EPILOGUE:

Five Hundred Years and Counting: What the Past Teaches About the Future

Any one of the innovations described in the preceding chapter has the potential to radically change the nature of warfare and with it the nature of the international system. While the U.S. has been dominant so far in the Information Age, there is no guarantee that its streak will continue. A challenger, whether a rival state like China or even a nonstate group like al Qaeda, could utilize new ways of war (or, in the case of nuclear weapons, not so new) to alter the balance of power. Cheap to produce and easy to disseminate, germs, chemicals, and cyber-viruses are particularly well-suited for the weak to use against the strong. If any of them become common and effective tools of warfare, especially terrorist warfare, the U.S. and its allies could be in deep trouble.

History is full of examples of superpowers failing to take advantage of important Revolutions in Military Affairs: The Mongols missed the Gunpowder Revolution; the Chinese, Turks, and Indians missed the Industrial Revolution; the French and British missed major parts of the Second Industrial Revolution; the Soviets missed the Information Revolution. The warning that appears at the bottom of mutual fund advertisements applies to geopolitics: *Past performance is no guarantee of future returns.* The end can come with shocking suddenness even after a long streak of good fortune.

Perhaps *especially* after a long streak of good fortune. The longer you are on top, the more natural it seems, and the less thinkable it is that anyone will displace you. Complacency can seep in, especially if, like the United States, you enjoy power without peer or precedent.

Israel discovered the dangers of primacy in 1973 when it almost lost the Yom Kippur War to Egyptian and Syrian forces that it had handily defeated just six years before. The Israelis were caught off guard by new antitank and antiaircraft missiles supplied by the Soviet Union—a foretaste of what the Information Age had in store.

In hindsight, the ability of the Egyptians and Syrians to bounce back from their humiliation in the Six-Day War (1967) should not have been so surprising. Defeat has often been a spur to innovation, from the Prussians' humiliation in the Napoleonic Wars, to the Germans' humiliation in World War I, to the Americans' humiliation in the Vietnam War. In the case of Japan in 1853, it did not take actual defeat but the mere threat of it, made explicit by the arrival of Commodore Perry's "black ships," to catalyze wide-ranging reforms. Out of all these setbacks were born new ways of fighting that led once-vanquished forces to victory on future battlefields.

It is much less common to see dominant powers innovating. More typical is the case of the Ottoman Empire, which mastered only one major military revolution—gunpowder—and then only in its early years. In their heyday in the fifteenth and sixteenth centuries, the Turks' gun-wielding armies and fleets carved out and defended a vast empire encompassing Asia Minor, North Africa, and the Balkans. By the eighteenth century, however, their glorious record of martial triumphs had become a major obstacle to making the innovations necessary to keep up with European competitors. The Sublime Porte's modernization was so belated and half-hearted that by the nineteenth century the onetime scourge of Christendom had become known as the "Sick Man of Europe." Early success set up the Turks, like so many others, for later defeat.

One of the few partial exceptions to this rule is Britain, whose Royal Navy stayed No. 1 from the age of sail to the age of steel. But not even the Royal Navy could successfully navigate the next major shift, from battleships to aircraft carriers—a failure that hastened the fall of the British Empire.

Business history is replete with the same story. Not a single maker of sailing ships made a successful transition to steam power. And not a single maker of minicomputers—not Digital Equipment Corporation, not Data General, not Prime, not Wang, all seen as invincible giants as recently as the 1980s—made a successful transition to personal computers. More recently, Sony, which was supremely successful in the era of transistor radios and portable cassette players, has struggled to adjust to the digital age, its Walkman having been superseded by Apple's iPod.

After a company fails, its employees, customers, and investors can always move on to a different firm. It is much harder for citizens to move on to another country after their homeland fails to keep up in the struggle for security. The stakes are obviously much greater in the geostrategic realm, making it all the more important to understand why some states fail and others succeed.

UNCONTROLLABLE CREATIVITY

History, alas, does not offer a blueprint of how the process of military innovation occurs. There is no single model that covers all cases, and this book has made no attempt to develop one. As James Q. Wilson noted in his magisterial study of bureaucracies:

> Not only do innovations differ so greatly in character that trying to find one theory to explain them all is like trying to find one medical theory to explain all diseases, but innovations are so heavily dependent on executive interests and beliefs as to make the chance appearance of a change-oriented personality enormously important in explaining change. It is not easy to build a useful social science theory out of "chance appearances."

To the limited extent that we can generalize about five hundred years of history, it seems fair to say that the most radical innovations come from outside of formal military structures. There are some recent exceptions, such as the atomic bomb, the satellite, and the stealth airplane, but most of the key inventions that changed the face of battle since the Middle Ages—the cannon, handgun, three-masted sailing ship, steam engine, machine gun, rifled breech-loader, telegraph, internal combustion engine, automobile, airplane, radio, microchip, laser, wireless telephone—were the products of individual inventors operating more or less on their own: geniuses such as Robert Fulton, Hiram Maxim, Johann Nikolaus von Dreyse, and Guglielmo Marconi. Some had military applications in mind; most did not. For instance, the casting techniques that made cannons more effective in the fifteenth century were originally developed to make church bells.

