistication of First World militaries. It implicitly recognizes that there is no hope of beating the great powers at their own game. In fact, when the Third World first began to resist conventional military force, most of it was still under foreign domination. Nascent resistance movements were in no position to raise and equip formal armies. Instead, they learned to evade the combat power of the occupation forces by making themselves militarily invisible. They waged "non-state" war, with no formal army the enemy could engage, no territory he had not already captured, and no government he could locate and destroy.[27]

A famous saying of Mao Zedong sums up the classic, enemy-oriented fighting doctrine of non-state resistance movements: "Withdraw when he advances; harass him when he stops; strike him when he is weary; pursue him when he withdraws."[28] The Third World resistance does not allow the enemy to engage when he is strong. It lets the enemy troops move in for what they expect will be a peaceful occupation and risks only enough "military" opposition at the outset to disappoint them and provide a focus popular resentment. This initial opposition may consist of virtually any form of violence, because military activity *per se* is relatively unimportant in this form of warfare.

In non-state war, armed combat is purely tactical. In conventional warfare, commanders attempt to make each tactical engagement contribute to a decisive military "campaign" at the higher, "operational." level. A typical campaign of this sort involves the maneuvering of forces across a geographic area. In non-state war, the decisive campaign is political rather than military. It takes place in a social context instead of a geographical area. Its key "operational" objectives are building political support for the non-state movement and undermining the political base of the enemy.[29] Violent acts, no matter what the level of violence or the degree to which it is organized, contribute directly to those political objectives. Deadly though they may be, the military engagements of non-state war are largely symbolic, useful only insofar as they reinforce the movement's political position.

While the resistance avoids decisive combat and builds popular support, time works against its purely military opponent. The only base of support the resistance needs is the people. Enemy units search in vain for critical targets, key terrain, lines of supply, bases of operation — all the traditional operational objectives that are supposed to bring victory in a "military" campaign. When victory eludes them, they become frustrated and confused. In Mao's words, the enemy becomes "weary."

At that point, the non-state resistance steps up its political and military activity. If the occupiers, in desperation, turn their firepower on the local population, they merely strengthen the movement's base of support. More subtly, if the expeditionary force of a developed country appears to be fighting the local population it is supposedly there to protect and assist, it risks undermining its support at home and depriving its own troops of a cause they can believe in. In large measure, that is what happened to France in Algeria and to the United States in Vietnam.

Caught in a moral dilemma, the occupiers eventually give up and withdraw. The non-state movement may then field a conventional army to pursue them, just as it may set up a formal government in the liberated territory, but the emergence of a traditional army and other formal state organizations — if, indeed, they do emerge — merely indicates that victory is already at hand. The decisive struggle has already taken place. The non-state resistance achieved victory the moment the enemy decided to retreat. Pursuit, to the extent it occurs, is simply a matter of mopping up. The composition of the mopping-up force is unimportant.

Although Mao did not realize it, the tremendous psychological advantage the resistance can develop by subordinating physical activity to a moral campaign may, under ideal circumstances, allow it to defeat a First World occupying force with little or no violence. Mahatma Ghandi used that psychological advantage to wage victorious "nonviolence" against the British in India. A non-state campaign of that nature, however, requires that the military occupier be unsure of his own cause right from the start. The fact that Britain subsequently yielded up all of her major colonial possessions virtually without a fight illustrates how ambiguously she had come to regard her role as a colonial power. France, on the other hand, had to suffer stinging defeats by much more

violent non-state movements in Indochina and Algeria before relinquishing the last of her imperial pretensions.

Non-State War Enters the Information Age

Third World resistance movements revolutionized war in the 20th century by removing the decisive campaign from the geographical to the political sphere and redefining the combatants. Technology has had little to do with this profound transformation. Invariably, the non-state resistance had far less technical expertise and equipment than the formal military it defeated. This does not mean, however, that non-state war is poorly suited for a high-tech world. On the contrary, it has several characteristics that could make it highly effective in the information age.

Non-state movements wage information war in a much purer form than any conventional military organization.[30] Even a conventional force equipped for the high-tech revolution in military affairs still relies primarily upon its ability to manipulate the physical environment. It seeks to defeat the enemy by applying physical energy in the form of firepower or movement. In contrast, a non-state organization seeks to defeat the enemy politically. It relies primarily on the manipulation of information and ideas. The physical effects its achieves are secondary. In non-state wars, the resistance forces usually suffer far more physical damage than they inflict on the enemy, but that seldom affects the outcome.

The structure of non-state movements reflects their focus on information. They are "open" to an extent that no formal military organization could tolerate. Survival in the face of overwhelming enemy firepower demands an extraordinary amount of decentralization and reliance on local initiative. For this reason, non-state movements routinely accept an extremely low level of training, efficiency, and coordination. They are more akin to political parties than armies. In fact, many of them *are* political parties, albeit clandestine ones.

Non-state war focuses on small groups — cells, committees, neighborhood militia bands, etc. The groups tend to cooperate on an *ad hoc* basis, even when a given tactical action calls for fairly elaborate planning. Aside from their typical lack of formal training, these small groups

somewhat resemble the low-level tactical units the Imperial German Army developed in World War I. The difference is that non-state organizations, unlike any formal military, apply the same decentralized organization to the campaign level and even the strategic level. Top headquarters must often be as small as local cells and just as capable of blending into the local population. This requirement sharply restricts the amount of planning and direction the leadership can impose.

A non-state leader may actually do little more than articulate the overall philosophy and general goals of the organization. Communicating and instilling such belief in the cause is much more important for a non-state movement than it is for even the most decentralized conventional force. Whereas the open tactical organization the Germans developed in World War I relied on training, teamwork, and a thorough understanding of the physical problems posed by the conventional battlefield, non-state war places a premium on personal commitment. People at every level of its organization must have the emotional commitment to endure the isolation of clandestine activity, to carry on the struggle against seemingly insuperable physical odds, and to put up with the apparent weakness and inefficiency of the organization itself.

The ability to communicate and instill belief can be a tremendous asset in the information age. The prevailing high-tech concept of information war focuses principally on military communications. It largely ignores the vast civilian information network that grows more powerful and pervasive with each passing year. This "world net" gives non-state organizations easy access to voracious international news organizations, and that, in turn, puts them in direct contact not only with their own people, but with the enemy's people as well.[31] Military commanders are seldom adept at exploiting such opportunities for persuasion, but politicians are, and the leaders of non-state organizations are first and foremost politicians.

