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Arms Control in an Age of Strategic and Military Revolution

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Source Notes

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1. A world transformed [1]

We have come a long way since autumn 1989 and the few optimistic years that followed. During that dawn of the post-Cold War era, security policy discourse focused briefly on notions of common security and a peace dividend. Since then, these ideas have been displaced by other, more bellicose ones: the clash of civilizations, the war on terrorism, and their constant companion: the Revolution in Military Affairs.

My task today is to describe some of the challenges that the military revolution has set for arms control. But to do this I must place it in its broader context. The past 15 years have seen several types of relevant transformation – not just one. The strategic balance among nations has changed. The very composition of the strategic system has changed. And military technology has changed. These transformations have interacted to alter the global dynamics of war and military competition. And, together, they have established an entirely new (and not so friendly) context for arms control.

1.2. The geo-strategic revolution: emergence of a unipolar military system

The primary transformation is the geostrategic one, comprising the end of the East-West confrontation and the shift toward a unipolar world military system. The outstanding feature of this new configuration is US military primacy. One gauge of the change in America's position is comparative military expenditure: today the United States accounts for 50 percent of world military spending – up from 27 percent in 1989. While America's nearest competitor in 1989 – the Soviet Union – spent as much or more on military power as did the United States, America's nearest competitor today probably does not spend 15 percent as much. The disparity is even more pronounced with regard to military research, development, and procurement, with the United States presently accounting for nearly two-thirds of the world total.

Commensurate with the geostrategic revolution, three successive US administrations have lowered the threshold on the use of American military power. Beginning with George Bush senior, US national leadership has set aside the “last resort” principle regarding the use of force in favor of more permissive formulations – most recently: the doctrine of “preemptive war”. Many critics argue that the term “preventative war” would better describe the doctrine. This, I think, is too generous.

Preventative war was last contemplated by the United States during the early years of the East-West confrontation, when it was feared that general aggression by the USSR awaited

only the development of the Soviet bomb – an eventuality known to be in the offing. But the current doctrine is more permissive than this. It does not hinge on a high probability of future aggression or strong evidence of emergent weapon parity or even capability. Instead, it prescribes applying force even when reasonable people would conclude that conflict probabilities and adversary capabilities are modest or low. Perhaps “precautionary war” best describes the new doctrine. It is a doctrine well-suited to a power that possesses super-abundant warfighting potential as well as an over-abundant faith in war’s effectivity.

1.3. Geo-systemic transformations: toward post-modern modes of conflict

1.3.1. Transnational phenomena and non-state actors

The second relevant transformation is the post-cold war rise to prominence of “transnational” phenomena and non-state strategic actors. This is associated with economic and cultural “globalization”, the collapse of the bloc system, the weakening of the nation-state in some regions, and the migration of power from state structures (or actors) to subnational and transnational ones. This change is akin to the emergence of the nation-state, nationalism, and mass armies that occurred during the period 1500-1800. Such changes not only introduce new strategic actors, with their distinctive modes of behavior, but also alters the nature of “strategic space”. So, today more so than 20 years ago, there are important strategic dynamics not encompassed or mediated by relations among states. We might say that the “gaps” in the nation-state system have opened wider.

Regarding the newly prominent non-state actors: the integrating principles for these agents are not political and territorial, like the liberal nation-state, but corporate, ideological, and cultural. Of special concern among the transnational actors are armed “social movement” organizations and criminal and terrorist networks. Relative to the nation-state, these non-state forms are amorphous and rootless. They can penetrate nation-states while remaining themselves hard to isolate and target. In war, they are apt to employ irregular, unconventional methods, including terrorism. And they often operate outside the logic of deterrence and the conventions of war. These features have led some analysts to say that the new actors fight in ways “asymmetric” to nation-state practice (which emphasizes specialized, capital-intensive war-making organizations). Their addition to the global system transforms the nature of war as a social phenomena. Also relevant to this transformation is the emergence of “freelance” commercial military organizations.

1.3.2. Cyberspace and cyberwar

The third transformation of note is the emergence of cyberspace as a new venue for conflict, which, like the rise of transnational actors, has the effect of altering the strategic system or “playing field.” Cyberspace adds a new dimension to conflict. In this dimension, malicious computer code serves as a weapon able, in short order, to threaten every corner of the

domain. Here, clever and resourceful actors can achieve global effects nearly instantaneously.

The information flow on the internet is now doubling every year, having grown from about 1 terabyte per month in 1990 to over 100,000 terabytes per month in 2002. Today, 15 percent of the world's households are "plugged in". Industry, government, and security establishments are even more dependent on cyberspace – indeed, critically dependent. And, as US Secretary of State Condoleezza Rice has put it: "The cyber-economy *is* the economy." Almost nothing of import occurs anywhere in the financial realm that is not dependent on digital transfers.