Even where government has played a big role in the development process, as with the Internet and the electronic computer, the key advances were usually made by people not on its payroll: William Shockley, John Bardeen, and Walter Brattain (the transistor); Jack Kilby and Robert Noyce (the microchip); Ted Hoff (the microprocessor); Paul Allen and Bill Gates (MS-DOS and Windows); Tim Berners-Lee (the World Wide Web); Marc Andreessen and Eric Bina (the Mosaic browser); and many others. The laser is another case in point: It was invented in 1960 by Theodore Maiman, an unknown young physicist at Hughes Aircraft Company who had no Pentagon funding and who worked on the project despite, not because of, the wishes of his superiors.

While government and corporate R&D programs have grown exponentially since World War II, fundamental technological innovation (as opposed

to small-scale, incremental improvement) is simply too erratic and mysterious a process to be at the beck and call of any institution. "We can no more 'explain' the breakthroughs inside the minds of a Montgolfier or a Westinghouse," notes economist Joel Mokyr, "than we can explain what went on inside the head of a Beethoven when he wrote the *Eroica*."

Because creativity is so unpredictable, no country can count on making all, or even most, major scientific and technological breakthroughs.

DISSEMINATION AND NULLIFICATION

Moreover, few if any technologies, much less scientific concepts, will remain the property of one country for long. France matched the Prussian needle gun less than four years after the battle of Königgrätz. Germany matched the British *Dreadnought* three years after its unveiling. The USSR matched the U.S. atomic bomb four years after Hiroshima and Nagasaki. It is a truism that new technology, if it proves effective, tends to disseminate quickly.

One exception, and it is a notable one, is that technology was slow to move from the West to the rest of the world in the late stages of the Gunpowder Age and during the First Industrial Age. This created a yawning imbalance of power that allowed Europeans to conquer much of the world on the cheap. But by the mid-twentieth century the balance had righted itself, and Asians and Africans in possession of modern weaponry were able to win their independence from European states weakened by two world wars and the collapse of assumptions of racial superiority. Some analysts may discount the importance of technology in determining the outcomes of battles, but there is no denying the central importance of advanced weaponry in the rise of the West.

Military revolutions usually favor the offense at first, but, with the major exception noted above, that initial edge soon dissipates. The spread of *trace italienne* fortresses in the sixteenth century negated the advantage that heavy artillery had conferred on besieging forces. The spread of trenches starting in the American Civil War offset the impact of rifles and then machine guns. Today, sophisticated radar systems may be negating the edge enjoyed by first-generation stealth aircraft. More significantly, enemies are increasingly resorting to guerrilla tactics to avoid the full fury of American firepower.

The process of technological dissemination and nullification has speeded up since the rise in the mid-nineteenth century of such major arms manufacturers as Krupp, Winchester, and Armstrong, which were happy to sell to just about anyone. Thus, German troops were killed during the

Boxer Rebellion in 1900 by Chinese soldiers firing Mauser rifles and Krupp artillery pieces.

Contemporary arms manufacturers such as Lockheed Martin, Northrop Grumman, and the European Aeronautic Defense & Space Company operate under greater export restrictions but still seek to market the latest technology around the world. Even more pervasive today are firms that sell dual-use devices such as computers, night-vision goggles, and GPS trackers which can have both military and civil applications. Thanks to their success, many of America's key Information Age advantages are rapidly passing into the hands of friends and foes alike. This is part of a longer-term trend—the Westernization of the world increasingly puts the peoples of Asia, the Americas, and Africa on a par, economically as well as militarily, with those of Europe and North America.

As important as technological nullification is psychological nullification. The first time an army faces a major new weapon—the needle gun at Königgrätz, the machine gun at Omdurman, the tank in Poland and France, the smart bomb in the Gulf War—it is likely to be caught off guard. The resulting panic can be as damaging as the physical effects of the weapon itself. The next time, if there is a next time, the other side is likely to be less impressed. Thus the coalition bombing campaign of Iraq in 2003 did not induce the same "shock and awe" as its predecessor in 1991. Having been bombed more or less continuously for a decade, Iraqis had become inured to the effects of precision munitions. The speed and ferocity of the U.S. armored advance, by contrast, came as a surprise.

The way to gain a military advantage, therefore, is not necessarily to be the first to produce a new tool or weapon. Often it is to figure out better than anyone else how to utilize a widely available tool or weapon.

WEAPONS OF MASS DISRUPTION

Faster aircraft, heavier tanks, more accurate rifles, and longer-range artillery are all examples of what management guru Clayton Christensen calls "sustaining" innovations—i.e., products that don't require major organizational adjustments in order to assimilate. They are part of a process of continual improvement undertaken by most modern armed forces. But other innovations, the ones that are the focus of this book, are "disruptive" breakthroughs that occur less frequently and profoundly unsettle the status quo.