Skillful use of the world net can, for example, turn the physical strength of a formal military organization into a moral liability. Superior firepower at the tactical level can translate into disastrous images the resistance can use to wage information war at the more critical operational level. The disparity of firepower makes it much easier for international news organizations to capture the violent acts of a formal military than those of scattered resistance fighters. The

difficulty of separating non-state fighters from ordinary civilians compounds the problem, making the images that go out over the world net that much grimmer.

Even at the purely tactical level, the world net provides new opportunities for loosely organized movements to attack formal organizations. The most salient characteristic of the information revolution is a disproportionate growth in the processing power available to individuals and small groups. A few computer hackers working alone or in small groups have already employed this growing power to mount disconcerting and potentially dangerous assaults on the information systems of large organizations, including the U.S. Department of Defense.[32] Although the developed world still accounts for almost all of these assaults, the Third World is now coming on line, and many of the students diligently studying information science in First World universities come from less developed countries. This could pose a serious challenge to the secure, reliable, high-volume communications and processing at the heart of the conventional RMA.[33]

Encryption capability is also increasing disproportionately for low-level organizations. Affordable equipment embodying existing technology promises to make private electronic communications impossible to intercept. The U.S. government has now abandoned its campaign to impose the readable "Clipper Chip" on makers of electronic equipment, except perhaps for telephones. Government officials have admitted that, even if the Clipper effort had succeeded, at least some unbreakable encryption capability was bound to reach private hands.[34] The implications for gathering intelligence on non-state organizations are obvious.

The information explosion is also helping to make non-state organizations more competitive in terms of firepower, the one area where First World militaries have enjoyed an indisputable advantage up to now. As with other products of the information revolution, the power of high-tech weaponry is increasing most rapidly at the lowest level. Advanced processing makes the shoulder-fired Stinger anti-aircraft missile one of the most dangerous weapons on the clandestine international arms market. Terrorists are also finding that the right information can enable them to turn many common civilian items to military use. They are now supplementing powerful but

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TITLE	**NO. COPIES**
1. LOUISIANA MANEUVERS THE FIRST YEAR	2
2. ARMY LEADER'S GUIDE TO NEPA	2
3. FUTURE VISION	2
4. HISTORICAL REVIEW AND EVALUATION OF COMBINED ARMY DOCTRINE	2
5. AMERICA'S ARMY OF THE 21ST CENTURY	2
6. AMERICA'S ARMY IN TRANSITION	2
7. U.S. ARMY CADET COMMAND THE 10 YEAR HISTORY	2
8. AMERICAN ARMY DOCTRINE IN THE COLD WAR	1
9. TRADOC PRIMER	1
10. A SHORT HISTORY OF CAMP PICKETT	1
11. REFLECTIONS ON THE REVOLUTION IN MILITARY AFFAIRS	2

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relatively scarce military explosives with large quantities of explosive material made from ingredients available in unlimited quantities on the civilian market. They have also learned to adapt high-tech civilian gadgets to serve as sophisticated remote detonation devices.[35] It seems only a matter of time before non-state movements learn to wield far more potent technologies as "equalizers" in the firepower race.

The Decline of Conventional War in the Nuclear Age

While the potential for non-state warfare expands, the scope of formal conventional war is steadily diminishing. One reason is simply that non-state war gives opponents in the least developed portions of the Third World a highly effective counter to any conventional military force, no matter how well that force has succeeded in incorporating RMA technology. An equally important reason, however, is the proliferation of nuclear weapons.

Discussions of military technology seldom pay much attention to the atomic revolution. Proponents of a "high-tech" RMA frequently point to *Blitzkrieg* as a prime example of how technology can affect warfare, but *Blitzkrieg*, as we have seen, was only partly technological. The power of pure technology to revolutionize warfare manifested itself not at the beginning of World War II, but at the end, when the first nuclear weapons destroyed the cities of Hiroshima and Nagasaki. Nuclear weapons were the greatest military achievement of industrial organization — the ultimate refinement of sheer, brute firepower.[36] As with other revolutions in firepower alone, the result has been stalemate. For half a century now, the awesome destructiveness of nuclear weapons has loomed so appallingly on the horizon that they have never again been used. The nations that possess such firepower have been only too happy to institutionalize the prevailing stalemate under the rubric of nuclear deterrence.[37]

Moreover, the inhibiting effect of nuclear weapons has extended to all formal warfare — including conventional war — whenever there has been the slightest chance of escalation. For four decades the most powerful conventional forces the world has ever seen stood poised for combat in Central Europe and never fired a shot in anger. Just as the firepower of World War I artillery

convinced the most powerful armies of that era not to let themselves be seen on the battlefield, so nuclear firepower has convinced today's leading nations not to be seen waging war in any formal sense. Since Hiroshima and Nagasaki, declarations of war have become as rare as challenges to knightly combat, and the major powers have grasped the fig leaf of international sanctions at every opportunity.

Nonetheless, while the great powers have explicitly accepted stalemate at the nuclear level, they have been much slower to recognize it at the conventional level. The same theory of nuclear deterrence that has kept the atomic genie safely inside the bottle has also kept him out of sight. After a brief flirtation with the metaphysics of Armageddon in the 1950s and early 1960s, the contemplation of nuclear destruction fell out of fashion, and the apparent security of "mutually assured destruction" once again tempted military thinkers to resume planning for conventional war without regard to its ultimate consequences.