As our lives and livelihoods have become increasingly mediated through cyberspace, new opportunities for strategic warfare have opened up. What I mean by "strategic warfare" is direct attack on those things that people and nations value most, including the sources of national power and vitality.

A final consideration is that cyberwar has a relatively modest "entry fee" for malicious actors. Any agency that is willing and able to invest \$100 million per year can develop a resilient, world-class cyber-warfare capability within a decade or less. More than 100 nations and corporations can meet this criterion today.

The growing importance of cyberspace together with the new circumstances summarized in the previous section define the "post modern" transformation of conflict.

1.4. Military-technical transformation

The final transformation of note is the military-technical one, which foremost involves the exploitation of new information and communications technologies to achieve dramatic new battlefield effects. Secondly, this transformation depends on new, high-cost materials and material fabrication techniques.

At heart, the promise of the information revolution as it applies to the military realm is to allow (1) a reduction in the mass and density of armed forces and (2) a corresponding increase in their speed, flexibility, and agility. In this equation, information substitutes for mass by, among other things, allowing armed forces to shed some of their organizational redundancy (which has served historically as a hedge against uncertainty). Information power is supposed to accomplish this by giving military organizations:

- # Improved situational awareness;
- # Greater precision and range in the attack;
- # Better coordination among friendly units; and

More efficient support.

In turn, these improvements allow forces:

To become smaller and lighter,

To operate in a more dispersed fashion,

To act with greater speed and agility, and

To adapt more rapidly to new circumstances and missions.

Presently, the chief organizing concept for US military transformation is “network centric warfare”. This envisions all units and assets as nodes in a theater-wide (and eventually, global) network comprising several types of “grids”: sensor, information processing, support, and weapon or “strike” grids. Although widely-dispersed, the units comprising these grids would be highly mobile and digitally interlinked – and thus able to rapidly concentrate themselves or their fires in the right combination and at the right time and place to quickly defeat a foe.

Or so the theory goes.

Is this what we saw at work during the main conventional phase of Operation Iraqi Freedom – that is, during the first month of the war? Was this “netcentric warfare” in action? No, not actually.

During the Iraq war, nothing like a theater-wide digital network linked all US units.[2] Nor was there even a “common operating picture” available to all units. Indeed, Army and Marine commanders spoke of a “digital divide” between air and ground power and between high-level headquarters and tactical units. Among other realities of the conflict that detract from the image of netcentric warfare:

Ground units, although overburdened with new communication equipment and deluged with data, often felt in the dark about enemy dispositions.

Tactical level communications systems had a hard time keeping pace with operations. While terrestrial communication systems were insufficiently reliable, satellite systems were frequently overloaded.

The movement of material to the theater went much better than it had during Desert Storm, but efforts to move the material forward to tactical units often came up short.

Although target acquisition and precision strike worked well for air units, they suffered from insufficient intelligence and bomb assessment, which degraded their understanding of what they were actually accomplishing.

The fact is: the Pentagon remains far from achieving its vision of “network centric” armed forces. Indeed, the simplest, most essential thing – getting the services to use compatible radios and communication protocols – remains deeply conflicted. Partly, this reflects persistent and deep-rooted difficulties in achieving interservice cooperation.

What we did see during the one-month conventional phase of the Iraq war was a more limited type of a network. This principally involved reconnaissance and precision strike assets – air power, mostly. It resembled something the Soviets used to call a “reconnaissance and fire complex”. Apart from being a more accurate description, this phrase has the benefit of reminding us of the central role played by firepower in US doctrine and operations. And in the case of the Iraq war, an avalanche of fire was used: More than 12 equivalent kilotons of TNT in one month. About half of this was air-delivered. And about 68 percent of air-delivered weapons were of guided types.

With the Iraq war as our reference point, we can consider what might be called the “actually existing military revolution”. The pivotal capability that it conveys is “standoff (or longer-range) precision strike”.

1.4.1. Precision attack and the “kill ratio” revolution [3]

“Precision” is a relative attribute. In the case of the Iraq war, it refers to the delivery of bombs weighing between 225 and 900 kilos to within 13 meters of their targets. On impact, these weapons destroy virtually everything within a radius of between 20 and 35 meters. Truly safe distances for unprotected people in the open range between 500 and 1000 meters. So these “precision weapons” have some inherently imprecise effects upon delivery. And the “precision revolution” partly depends on these broad area effects.