Taking advantage of these major advances usually requires what James Q. Wilson calls a "change-oriented personality"—someone like John Hawkins, Gustavus Adolphus, or Curtis LeMay who is not afraid to shake up

conventional ways of doing things. Fundamental changes can be preached from the outside but seldom imposed by civilians on a professional military. Consider the lack of success that J. F. C. Fuller and Basil Liddell Hart had in the 1930s preaching the gospel of armored warfare to the British army. John F. Kennedy had equal lack of success when he tried to get the U.S. Army interested in guerrilla warfare in the early 1960s—and he was the president!

The most successful innovators have tended to be people like Field Marshal Helmuth von Moltke, Admiral William Moffett, General Hap Arnold, and Generals Hans von Seeckt and Heinz Guderian: insiders, not outsiders. At best, civilians can play a supporting role in aiding military mavericks against their bureaucratic foes, though popular accounts tend to overstate the influence of flamboyant rebels such as Billy Mitchell. As political scientist Eliot Cohen writes: "To the extent that civilians can control the Department of Defense, they do so less by issuing edicts (which can be evaded, watered down, or delayed by the military and civil service bureaucracy) than by grooming and selecting internal leadership."

Change usually begins in peacetime, but it often takes a major battle—a Spanish Armada, Breitenfeld, Tsushima, Pearl Harbor, or Gulf War—to cause militaries to decisively shift how they do business. Sometimes battles take place during a time of great ferment but neither side can effectively implement a revolutionary operational concept, or both sides come up with the same concept, thereby forfeiting a chance to seize a decisive advantage. This was true of the U.S. Civil War and World War I, which is why both conflicts were such fearful, protracted slaughters and why neither one is considered at length in this book.

STRATEGY AND INNOVATION

Culture, geography, politics, and other factors greatly affect how receptive a military is to proposed changes. Especially important is a country's strategic situation, a combination of its location and its fears and ambitions. Geography is not destiny, or else it would be impossible to explain why Britain was a naval power for centuries while Japan—another island nation off the coast of a major continent—was not. Or why Prussia, rather than another nearby state such as Saxony or Bavaria, became a Great Power starting in the eighteenth century. Or why Sweden rose from obscurity to prominence in the seventeenth century and then fell back into obscurity in the eighteenth century—all without changing its geographic position. But, even though it is only one factor among many, there is no doubt that geography has influenced which nations are more receptive to which military revolutions.

Early in the modern period, Italian states like Venice were content to rely on galley fleets that served them well in the placid waters of the Mediterranean, the chief source of their foreign trade, but that proved utterly unsuited for a new way of naval warfare pioneered by Atlantic powers like Holland, Portugal, and England. Spain and France were caught in the middle, with one foot in the Mediterranean and another in the Atlantic. They never managed to become as effective at sail-and-shot tactics as the more single-minded English and Dutch. Centuries later, Germany became a leader in utilizing panzers because it planned to fight a fast-moving land war against numerous enemies on its frontiers. The Nazis did little to develop aircraft carriers or four-engine bombers because they did not think they needed them against their continental rivals. The United States was the mirror image: It led the way in the development of long-range bombers and aircraft carriers because it expected to fight a naval and air war against enemies far removed from its borders, but it did little to develop tank units because it did not expect to fight a major land war. Such expectations may turn out to be ill-founded (Germany could have used B-17s; the U.S. could have used Tiger tanks), but they powerfully affect decisions about the allocation of scarce resources.

It helps to have relatively few scenarios to prepare for. Germany in the interwar years had the luxury of preparing only for a land war in Europe, whereas Britain had to prepare not only for that contingency but also for naval wars in the Atlantic and Pacific as well as for imperial policing in its colonies. The U.S. had the advantage of focusing on a single foe after the Vietnam War. The concepts and technologies created to fight the Red Army just happened to be perfectly suited to battling the Iraqi army.

Today the U.S. faces a much bigger challenge because it has many potential foes, ranging from nonstate actors (al Qaeda and its ilk) to medium-sized powers (North Korea, Syria, Iran) and a rising great power (China). Because the U.S. has chosen to be strong in every sphere of combat (sea, land, air, space, cyberspace), in every type of warfare (from peacekeeping to high-intensity conflict), and in every corner of the globe, it faces pressure to invest and innovate in many different fields at once, or else to rein in its ambitions.

IS THERE A DEMOCRATIC ADVANTAGE?

Western states have been the most successful military innovators over the past five hundred years. There was something about western Europe (and its overseas offspring) that made it much more dynamic and open to change than other civilizations. Having a relatively liberal political and intellectual climate, of the kind that the West developed toward the end of the Middle

Ages, helps to create an atmosphere in which innovation can flourish. The Soviet Union's lack of freedom ultimately sabotaged its attempts to keep pace in the Information Age, just as the lack of freedom in Spain and France made it difficult for them to keep pace in a naval arms race with first the Netherlands and then Britain.