During the last decades of the Cold War, military thinking in the West attempted to turn the clock back on the nuclear revolution, claiming that advanced conventional armaments might decide even a global conflict between superpowers without anyone's resorting to nuclear escalation.[38] There was even talk of striking the Soviet Union itself with precision conventional munitions, touted by their advocates as rivaling the effectiveness of nuclear munitions. But recently revealed Soviet war plans for the invasion of Western Europe, not to mention America's own refusal to accept "no first use" until the end of the Cold War, betrayed the fundamental fact that such concepts were never anything more than wishful thinking.[39]

The end of the Cold War has given rise to a new school of wishful thinking. This one holds that high-tech conventional weaponry "provides the Untied States with both the incentive and the means for elbowing nuclear weapons to the margins of world politics."[40] There is now talk of "conventional deterrence" and the "gradual denuclearization" of U.S. military doctrine and forces. Several analysts have proposed that non-nuclear precision weaponry might provide an effective deterrent against "small" nuclear attacks by regional powers.[41] No less an authority than Paul Nitze has published a piece in the *Washington Post* entitled "Is It Time to Junk Our Nukes?", in

which he suggests the United States consider "converting its principal strategic deterrent from nuclear weapons to a more credible deterrence based at least in part upon 'smart' conventional weapons." Nitze went so far as to speculate that a non-nuclear deterrent based on precision weaponry might someday "overcome" the threat of "a first-class strategic arsenal, such as that of Russia.[42]

Despite such incantations, nuclear weapons have not gone away. On the contrary, they have effectively displaced all formal military conflict to the relatively safe, neutral ground of the Third World. What the U.S. Navy now calls "littoral operations"[43] did not suddenly become the focus of conventional forces with the disappearance of the Soviet threat and the emergence a "new world order." Despite Cold War intellectual fantasies like the Navy's erstwhile "Maritime Strategy," the Third World has been the only rational arena for conventional war for the last half century. Now, the proliferation of nuclear weapons is beginning to limit the scope of conventional warfare even there. How much longer a conventional expeditionary force, with or without RMA technology, can guarantee "battlespace dominance" anywhere in the Third World will depend to a large extent on how soon local forces obtain nuclear arms.

A few nuclear weapons in local hands will completely alter the military situation, a fact that great conventional powers like the United States may have to relearn at their cost. A nuclear response by a Third World entity of any sort could render the conventional RMA utterly irrelevant. What might seem a critical national interest in the context of conventional warfare — reliable access to Persian Gulf oil, for example — would pale to insignificance in the wake of merely a half-dozen medium-sized nuclear detonations. A few explosions of that magnitude could brush away the most elaborate RMA infrastructure. Worse, they might bypass the RMA force altogether and visit their destruction directly on regional allies who have provided bases for it — or, in time, on the United States itself.

One might argue that the RMA will provide conventional defenses that can defeat every attempt to deliver a nuclear warhead, but how much would the United States — or regional allies who provide bases — care to bet on that? How eager would anyone be to wage conventional war

if some Third World dispute had recently provided a graphic reminder of what a single warhead can do? Nuclear weapons are so awesome precisely because their effect is grossly disproportionate to the effort expended in delivering them. They are an incontrovertible example of the non-linearity of war. Any failure at any time for whatever reason to defeat a single, easily-hidden delivery vehicle — perhaps a civilian delivery vehicle — could result in the death of an entire city. For precisely what cause would the United States itself care to wager an expeditionary force on the infallibility of a conventional defense against a nuclear attack? Certainly not for a humanitarian mission. Apparently not in response to garden-variety terrorism like the downing of a Pan Am flight over Scotland. Perhaps not to shore up a dubious regional ally.

One could argue that no Third World state would risk a nuclear attack given the massive conventional retaliation a superpower like the United States could mete out, particularly with RMA technology. But how much effect did such "strategic" conventional strikes have on the resolve of Saddam Hussein? If an enemy nuclear weapon struck a civilian target in an allied nation, would Americans be willing to retaliate by going beyond military targets and deliberately targeting civilian neighborhoods with RMA weaponry? If not, would our retaliation seem at all proportional to the regional ally who had suffered a nuclear attack? How would we retaliate if, as was the case with Iraq, we were already attacking every plausibly military target throughout the country, and then the enemy used nuclear weapons to destroy a U.S.-led invasion force, perhaps on his own territory?

Questions such as these illustrate why opportunities to apply conventional military force are bound to diminish in the face of nuclear proliferation. Moreover, it seems likely that other "weapons of mass destruction" will eventually join nuclear arms in inhibiting conventional warfare. Chemical and biological weapons do not yet inspire the same level of dread, but this is partly due to the fact that no one has demonstrated their lethality by launching a large-scale attack on any civilian target comparable to Hiroshima. It is also due to the lack of a simple, proven method of distributing chemical agents reliably over a wide are from a single weapon, thereby duplicating the grossly disproportionate impact of a nuclear warhead. However, a bitter ethnic

war, of which there is no shortage, could provide the necessary demonstration, and the wonders of RMA technology could provide the necessary delivery system.

Advances in biotechnology could have even nastier surprises in store. Is it possible, for example, to link a particularly contagious and virulent biological agent to genetic traits found mainly in the population of a detested enemy?[44] Only time will tell whether advancing technology will produce a nightmare of that sort, but the march of technology is certain to make weapons of mass destruction more capable and more readily available, and conventional military power can do little to forestall — or resist — that trend.

Non-State War in the Nuclear Age

In contrast to conventional warfare, non-state war could flourish in an age of mass destruction. Embedded in the civilian population, non-state organizations are difficult to identify and even harder to target. They are well-suited for waging war in an era in which the proliferation of weapons of mass destruction stays the hand of traditional nation-states and constricts opportunities for conventional combat.

Secure in their anonymity, a non-state movement may dare to use weapons that more definable and therefore vulnerable political entities instinctively shy away from. For example, Islamic terrorists with bases of popular support in the restive populations of Egypt, Lebanon, Jordan, and Algeria might feel they could accept the risk of planting a nuclear device in Norfolk, Virginia, or a chemical agent in the water supply of Washington, D.C. Against whom could the United States retaliate in kind? How could it retaliate at all?

But the specter of terrorists wielding weapons of mass destruction may prove to be less significant in the long run than the simple fact that non-state organizations can wage successful war regardless of the physical weapons arrayed against them. Only a regime willing and able to exterminate the population in which a non-state an organization is embedded can be sure of defeating it by purely military means. Otherwise, formal military power can prevail only as an auxiliary to a political campaign with the leverage to drive a decisive wedge between the movement

and its base in the population as a whole. This is a tall order for any conventional military, no matter what its choice of weapons.

The ability of non-state war to prevail in the face of normal conventional weapons, RMA technology, and even weapons of mass destruction will presumably make it the leading form of conflict in the 21st century. Non-state wars to date have been mostly defensive, inspired by the desire to throw off foreign domination or overthrow state structures that do not share the movement's convictions. It remains to be seen to what extent they can or will go over to the offensive. In some places such as Lebanon, Somalia, and Afghanistan — places where formal government has never had deep roots — the state has already withered away under the attacks of non-state organizations, leaving them to fight one another. Could this tendency spread to states with seemingly deeper roots?