But we should be wary of simple-minded democratic triumphalism. History has offered many examples of autocratic states that proved more adept than their democratic rivals at exploiting military revolutions. The success of the Prussian and German armed forces between 1864 and 1942 and of the Japanese between 1895 and 1942 shows how well even relatively undemocratic systems can innovate. All that is required is some degree of openness to change, a commitment to meritocracy, and an ability to critically examine one's own mistakes—all disciplines in which the German General Staff, however illiberal, excelled. In fact, most democracies, which tend to be less militaristic than autocracies, face a disadvantage in taking advantage of military innovations because they are less inclined to be generous to their armed forces in peacetime—a problem that beset liberal Western nations during the 1930s.

Nor is there much evidence to suggest that soldiers fight better for a democracy than for a dictatorship. Man for man, the Wehrmacht was probably the most formidable fighting force in the world until at least 1943, if not later. German soldiers were even known for showing more initiative than the soldiers of democratic France, Britain, and the United States. Meanwhile, Soviet soldiers stoically endured privations and casualties far beyond anything suffered by their Western allies. North Vietnam is another modern state that fielded superb armies despite a notable democracy deficit.

In any case, the differences between the armies of dictatorships and democracies are less significant than they may appear at first blush. Even the most liberal states have to employ command-and-control methods in their armed forces. And even the most autocratic states have to pay attention to troop morale and to allow room for individual initiative.

But if democracies do not have an advantage in creating formidable war machines, they do seem to have an intrinsic edge in figuring out how to use them. Autocracies tend to run amok because of the lack of internal checks and balances. Philip II, Gustavus Adolphus, Louis XIV, Frederick the Great, Napoleon, Wilhelm II, Hitler, the Japanese leaders of the early twentieth century—they all built superb militaries but ultimately led their nations into ruinous wars. (So did Saddam Hussein with his less impressive but nevertheless formidable army.) They had no sense of limits, and no politician was strong enough to stop them. Their tactics may have been superb, but their grand strategy was lousy, the best examples being Napoleon's and Hitler's foolhardy invasions of Russia. Democracies sometimes overreach too (witness the Boer, Algerian, and Vietnam wars), but they tend to avoid the worst traps be-

cause they have a more consensual style of decision-making. As two political scientists note, "being vulnerable to the will of the people restrains democratic leaders and helps prevent them from initiating foolhardy or risky wars."

BUILDING BETTER BUREAUCRACIES

The key to successful innovation, whether for a dictatorship or a democracy, is having an effective bureaucracy. This was the chief advantage enjoyed by Elizabeth I over Philip II, George III over Daulat Rao Sindia and Raghuji Bhonsle II, Emperor Meiji over Czar Nicholas II, Adolf Hitler over Édouard Daladier and Paul Reynaud, and the two George Bushes over Saddam Hussein. Prussia's secret weapon in the nineteenth century was not the needle gun or the railroad or the telegraph. It was the General Staff, which figured out how to utilize these innovations.

America's secret weapon today is not the stealth airplane or the Predator but the agency that was responsible for their development (and much else besides)—the Defense Advanced Research Projects Agency. Ever since its forerunner was set up in 1958 during the Sputnik crisis, DARPA has shown how a government agency can push the frontiers of innovation by allocating grants to universities, think tanks, and private companies for high-risk ventures. To the limited extent that innovation can be systematized, DARPA has done it. Other nations trying to compete with the United States are hobbled by not spending as much as the U.S. does on research and development, but even spending more money would be no guarantee of success. If it were, then the European Union, whose collective defense budget is two-thirds the size of America's and which has even more soldiers under arms, would be much closer to the U.S. in military capabilities than it actually is. The problem is that most European spending is unfocused, duplicative, and inefficient, whereas DARPA has been smart about allocating its $2 billion annual budget.

Bureaucracies are so important because, as this book has stressed, the realization of a Revolution in Military Affairs requires far more than simply revolutionary technology. It also requires revolutions in organization, doctrine, training, and personnel. That was achieved by the Swedes when they crafted mixed-arms formations made up of pikemen and musketeers; by the Prussians when they figured out how to rapidly mobilize and move large numbers of riflemen by railroad; by the Japanese when they decided to group aircraft carriers together in strike groups; and by the Americans when they integrated smart bombs, sensors, stealth, and professional soldiers in the AirLand Battle doctrine.

Bureaucratic innovation can seldom be limited to the military alone

because armed forces are always a reflection, however refracted, of the broader society. Each military epoch comes with its own distinctive system of governance. The rise of the Gunpowder Age fostered the growth of absolute monarchies. The First and Second Industrial Ages fostered giant welfare and warfare states. The Information Age is leading to a more decentralized, flatter form of government and the rise of more powerful nongovernmental groups. States that fail to keep up with these transformations risk getting run over by those that do.

For powers that lack effective bureaucratic structures, the possession of modern weaponry is of dubious utility, as states from eighteenth-century India to the twentieth-century Middle East have found. The Arab nations are particularly egregious in this regard: Their long record of military futility since 1945 comes despite having access to copious stocks of modern arms from such outside suppliers as France and the Soviet Union. No matter how great the Arab preponderance in men and materiel—and against Israel in 1948, 1956, 1967, and 1973 their advantage appeared, on paper at least, to be insuperable—they have continually contrived to snatch defeat from the jaws of victory. In one of the lesser-known episodes of this long record of ignominy, the well-armed Libyan military was routed by ill-armed Chadians in 1986–87 after Moammar Qadafi tried to annex northern Chad. The only military strategies (if such they are) that Arabs have been able to employ with any success are terrorism and repression. "The incompetence of Arab tactical leadership, their severe problems managing information, and the inability of their personnel to properly employ and maintain their military hardware," writes former CIA analyst Kenneth M. Pollack, "left the Arab states highly vulnerable to most potential adversaries."

The armies of Russia and the United States were far more competent, but in Afghanistan and Chechnya, Vietnam and Iraq, they, too, found themselves stymied by smaller, poorer adversaries, largely because their armed forces were not properly configured for counterguerrilla warfare. This does not mean that modern military hardware is useless—only that by itself it is not enough to guarantee victory against a clever, determined adversary. When combined with the right organization, doctrine, training, and leadership, however, sophisticated weaponry can confer a decided advantage even in battling irregular foes.

DREAD OF INNOVATION

It is no surprise that the authoritarian Arab states have not, for the most part, managed to make the changes necessary to harness modern military

power. No Arab dictator can afford to have a military that is too strong for fear that it will be employed against him. But even for more liberal polities, which generally need not fear a military coup d'état (though France faced such a prospect as recently as the early 1960s), transitions from one military system to another can be wrenching, because they require uprooting existing career patterns and deeply held beliefs. Officers trained in cavalry charges were not happy about the advent of tanks, any more than sailors trained in battleships were happy about the arrival of aircraft carriers, or knights trained in sword fighting were happy about the spread of firearms. Militaries are inherently conservative organizations. As a British army colonel noted in 1839: "In no profession is the dread of innovation so great as in the army."

Successful adaptation to major technological shifts requires overcoming that dread and changing the kinds of people who are rewarded within a military structure. The rise of railroads and steamships in the nineteenth century elevated the importance of logisticians and engineers, technocrats who were initially despised by traditional army and navy officers. In the Imperial German Navy, engineering officers were sent to a separate school, they wore less gaudy uniforms, without the sashes and imperial crowns sported by regular officers, and they were not allowed to dine in the officers' mess. They even had to endure the indignity of having their wives addressed as "women," not "ladies." It was not until 1899, half a century after the adoption of steam power, that the U.S. Navy merged "line" and "engineering" officers. In the more aristocratic British and German navies the process took even longer.

Today, the U.S. Air Force faces difficult dilemmas as it figures out how to integrate unmanned aerial vehicles: Should someone controlling a Predator from a trailer thousands of miles away be a certified pilot? Should control time count as "flying" hours? This may seem a picayune matter, but it looms large in a service where the fastest advancement has always gone to fliers. If the air force doesn't give greater promotion opportunities to UAV operators, it cannot attract and keep the best people for these jobs, but if it advances them its fighter-jock culture will inevitably change.

This is part of a broader challenge confronting all Information Age militaries: how to make room for those who fight with a computer mouse, not an M-16. Will traditional warriors—men with shaved heads and hard bodies—continue to run things, or will nerds with bad posture and long hair, possibly even women, assume greater prominence? Two Chinese strategists write that "it is likely that a pasty-faced scholar wearing thick eyeglasses is better suited to be a modern soldier than is a strong young lowbrow with bulging biceps," but, even if that is true, reordering any military along those lines presents a far more profound and problematic challenge than questions about which tank or helicopter to buy. As Eliot Cohen writes: "The cultural challenge for military organizations will be to maintain a warrior

spirit and the intuitive understanding of war that goes with it, even when their leaders are not, in large part, warriors themselves."

THE DANGER OF TOO MUCH CHANGE—AND TOO LITTLE

This book surveys many instances where militaries had to change or die. Those armed forces that did not successfully integrate the gun, the long-range bomber, precision-guided munitions, or other important innovations experienced the agony of their members dying in great numbers. But we have also looked at some instances of militaries too eager to change in the wrong way. In the 1930s, the U.S. Army Air Corps and the Royal Air Force placed too much faith in the ability of unescorted bombers to win a future war—a doctrinal mistake that cost the lives of tens of thousands of air crews over Europe. In the 1940s Hitler poured vast resources into the development of the V-1 and V-2, resources that might better have been employed on his conventional forces. And in the 1950s the U.S. Army, Navy, and Air Force did so much to rearrange themselves around the demands of the nuclear battlefield that they were not ready for the actual threat they would soon confront in the jungles of Vietnam.

Arguably a similar phenomenon has occurred in Iraq, where the Information Age armed forces of the United States have found themselves frustrated by less sophisticated adversaries. Many now ask: Why did the Defense Department not invest in more linguists, more MPs, more civil affairs specialists, more soldiers in general, rather than in more JDAMs and JSTARS? The answer is that senior leaders, such as Donald Rumsfeld, believed that the future of warfare lay in high-tech information systems, not in lowly infantrymen. This does appear to be a mistake in light of events in Iraq—but it may not turn out to be so mistaken if the U.S. finds itself in a clash with China or North Korea.