It is also unclear to what extent non-state movements will continue to be primarily a Third World phenomenon. There is no obvious barrier to prevent such movements from arising in developed countries. Italy and Germany have had serious problems with home-grown terrorists in the recent past, and the developed world as a whole is now experiencing unprecedented immigration from the Third World, increasing the potential for ethnic and religious strife. Non-state warfare is currently taking place in Yugoslavia, on the doorstep of Europe, and in Mexico, where it was touched off by the signing of the North American Free Trade Act. First World nations may find in time that dealing with non-state warfare is not merely an issue for expeditionary forces deploying to the far corners of the globe.

Conclusions

The information revolution now under way will undoubtedly bring about a revolution in military technology, but the result is unlikely to resemble the centrally-controlled, highly synchronized conventional warfare that technologists are now predicting. The inherently chaotic nature of war — and of information itself — will probably require military forces more akin to the open organizations that have appeared in private business. An interesting historical model for a

more open military organization is the decentralized, cooperative, enemy-oriented force that the Imperial German Army developed toward the end of World War I. This early innovation provided the conceptual basis for Germany's operationally decisive "blitzkrieg" campaigns at the outset of World War II.

Information-driven militaries will, in all likelihood, have to take the open, enemy-oriented approach farther than ever before. It is impossible to say as yet what the new combat organizations will look like, but it is possible — indeed, it is critical — to keep the fundamental principles of open organization firmly in mind as we seek to adjust to the inevitable military applications of the new information technology. Among the most important principles are minimizing hierarchy, reducing planning to the essentials, decentralizing decision-making, promoting individual initiative, encouraging working-level networking and cooperation, instilling a common understanding of how to think about problems, and clearly articulating the overall goals or the organization.

In broader terms, the information revolution, coupled with the proliferation of weapons of mass destruction and the declining utility of military domination, will probably entail a general shift away from formal conventional warfare, including conventional RMA capabilities. A much less formal and in many ways more primitive and barbaric form of warfare is already on the rise. It appeared first in the national liberation movements of the Third World and has now spread to a wide variety of ethnic and religious struggles. This "non-state" warfare could pose a daunting challenge to the developed world. It may be the greatest military challenge the West has faced in centuries.

However, we must also bear in mind that trends are not deterministic, they are merely indications of the way things are going. They can change, and they can mislead. It is therefore essential to keep an open mind and to weigh all the evidence impartially as it becomes available. Although conventional forces are clearly on the defensive at the end of the 20th century, there is no set timetable for their demise and no assurance that they will ever cease to play some role as long as war exists. Nor is it clear which types of conventional forces might continue to have the greatest utility. One could speculate, for example, that navies may have a larger role in the future than

conventional armies, because waterborne transport may become more important in times of social disintegration, or simply because the ocean is not a very hospitable place for unstructured human activity. But there are few data points and no analysis to support such conjecture, at least as yet.

The rise of non-state warfare based on the resistance model is equally fraught with uncertainty. To what extent will irregular organizations supplant not just conventional military forces, but the traditional nation-states that create and support formal militaries? Can nation states create and control less formal organizations designed to attack resistance organizations and, perhaps, one another? What will informal combat look like on the "net" created by the information revolution? Is the fog of war increasing? Can we learn, as one popular business book has it, to thrive in chaos?

We cannot know the future, but we do have methods that may help us prepare for it. We can observe the trends, and we can make logical deductions about how they will interact and what they will require. We can also attempt to draw upon historical experience, at least to indicate what is *not* likely to happen. Admittedly, these are imperfect tools, but we must not wait for better ones. The revolution in military affairs may not be at all what its advocates of the moment seem to expect, but it is real, nonetheless, and it is already under way. We cannot afford to stand idle as it overtakes us.

NOTES

1. The term "revolution in military affairs" was coined by the Soviet military in the 1960s. By the early 1970s, it had already appeared in the title of a major book of military theory. (*Scientific and Technical Progress and the Revolution in Military Affairs*, Colonel General N.A. Lomov, editor, Moscow, 1973. English translation under the auspices of the U.S. Air Force) Lomov's book dealt primarily with the strategic and operational exploitation of nuclear firepower. However, by the early 1980s the Soviet General Staff, taking the same approach to high-tech conventional firepower, developed the concept of "reconnaissance-strike complexes" based on advanced data processing and communications technology. (Stuart Kaufman, "Lessons of the Gulf War and Russian Military Doctrine," paper prepared for the Conference on Conventional Deterrence in the Post-Cold War Era, Naval Postgraduate School, Monterey, CA, August 13-14, 1992, pp. 11-12.)

The Soviet concept of RMA caught on in the U.S. defense community at the end of the 1980s and has since become the conventional wisdom in much of the West concerning the military implications of the information revolution. At first, the U.S. military theorists preferred the term "military-technical revolution" (MTR), but by 1994 the term "revolution in military affairs" had once again come to the fore, denoting a growing interest in the presumed organizational and doctrinal implications of high-tech military systems and decreasing emphasis on technology itself as the dominant factor. (Commanders James R. FitzSimonds and Jan M. van Tol, USN, "Revolutions in Military Affairs," *Joint Forces Quarterly*, Spring 1994, p. 26.)

It is ironic that the West's current conventional wisdom about the future of warfare originated among Marxist military thinkers who ignored the decay of the Soviet Union's centralized command economy and utterly failed to anticipate the political revolution that would soon sweep away the entire Soviet system. Few would claim that Marxist thinkers have offered any useful insights into the economic effects of the information revolution. The West would probably do well to treat their insights on its military effects with caution.

2. Author's recollection from the Fifth Annual Conference on Strategy, U.S. Army War College, Carlisle, PA, April 27-28, 1994. The context of Dr. Guilmartin's paper, "Technology and Strategy: What Are the Limits?", indicates that his offhand comment referred specifically to the involvement of the scientific community in modern warfare. This does not detract from the wider validity of his insight.