There is no rule of thumb to suggest how much or how little a military should change in response to technological developments. Each revolution raises painful questions of prioritization such as those that the United States and other countries confront today: Should they pay for more traditional infantrymen, or push resources into "transformational" programs like surveillance satellites, wireless broadband networks, and directed-energy weapons? Should they continue to build traditional tanks, aircraft, and ships or switch to unmanned platforms? Each path has major risks and trade-offs: Paying for larger standing forces can make it easier to respond to today's threats; cutting force strength and using the savings to pay for high-tech hardware

can make it easier to respond to tomorrow's threats. (The only strategy that definitely won't work is the one that many European countries are pursuing: cutting existing forces but not investing the savings in any other defense program.) It would be nice to be able to do everything at once. But no one, not even the Pentagon, has enough money for that.

History indicates that the wisest course is to feel one's way along with careful study, radical experimentation, and freewheeling war games. Paradoxically, revolutionary transformation often can be achieved in evolutionary increments. The Germans did not shift over their entire army to panzer divisions in the interwar years. In 1939–40 only about 10 percent of German forces were composed of armored units, and the Wehrmacht had more ponies than panzers, but this was enough to produce breakthroughs from Poland to France. Likewise, General H. H. Kitchener did not have many machine guns when he confronted the Mahdists at Omdurman, but the few he had produced utterly devastating results. Nor did the U.S. in the 1980s convert its entire air force to stealth aircraft, but having even a few F-117s had an outsize impact on the outcome of the Gulf War. A little cutting-edge technology can go a long way against a less advanced foe.

A corollary is that a military revolution does not necessarily sweep aside all old weapons and old ways of doing things. Battleships may have been dethroned as queens of the sea in 1941, but they continued to perform a valuable auxiliary role as a shore bombardment platform into the 1980s. Gustavus Adolphus did not simply toss out pikes in order to make way for muskets and cannons; he used a combination of weapons, old and new, to achieve the maximum shock effect. Indeed, bayonets continue to be fixed onto rifles (though rarely used) hundreds of years after edged weapons lost their primacy on the battlefield. And nuclear weapons have hardly rendered conventional weapons obsolete.

This offers a counterpoint to skeptics who deny the existence of an Information Revolution simply because not everything has changed: It never does. On the other hand, this also offers a cautionary lesson that some modern-day J. F. C. Fullers or Billy Mitchells anxious to scrap the tank, the aircraft carrier, or the manned airplane should keep in mind: Introducing "transformational" systems does not necessarily mean getting rid of all "legacy" platforms. Rather, it means readjusting the balance between the two. "You need to think about how to make a transition," counsels Andrew Marshall of the Pentagon's Office of Net Assessment, "not about how to eliminate current weapons."

While no one would wish for more combat, the U.S. armed forces are helped in this process by having so many wars to fight that can serve as field laboratories for the testing of new technologies. The first Predator was rushed into service for the Kosovo War. Having performed well there, an armed

version made its debut two years later in Afghanistan. This, in turn, spurred the development of purpose-built unmanned combat aerial vehicles that will no doubt be tried out in another conflict before long.

The U.S. armed forces would be even more adept at innovation if they were willing to stage more realistic war games in which adversaries could use unconventional tactics instead of fighting in the way that American admirals and generals would prefer. They would also be helped if defense spending could be allocated according to a rational judgment of strategic priorities, not based on the political muscle of major defense contractors and their allies on Capitol Hill. That, however, seems unlikely to change as long as America remains a democracy.

SILENT SPUTNIK?

The quickening pace of scientific and technological progress, which has been speeding up ever since the start of the Industrial Revolution more than two hundred years ago, puts a greater premium on having scientists and engineers who can stay at the frontiers of change. It is neither necessary nor possible to invent everything yourself. But it is vital, at a minimum, to be able to keep up with breakthroughs made elsewhere and take advantage of their military potential. The Royal Navy did not have to be the technological leader in the nineteenth century, but it did need the capability to quickly match and surpass any innovation by the No. 2 naval power, France.

In this regard, many experts note that U.S. hegemony might be endangered by its failure to produce more math, science, and engineering graduates. The U.S. has made up for this shortfall in the past by importing smart people from abroad (38 percent of science and engineering doctorate-holders in the U.S. are foreign-born). But that has become harder to do in the wake of post-9/11 visa restrictions and booming economies in eastern Europe, India, China, South Korea, and Taiwan—the major sources of American scientific and engineering talent—that discourage immigration to America. If China can keep more of its geniuses at home, it will be easier for Beijing to challenge U.S. power. Some scientists warn that the U.S. is facing a "Silent Sputnik" crisis which could imperil U.S. leadership.

Remedying this looming shortfall will probably require more funding for math, science, and engineering education, and that won't be cheap. It will be even more expensive to translate the resulting ideas into actual military programs. It does not necessarily take a lot of money to innovate; breakthroughs like the blitzkrieg and carrier warfare emerged out of paltry military budgets in the interwar years. But it does take a lot of money to

bring inventions to fruition, especially today, when each new weapons system costs several times more than its predecessor. It also costs a lot to field high-quality soldiers able to cope with the complexity of modern war. The annual cost to the United States for each member of its armed forces more than doubled in constant terms over the past thirty years—from $125,000 per person in 1970 to $264,000 per person in 2003—and it continues to increase.

There is no free lunch: Despite the fervent hopes of some transformation advocates, there is no way to significantly increase military power while cutting costs. Today, even more than in the fifteenth century, more military capability requires "money, more money, and again more money." With the U.S. facing budget deficits and looming bills for social welfare programs, questions inevitably arise about whether it can afford to keep spending so much on defense. Other countries confronting tight budgets face similar debates: Is it necessary to stay at the forefront of military change? Is it vital to take advantage of the Information Revolution and its successors?

The answer will vary from country to country. As one security analyst notes, "try as they might, countries like Burkina Faso or Paraguay . . . will never be candidates for the exploitation of the RMA." But for the United States and other countries that aspire to be first- or second-tier military powers, there is no alternative but to stay abreast of the changes—tactical and technological, conventional and "asymmetric"—transforming the modern battlefield.

WHY RMA'S MATTER

The major theme that runs throughout this book is the importance of not missing out on the next big change in warfare. History is driven by many factors, but while academia focuses on economics, race, class, sexuality, geography, germs, culture, and other influences on the course of human events, it would be foolish and short-sighted to overlook the impact of military prowess and especially aptitude in taking advantage of major shifts in war-fighting. Of course, a country's success or failure in harnessing change cannot be divorced from such underlying factors as its economic health, scientific sophistication, educational system, political stability, and so forth. But, contrary to Napoleon, God is not necessarily "on the side of the big battalions." Even big and wealthy countries often lose wars and head into long-term decline through a lack of military skill.

The considerable gains of the Axis during the early years of World War II came, after all, against a coalition of Allied states that in aggregate had 40

percent greater GNP and 170 percent larger population. That the Axis ultimately lost shows that military skill can sometimes be trumped by greater resources if a war drags on long enough *and* if the side with greater resources shows sufficient wisdom in their employment. But even in a long coalition war, the side with the greater resources does not always prevail. The alliance of Britain, Hanover, and Prussia was dwarfed in economic and demographic resources by its adversaries in the Seven Years' War (1756–63)—France, Austria, Russia, Sweden, Saxony, and (near the end) Spain—but still managed to win largely because of the superior skill of the Prussian army and the British navy. This book chronicles many other examples of the poorer side emerging victorious: Britain beat the Spanish Armada, Sweden beat the Holy Roman Empire at Breitenfeld and Lützen, Prussia beat the Habsburg Empire at Königgrätz, and Japan beat the Russian Empire in 1904–1905. More recent instances might be cited, such as North Vietnam's defeat of the United States or the Afghans' defeat of the Soviet Union.

These were not anomalies. In a statistical analysis of twentieth-century wars, the side with the larger GNP, population, armed forces, and defense expenditures won only a little more than half the time, making these factors about as useful in predicting military outcomes as flipping a coin. Political scientist Stephen Biddle, who analyzed these statistics, writes, "Superior numbers can be decisive or almost irrelevant depending on the two sides' force employment. This in turn means that states' relative economic, demographic, or industrial strength are poor indicators of real military power: gross resource advantages matter only if they can be exploited via modern-system force employment, and many states cannot do so. . . . How forces are used is critical."

Indeed, while some states translate riches into military power, as the U.S. did in the early years of the twentieth century, just as many states translate military power into riches. That is what England did when it sent its navy to conquer colonies and carve out trade routes, and what Prussia did when it sent its army to overrun the neighboring German principalities. Some states are drained by war, but many others attain Gustavus Adolphus's ideal of making war "pay for itself"—a feat achieved most recently by the United States when it succeeded in making its allies foot most of the bill for liberating Kuwait in 1991.

The ongoing proliferation of destructive technology means that the link between economic and military power is more tenuous than ever. Al Qaeda, whose entire budget would be insufficient to buy a single F-22, can inflict devastating damage on the world's richest country. Advances in biological and cyberwar promise to put even more destructive potential into the hands of ever smaller groups, as does the continuing proliferation of nuclear weapons.

Imagine the devastating consequences of a mega-attack by terrorists. Not only could millions die, but international travel and commerce—the lifeblood of the global economy—could be severely disrupted. Such a scenario reveals the falsity of economic determinist arguments which counsel that military strength is unimportant and that it is feasible to stint on military preparedness in order to strengthen the economy. On the contrary, there can be no long-term prosperity without security. The entire world today depends, no matter how begrudgingly or unwittingly, on the protection provided by the United States, whose armed forces keep open air and sea lanes, safeguard energy supplies, and deter most cross-border aggression.

Dreamers can convince themselves that military power no longer matters, that economic interdependence has consigned war to the dustbin of history, that a country need wield only "soft power," but history is likely to deliver a stark rebuke to such wishful thinking. As a matter of fact, it already has. The attacks of September 11, 2001, put an end to a decade of talk about the "end of history," a "strategic pause," the inexorable flow of "globalization," and the "peace dividend." The incidence of war may have declined for the moment, but great dangers still loom ahead. Santayana had it right: "Only the dead have seen the end of war."