3. This brief overview of conventional wisdom concerning the RMA draws upon the following sources:

Frank Kendall, "Exploiting the Military Technical Revolution: a Concept for Joint Warfare," *Strategic Review*, Spring, 1992, pp. 23-30.;
Michael J. Mazaar, *et alia*, *Military Technical Revolution: a Structural Framework*, Final Report of the Study Group on the Military Technical Revolution, Center for Strategic and International Studies (CSIS), Washington, DC, March, 1993, pp. 17-39;
Dan Gouré, "Is There a Military-Technical Revolution in America's Future?", *The Washington Quarterly*, Autumn, 1993, pp. 175; and
FitzSimonds and van Tol, "Revolutions in Military Affairs," *Joint Forces Quarterly*, Spring, 1994, pp. 175-192.

Kendall's article is indicative of high-level thinking in the U.S. DoD. At the date of publication, he was Under Secretary of Defense for Research and Engineering in the Bush Administration. He continued to serve in the Clinton Administration with the new title of Director of Defense Research and Engineering until retiring from government service in September 1994.

Gouré was the Deputy Director of Political-Military Studies at CSIS when his article was published. Mazaar was the project director of the CSIS MTR study group as well as the principal

author or its report. Among Washington "think tanks," CSIS is said to be particularly attuned to the dominant views within the U.S. defense community. The CSIS study is one of the most thorough expositions yet published of conventional wisdom on the RMA.

FitzSimonds and van Tol follow the new fashion in referring to a "revolution in military affairs" rather than a "military-technical revolution." When their article was published, both authors were assigned to the Office of Net Assessment in the Office of the Secretary of Defense.

4. Mark Hewish ("Fishing in the Data Stream," *International Defense Review*, July, 1994, p. 51) points out that Admiral David E. Jeremiah, then Vice Chairman of the Joint Chiefs of Staff, identified "maintaining near-perfect real-time knowledge of the enemy and communicating that knowledge to all forces in near-realtime" as one of five critical capabilities for future joint warfare.

Apparently, some advocates of a high-tech RMA now aspire to something even better than perfect information: perfect foresight. According to Vice Admiral Arthur Cebrowski, the U.S. Navy's Director of Space and Electronic Warfare, "merely knowing the situation, merely knowing the environment, even perfectly, is inadequate because what is required now is the ability to predict, the ability to draw inferences, the ability to understand subtle differences.... This all has to do with inserting modeling simulation, mission planning, mission rehearsal, and all of the supporting data inside the command and control system." (Beth Jannery, "New Navy Info Warfare Office Taps Info Advances for Military Uses," *Inside the Navy*, August 29, 1994.)

5. Mazaar, "The Revolution in Military Affairs: a Framework for Defense Planning," paper prepared for the Fifth Annual Conference on Strategy, U.S. Army War College, Carlisle, PA, April, 1994, p. 18. (Referred to hereafter as Mazaar paper.)

6. The following section dealing with the organizational paradigm of the industrial age draws upon W. Richard Scott, *Organizations: Rational, Natural, and Open Systems*, 2nd ed., Prentice-Hall, Englewood Cliffs, NJ, 1987, pp. 31-50. Scott refers to this paradigm as a "rational system." Although he does not discuss organizational paradigms in historical context, the pioneering research he cites on rational systems predates World War II, much of it going back to beginning of the century or earlier. Scott particularly emphasizes that the rational system approach focuses on formal structure within the organization itself (p. 48) and places great emphasis on control (p. 50).

The author of this paper has attributed several specific traits to the industrial paradigm that Scott does not explicitly discuss, most notably the way information flows within the organization. That information flow, however, is implicit in Scott's discussion of "Taylorism" (pp. 36-37), as well as his later discussion of experimental work concerning information processing by centralized hierarchies and decentralized networks (pp. 151-154). The research he cites indicates that centralized organizations deal more rapidly and efficiently with routine decision-making and well-defined information, but decentralized nets tend to excel when the information becomes more complex or ambiguous.

7. General Gordon R. Sullivan and Colonel James M. Dubik, USA ("War in the Information Age," *Military Review*, U.S. Army War College, April, 1994, pp. 46-62) specifically identify today's military with the commercial organizations of the industrial age and point out the need to follow private enterprise in transitioning to a new model for the information age. They do not, however, describe the characteristics of an industrial-age military organization in any detail. The author of this paper is responsible for the specific characteristics attributed to contemporary armed services in this section.

Sullivan and Dubik assert that the U.S. Army is already making the transition to the information age. However, they fail to substantiate their contention other than by citing a few programs. They pass lightly over the issue of organizational change, offering no ideas comparable to changes that have already occurred in many commercial organizations. They strongly endorse the conventional-wisdom version of the RMA.

General Sullivan is Chief of Staff of the U.S. Army.

8. One exception is the Israeli army, which has retained a flexible, open command style derived from its early experience as an outnumbered and outgunned resistance movement and proven in fast-paced, short-notice maneuver campaigns fought primarily by reservists.

9. As an example of the psychological shock to officers facing retirement sooner than expected — in this case not actually early retirement, since the officer had served 24 years — see Captain James B. Waddell, USN, "SERB'd," Naval Institute *Proceedings*, June, 1994, pp. 39-40. Although the government has not always succeeded in maintaining the real value of military pensions in recent years, even the attempt to do so is extraordinary given recent trends in civilian retirement benefits.

10. Martin Van Creveld, *Command in War*, Harvard University Press, Cambridge, MA, 1985, pp 247-48.

11. William Matthews, "U.S. Forms Warfare School to Fight 'Information Overload'," *Defense News*, May 16-22, 1994, p. 22. Cf. Mazaar paper, p. 13.

12. The following section draws upon Scott, *op. cit.*, pp. 76-92, particularly the attributes of "open systems" listed on pp. 90-91. Scott concludes: "Rather than overlooking the environment, as tends to be true of the rational system perspective,... the open systems model stresses the reciprocal ties that bind and relate the organization with those elements that surround and penetrate it. The environment is perceived to be the ultimate source of materials, energy, and information.... Indeed, the environment is even seen to be *the source of order itself.* (Italics added.)

Although Scott states that the theory of open organizations has only emerged since World War II, he does not relate that development to the information revolution. However, Jeremy Wolff ("Managing in a Wired Company," *Fortune*, July 11, 1994, pp. 44-47, 50, 54-56.) specifically relates many of the organizational attributes noted in this section to the opportunities and demands of computer networking.