FIGHTING WILDCATS AND RODENTS

Technological advances will not change the essential nature of war. Fighting will never be an antiseptic engineering exercise. It will always be a bloody business subject to chance and uncertainty in which the will of one nation (or subnational group) will be pitted against another, and the winner will be the one that can inflict more punishment and absorb more punishment than the other side. But the way punishment gets inflicted has been changing for centuries, and it will continue to change in strange and unpredictable ways.

In assessing the future conduct of conflict, most analysts tend to fall into one of two camps. One group stresses the dangers of terrorists and guerrillas who use cheap, simple weapons like AK-47s, machetes, or explosives. Another group stresses the danger of high-tech weapons such as cruise missiles and killer satellites proliferating around the world and into the hands of states such as China and North Korea. The former school (associated with ground-combat arms) stresses the need for better warriors; the latter school (associated with air and naval forces), the need for better machines. The reality is that both high-intensity and low-intensity threats are real and that both top-notch people and first-rate equipment are needed to counter them.

Michael Evans of the Royal Military College of Australia offers sage advice when he writes: "In a dangerous and unpredictable world, military professionals and their political masters must . . . be ready to tame the big wildcats and not simply the vicious rodents, to be able to fight troops like Iraq's former Republican Guard as well as Taliban, al-Qa'ida militia, and terrorists."

Today, the U.S. is much farther along in figuring out how to tame the Republican Guard than al Qaeda, and it needs to place more emphasis on making up for its deficiencies in irregular warfare rather than simply enhancing its already substantial lead in conventional warfare. While the Information Revolution has decreased the number of weapons and soldiers needed to defeat a conventional adversary, occupation duty and nation-building—the prerequisites for turning a battlefield triumph into a long-term political victory—continue to demand lots of old-fashioned infantry. Therefore, the U.S. and its allies would be making a mistake if they were to seriously stint on force size in order to procure more high-tech systems.

But that doesn't mean that the U.S. can ignore the dangers of major warfighting or the dictates of technological change. That was the mistake Britain made before 1914 and again before 1939. The British had the world's best "small war" force—an army well-trained and equipped for fighting bandits and guerrillas—but it was ludicrously insufficient to deter German aggression or to defeat Germany once a world war broke out. That mistake, symbolized by deficiencies in tanks and aircraft carriers, hastened the end of the Pax Britannica.

Today, the possibility of conventional interstate war is lower than at any time in the past five hundred years, but it has not disappeared altogether. Because Americans and other citizens of Western democracies no longer seem willing to suffer the same level of casualties experienced by their ancestors, their armed forces must be able to defeat adversaries at scant cost in lives. That argues for keeping the qualitative edge that the U.S. gained in the Information Age—an edge that cannot be preserved by standing still. It will be necessary to keep innovating because, as previously indicated, some of the technologies and techniques employed by the U.S. are starting to be negated by their dissemination around the world. Innovation must be organizational as much as technological, and it needs to focus on potential threats across the entire spectrum, from low-intensity guerrilla wars to high-intensity conventional conflicts.

In any case, the boundaries between "conventional" and "unconventional," "regular" and "irregular" warfare are blurring. Even nonstate groups are increasingly gaining access to the kinds of weapons—from missiles and land mines to chemicals and perhaps even atomic bombs—that were once the exclusive preserve of states. And even states will increasingly turn to unconventional strategies to blunt the impact of American power.

Two colonels of the Chinese People's Liberation Army envision "unrestricted warfare" encompassing not only traditional force-on-force encounters but also financial warfare (subverting banking systems and stock markets), drug warfare (attacking the fabric of society by flooding it with illicit drugs), international law warfare (blocking enemy action by using multinational organizations), resource warfare (seizing control of vital natural resources), even ecological warfare (creating man-made earthquakes, tsunamis, or other disasters). In a clever bit of jujitsu, many of these strategies turn the strengths of Information Age countries against them. Al Qaeda is pursuing similar strategies.

Countering such threats will require much more than simply buying more advanced aircraft, tanks, or submarines. Such traditional weapons systems may be almost entirely useless against adversaries clever enough to avoid presenting obvious targets for precision-guided munitions. To fight and win the wars of the future—wars that may more closely resemble a series of terrorist attacks or hit-and-run raids than traditional force-on-force armored, aerial, or naval engagements—will require reorganizing conventional militaries to emphasize such skills as cultural awareness, knowledge of foreign languages, information operations, civil affairs, and human intelligence. It will also require cutting away the bureaucratic fat to turn bloated Industrial Age hierarchies into lean Information Age networks capable of utilizing the full potential of high-tech weapons and highly trained soldiers.

The United States' readiness for such challenges will determine whether it can keep its position as the lone superpower or whether the world will see another power shift of the kind that accompanied the Gunpowder Revolution, the First Industrial Revolution, the Second Industrial Revolution, and the early stages of the Information Revolution. The course of future history will turn on the outcome.

WAR MADE NEW

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