Wolff points out that networks "irrevocably alter the nature of managerial authority and work. They inspire an informal style; bossy behavior ... is not congenial to them. In a wired world, fundamental management jobs such as planning, budgeting, and supervising must be done differently. Tools like E-mail, teleconferencing, and groupware let people work together ... almost regardless of departmental or corporate boundaries, which networks fuzz up or even obliterate. (p. 44)

"A technological network supercharges social networks; no longer adjuncts of the hierarchy, they can supplant it.... More and more, the operations companies conduct on-line are critical ones — trading at brokerage houses ... and design and development of new aircraft at Boeing." (p. 46)

Wolff backs up his assertions with numerous real-world examples. One is particularly arresting because it describes something akin to the "near-perfect information" heralded by proponents of the conventional-wisdom RMA. Hewlett Packard's global customer-response network enters each customer problem into a "live" data base that contains all customer files and instantly updates each file whenever any employee works on it. All of the specialized customer-response teams at 27 work centers around the world have instant access to the same complete, real-time information. A team at one center may start work on a file, then shift the work to another team at another center on another continent to ensure round-the-clock service. The information is already there.

What type of management does dealing with this "near-perfect" information require? Wolff writes: "No managers are involved in moving the work around the net; if they were, the process could not be seamless. 'I look out of my office, and often none of my people are there,' says John Karlsten, who manages two customer-response teams.... The people he supervises are there, or [at another office] ... or working from home. Unable to look over people's shoulders, Karlsten is learning to rely on his ability to choose and train employees, set clear expectations, and pay close attention to measurements of customer satisfaction. He admits, 'It's not entirely comfortable.'" (p. 46).

13. Very large information systems tend to be non-linear, i.e., they tend to be "chaotic" in the sense that their behavior cannot be predicted with confidence using the normal tools of linear logic. (See footnote 20.) Chaos theory provides techniques for attempting to predict the behavior of non-linear systems. Those techniques need not rival the predictive power of linear logic. For systems where linear logic does not apply, they need only be — literally — better than nothing. (Conversation with Richard J. Greenberg, PhD, Professor of Physics, Planetary Science Department, University of Arizona, August 18, 1994.)

14. Wolff (p. 47) lists "helping a company see its market more clearly" as a major benefit of networks. "In a bureaucracy, news on the Rialto comes in secondhand and edited.... Nets catch raw information."

15. For real-world views of what this can mean for manufacturing organizations, see Myron Magnet, "The Productivity Payoff Arrives, *Fortune*, June 27, 1994, pp. 81-83, 84; and "Solectron Tries to Stay Calm," *Information Week*, August 1, 1994, p. 54. The article on Solectron, a leading maker of personal computer circuit boards, underscores both the ease with which today's information technology can deliver high-quality products and the difficulties of tuning production to meet today's rapidly changing demand.

Solectron builds 3,000 different assemblies for which it buys and maintains some 60,000 different components. Still, the company's defect rate is only three per million, an achievement that has won it the coveted Malcolm Baldrige Quality Award. At present, however, Solectron's major concern is not quality *per se*, but dealing with customers whose constantly changing requirements demand last-minute changes in the production process for two out of every three orders. The clear implication is that Solectron's quality, while outstanding, is not so unique that customers cannot switch to another company if Solectron is not sufficiently agile in meeting their latest demands.

16. In fact, communications within commercial organizations are rapidly surpassing garden-variety E-mail. See Magnet, p. 94.

17. Edward A. Gargan, "'Virtual' Companies Leave the Manufacturing to Others," *New York Times*, Sunday, July 17, 1994, p. F5.

18. William Bridges, "The End of the Job," *Fortune*, September 19, 1994, pp. 62. 64, 68, 72, 74.

19. The following account of German doctrinal and organizational developments in World War I draws principally upon Martin Samuels, *Doctrine and Dogma: German and British Infantry Tactics in the First World War*, Greenwood Press, Westport, CT, 1992, pp. 13-110. Also Timothy T. Lupfer, "The Dynamics of Doctrine: the Changes in German Tactical Doctrine during the First World War," No. 4 in the *Leavenworth Papers* series, U.S. Army Command and General Staff College, Fort Leavenworth, KA, July, 1981.

20. Colonel John Boyd, USAF (Ret.), was perhaps the first to recognize that the concept of "non-linearity," which was originally developed to explain the apparently unpredictable behavior of certain large-scale physical phenomena, also applied to combat.

In classical physics, someone who knew all the significant variables of a system in its initial condition could predict the system's subsequent behavior with a high level of confidence. This is the fundamental physical theory behind the industrial assembly line. But in a non-linear system, such as a weather system extending over a large land area, imperceptible variations in the initial condition can have a radically disproportional effect on the outcome. Similarly, in battle, a slight change in the wording of an order due to some unfathomable influence on a commander's mind may drastically alter the fate of millions of combatants.

It is impossible to predict the behavior of a non-linear system with traditional linear methods because one can never know the initial condition of that system with sufficient precision. Consequently, it is impossible to control the system's behavior by centralized decision-making, which relies on linear predictive tools.

An open organization deals with non-linearity by foregoing centralized decision-making. Instead, it uses many decision-makers to respond to a host of individual developments, any of which can have a grossly disproportionate impact on the overall result. Decentralized decision-makers are free to focus primarily on achieving the organization's external goals rather than following its internal processes. Since they devote less energy to maintaining control within the organization, they have more energy available for perceiving and influencing events outside it.

Unfortunately, although Boyd has been giving his pioneering lectures on military theory since the early 1970s, none of his work has been published to date.

21. Samuels, *op. cit.*, pp. 113-168, demonstrates some of the reasons why other militaries, while adopting many of the outward forms of the German organization, have failed to capture the underlying concepts and spirit of openness that made it so successful. His analysis deals specifically with World War I British attempts to copy German doctrine and organization.

22. The U.S. military is no exception to the trend, although there have been some exceptions to the general lack of an open mindset. The foremost example of appreciation for open organization is the U.S. Marine Corps' basic doctrine manual: FMFM-1, *Warfighting*, U.S. Marine Corps, Washington, DC, 1989. This outstanding manual presents the essentials of World War I German open doctrine in a concise, easily readable format. However, its influence on the Marine Corps practice has reportedly been limited.

More recently, the U.S. Army's Training and Doctrine Command at Fort Monroe, VA, has shown a new appreciation of the need for open organization in information-age combat. (See TRADOC Pamphlet 525-5, *Force XXI Operations*, August 1, 1994, pp. 3.3-3.5). This latest TRADOC effort is uneven, however, attempting to have it both ways by retaining elements of the traditional industrial approach like synchronization (See p. 4-4).

23. In a pioneering article on war in the information age, John Arquilla and David Ronfeldt of the Rand Corporation ("Cyberwar is Coming," *Comparative Strategy*, pp. 141-165) predict that conventional forces in the information age will need to be organized more as networks than as hierarchies. These open organizations will have "superior command, control, and information systems that are decentralized to allow tactical initiatives, yet provide central commanders with unparalleled intelligence and 'topsight' *for strategic purposes*." (p. 141, italics added.)

However, Arquilla and Ronfeldt probably overestimate the ability of information technology to give higher levels of command "unparalleled understanding" given the non-linearity of both large information systems and war. On the other side of the coin, if advanced command and control could indeed give "central" commanders "unparalleled intelligence," why should they limit its application to "strategic purposes." Why not use it to direct tactical engagements as well?

24. Wolff (p. 56) points out that this is also critical for open commercial organizations dependent on information networks. "The more dispersed the work group, the more important it is to meet face to face.... The managerial skills that become most important when employees work free of close supervision — skills such as mentoring, aligning staff around a vision, nurturing relationships — require human contact."

25. Colonel Harry G. Summers, Jr., USA (Ret.) has made famous a telling conversation he had with a North Vietnamese in Hanoi in April, 1975. Summers remarked, "You know you never defeated us on the battlefield." The Vietnamese colonel replied, "That may be so, but it is also irrelevant." (*On Strategy: a Critical Analysis of the Vietnam War*, Dell Publishing, New York, 1984, p. 21.)

Note that the Vietnamese colonel did not actually concede that his side had never defeated the Americans in the field. Victory is psychological. It does not depend on who holds the ground at the end of the engagement or who suffers fewer casualties. If, for example, one side enjoys a great military reputation, its opponent may reap all the psychological rewards of victory simply by putting up a good fight. America has a famous monument to their victory — of sorts — in the Battle of Bunker Hill. Does Vietnam have a monument in the Ia Drang Valley?

26. Martin van Creveld ("New Face of War Confounds Modern Leaders, Technology," *Defense News*, 17-23 January 1994) points out that in contrast to the formal conflicts between states that dominated warfare up to the end of World War II, "since 1945, more than three-quarters of all armed conflicts have been fought by or against other kinds of political organizations." He adds that in such conflicts "the most powerful, modern, technologically advanced armed forces that ever existed have been humiliated by bands of terrorists, guerrillas, and militiamen — people who, in many cases, could not even read and literally went barefoot."

27. Two pioneers in charting the rise of non-state conflict at the expense of formal war are Martin Van Creveld and William S. Lind. Van Creveld, in his seminal work *The Transformation of War* (Macmillan, New York, 1991), uses the term "nontrinitarian war" to contrast such struggles with what he calls "trinitarian war" — a concept that arose in the European Enlightenment, was expounded by Karl von Clausewitz, and is now enshrined in international law. The trinitarian concept assumes that true war can be waged only by a *state* employing a formal *army* on behalf of its *people*.

Lind, who has heralded the eclipse of formal warfare in numerous papers, articles, and lectures since the late 1980s, refers to non-state conflict as "fourth-generation warfare." He considers it the successor to three earlier conceptual "generations" roughly corresponding to the regular warfare of the eighteenth century, the mass warfare of the nineteenth, and the mobile warfare of the twentieth. Lind believes that each "generation" arose from a unique idea of the nature of war, that all of those ideas still persist to some degree, and that the thinking of today's military organizations reflects a struggle among them.

28. Mao Zedong, *On Guerrilla War*, 1937. Cited in Colonel Robert Debs Heinl, Jr., USMC (Ret.), *Dictionary of Military and Naval Quotations*, U.S. Naval Institute, Annapolis, MD, 1966, p. 139.

29. Lieutenant Colonel Thomas X. Hammes, USMC ("The Evolution of War: the Fourth Generation," *Marine Corps Gazette*, September, 1994, pp. 35-44) illustrates the basic principles of non-state war with four examples: the Communist resistance in China, the Vietnam War, the Sandinista revolution in Nicaragua, and the Palestinian Intifada. His description of what he calls the "Second Indochina War" is particularly interesting because it shows how the Communist leadership of North Vietnam, an established state, waged successful non-state war in conjunction with the Viet Cong in South Vietnam.

Colonel Jeffrey R. Barnett, USAF, ("Non-State War," *Marine Corps Gazette*, May, 1994, pp. 85-89) proposes to deal with non-state foes by avoiding conflict *except* in cases where careful strategic analysis prior to committing forces reveals a strong probability that the formal military power can split the non-state organization away from its base of support in the population. In effect, Barnett proposes to play the non-state political game in reverse. However, this astute fabian strategy would probably result in avoiding engagement in most cases. It thus reveals the general weakness of formal military powers in non-state conflicts and underscores the fact they now find themselves on the defensive, with the initiative clearly in the hands of their non-state opponents.

30. Arquilla and Ronfeldt (p. 151) point out that Mao Zedong's doctrine that "command must be centralized for strategical purposes and decentralized for tactical purposes" closely resembles their own conclusion that future information warfare will call for organizations combining superior "topsight" for strategic purposes with decentralization to allow tactical initiatives.

31. Arquilla and Ronfeldt (pp. 144-146) refer to struggles waged through the international communications media as "net war." They note that both states and non-state entities can engage in this form of struggle, that they can do so in coalitions as well as individually, and that they can do so as adjuncts to either formal or informal warfare on the ground.

However, while their contributions to the theory of information warfare are valuable, they overreach in attempting to meld the conflicting theories of conventional warfare and non-state warfare into a sort of unified field theory of information-age conflict they call "cyberwar." This construct leads them to overlook the fundamental dichotomy between the two forms of war, as manifested in the fact that non-state warfare is designed to defeat formal militaries, whereas formal militaries are designed to defeat one another. This, in turn, leads them to overlook the increasing tendency for non-state conflict to *supplant* formal war.

32. For recent reports on the problem, see Peter H. Lewis, "Hackers on the Internet Posing Security Risks, Experts Say," *New York Times*, July 21, 1994, pp. A1, B10; "Hackers Enter DoD Computers via Internet; Security Plan Questioned," *Inside the Pentagon*, July 23, 1994, p. 18; Pat Cooper, "Computer Hackers Demonstrate Need for More Security," *Defense News*, July 25-31, 1994, p. 6; Pat Cooper, "DoD Escalates War against Computer Hackers," *Defense News*, August 1-7, 1994.

33. Alvin and Heidi Toffler, *War and Anti-War*, Little, Brown and Company, Boston, 1993, pp. 149-152. In this section of their book, entitled "Information Terrorism," the Tofflers do not specifically call into question the integrity of RMA information, but they point out that military systems are "hardly impervious" to information attack. As an example, they refer to the possibility of attack by a so-called "cruise virus" — the information equivalent of a cruise missile — designed to capture a specific password, steal specific information, destroy a specific hard disk, etc.

Isolating military computing may no longer be the answer. Steven Jobs, co-founder of Apple Computer, believes the computer is evolving into a communications device. (John Huey, "The New Economy," *Fortune*, June 27, 1994, p. 38.) Robert Moran ("Supercomputers: What Happened?", *Information Week*, August 15, 1994, p. 12) attributes the fall of stand-alone supercomputers to the fact that corporate users now want multi-purpose parallel computers with "compatibility from the desktop through the network to high-end servers." Christopher Locke ("The World's Nervous System," *Information Week*, August 1, 1994) speculates that "something like a global mind is emerging from the Net's dark waters," and adds that asking where the brain is in such a system "is analogous to asking where consciousness resides in biological organisms, or where genuine intelligence resides in an organization." (See also Michael Schrage, "Thinking Machine's Parallel Legacy: Software with a Mind of Its Own," *Washington Post*, August 19, 1994, p. C3.)

Taken together, these statements suggest that the Internet itself — or perhaps a future version of the world net — could eventually become the most powerful supercomputer, dwarfing the capability — and in some respects the military potential — of any system small enough to be effectively isolated.

34. Steven Levy, "The Cypherpunks vs. Uncle Sam," *The New York Times Magazine*, June 12, 1994, pp. 46-51, 60, 70.

35. Information on terrorist devices and the general trend in non-state technology is from the author's notes on informal remarks by Dr. Bruce Hoffman at the Fifth Annual Conference on Strategy, U.S. Army War College, Carlisle Barracks, PA, April, 1994. Dr. Hoffman's paper was entitled "Responding to Terrorism across the Technological Spectrum." He was, at the time of the conference, the Director of the Strategy and Doctrine Program, Army Research Division, The RAND Corporation, and an associate editor of *Studies in Conflict and Terrorism*, an academic journal published in the United States and England.

36. Alvin and Heidi Toffler (*op. cit.*, p. 192) refer to nuclear weapons as "the culmination of the search for efficient mass destruction that paralleled the search for efficient mass production ... the ultimate military expression of Second Wave [industrial] civilization."

37. The theory of nuclear deterrence was an American creation. For purely ideological reasons, the Communist powers clung for some time to the belief that they could fight and "win" a nuclear war, but grim reality convinced them to accept deterrence as the only feasible use for such weapons long before they showed any willingness to embrace other Western ideas, such as free markets.

38. The Maritime Strategy championed by the U.S. Navy in the 1980s not only advocated "threatening direct attack against the [Soviet] homeland" with conventional weapons to "terminate the war on terms acceptable to us," but also "changing the nuclear correlation of forces ... by destroying Soviet ballistic missile submarines and improving our own nuclear posture through deployment of carriers and Tomahawk platforms." Amazingly, this was supposed to "make escalation a less attractive option to the Soviets with each passing day." (Admiral James D. Watkins, USN, Chief of Naval Operations, "The Maritime Strategy," U.S. Naval Institute, Annapolis, MD, January, 1986, p. 14.)

39. "Offensive Defence in the Warsaw Pact," by Lothar Rühl, *Survival*, International Institute for Strategic Studies, pp. 442-450. Citing East German documentation on Soviet war plans that fell into western hands following Germany's reunification, Rühl states categorically: "Nuclear and chemical weapons would have been used in the assault on NATO forces in West Germany, even if NATO used conventional weapons only." (p. 442) U.S. refusal to accept a no-first-use policy clearly indicates that the United States also reserved the right to use nuclear weapons to ensure the defeat of Soviet conventional forces. In contrast to Soviet plans, however, it is generally believed that NATO did not contemplate escalating until a Soviet conventional attack broke through its conventional defense on the central front.

40. Mazaar paper, p. 40.

41. Seth Cropsey, "The Only Credible Deterrent," *Foreign Affairs*, March-April, 1994, pp. 14-20 (cited in Mazaar, paper, p. 40); and Lewis Dunn, "Rethinking the Nuclear Equation: The United States and the Nuclear Powers," *The Washington Quarterly*, Winter, 1994, pp 5-25. Although he does not refer specifically to a conventional RMA, Dunn advocates "assured nonnuclear retaliation" to a nuclear attack by a Third World power, noting, "Advanced conventional munitions technologies and systems now on the horizon increasingly hold out the possibility of greatly increased nonnuclear lethality against such targets as leadership command bunkers, headquarters and facilities; nuclear weapons production and storage sites; and other fixed military targets. Backed up by preconflict intelligence and intraconflict target acquisition, possession of such systems could afford the United States 'near-nuclear' capabilities." (p. 14) Dunn also calls for the capability to conduct "regional operations in a nuclear environment," urging that "U.S. defense planners explicitly plan for conducting regional operations against a hostile country armed with nuclear weapons." (p. 18) Shades of the Pentomic Division!

42. Paul Nitze, "Is It Time to Junk Our Nukes?", *The Washington Post*, January 16, 1994, pp. C1-C2. Cited in Mazaar paper, p. 40.

43. "...From the Sea: Preparing the Naval Service for the 21st Century," Department of the Navy, Washington, DC, September, 1992. The other services likewise hastened to announce the reorientation of their conventional forces from the "global threat" — i.e., the Soviet Union — to the Third World.

44. Alvin and Heidi Toffler, *op. cit.*, p. 122. According to the Tofflers, officials of the Soviet Union warned as early as 1976 of the potential for weapons genetically engineered to attack only a

selected ethnic group. They also note a 1992 warning by Bo Rybeck, director of the Sweden's National Defense Research Institute, that as researchers identify DNA associated with specific races and ethnic groups "we will be able to determine the differences between blacks and whites and Orientals and Jews and Swedes and Finns and develop an agent that will kill only [a particular] group."