The threshold of the precision revolution was crossed when the average “miss distance” of guided bombs was shrunk to less than their lethal blast radius. This ensured that even “misses” would most often destroy their targets. In this regard, it is noteworthy that official analyses that show one or two of today’s precision bombs doing the same work as many more 1970-vintage bombs are often comparing the effects of old 500-lb munitions with new 2000-lb ones. But the increased lethality of the latter is not due solely to their improved accuracy. Their greater explosive power also matters.

Contrary to official and popular treatments of “precision warfare”, the relationship between improvements in weapon precision and lower aggregate casualties in war is not a linear one. Nor is it a necessary one. Actual war outcomes are contingent on how precision capabilities are put to work.

Obviously, in cases where the goal is to achieve higher attrition rates per bomb – say, by accurately delivering cluster munitions on air defense and artillery units – increased precision may mean more dead, not less. But even in situations where casualty avoidance is an important objective, the relationship between improvements in precision and overall

casualties is not uniform. One reason for this is that improvements in accuracy lower the cost and risks of bombing for the bomber – and this can lead to the addition of targets that might otherwise be considered marginal.

Improvements in bombing precision allow targets to be attacked successfully today with only 5 percent of the effort required 25 years ago. More so than before, air forces can afford to attack targets whose destruction has an uncertain or less immediate impact on the current battle. Especially important in this category are political, leadership, and “dual-use” military-civilian targets. The rush to add targets to targeting lists has been evident in the run-up to all of America’s recent wars. And, in the execution of air campaigns, many targets are revisited multiple times in order to prevent repair or remove any doubt about their destruction.

Thus, while it is true that greater precision means that any individual target can be destroyed with far fewer bombs, there are countervailing trends whose effect may be to keep the aggregate tonnage of bombs used in a war quite high. In addition, the more vigorous pursuit of political and dual-use targets, which often sit in urban or populated areas, works counter to the efforts to keep civilian casualties low.

By our estimate – based on hospital, morgue, journalist, and military reports – US precision and other arms killed between 11,000 and 15,000 Iraqis during the conventional phase of the war, which lasted one month. About 30 percent of the dead were non-combatants. It is almost certainly true that many more would have died had America relied entirely on older, non-precision technologies to prosecute the war. Equally true, however:

- # The limit on carnage and collateral destruction was not nearly so great as the vast improvements in bombing accuracy might seem to promise – for the reasons outlined above. The often televised images of cruise missiles and laser-guided bombs surgically striking their targets do more to distort the ground truth of these wars than clarify it.
- # We certainly have not passed into an era of “clean” or “low impact” wars in any absolute sense – as we will explain in the next section.
- # Nor do the new technologies promise an era of fewer wars. In the case of the 2003 Iraq conflict: the war would not have been attempted except for the efficient and economical destructive capabilities that the new technologies conveyed. Without them, we would have had to rely on other means to reform Iraq.

So, what promise has standoff precision warfare actually fulfilled?

The original impetus for developing these attack capabilities was the Cold War confrontation in Europe, where NATO found itself outnumbered and fearful of deeply-echeloned Soviet ground troops. A series of deep attack initiatives begun in the 1970s and early 1980s – Follow-On Forces Attack, the Assault Breaker program, and AirLand Battle, among others –

promised to give US forces the capacities to “fight outnumbered and win”, to attack Soviet forces throughout their depth, and to achieve “near-nuclear effects” against hard targets using conventional weapons.

These efforts came to fruition during the early 1990s, when the United States faced adversaries much less competent and powerful than the Soviets. In this context, the new technologies gave America the capacity to disable its adversaries’ national infrastructures within a matter of weeks and to achieve very favorable “kill ratios” against their armed forces – 60:1 in the case of Iraq. Moreover, the “precision revolution” allowed the United States to accomplish these feats using a relatively small field force.

1.4.2. Iraq and the idea of a “new warfare”: enabling predominance

The notion that US precision attack capabilities make it possible to wage wars with a minimum of death and destruction has figured centrally in public consideration of US military activism. President Bush outlined the essentials of what I call the “new warfare hypothesis” in a speech before workers at a Boeing aircraft plant in April, 2003:

We've applied the new powers of technology... to strike an enemy force with speed and incredible precision. By a combination of creative strategies and advanced technologies, we are redefining war on our terms. In this new era of warfare, we can target a regime, not a nation.

Of course, RMA advocates had been heralding the advent of a new era of relatively “clean” warfare since the early 1990s. Beginning with the Kosovo conflict, and especially after the Afghan war, the hypothesis has enjoyed broad assent in the US press.

The political utility of the hypothesis should not be underestimated. Two great fears constrained the exercise of American military power in the final decades of the Cold War. The first was fear of uncontrolled escalation leading to general war with the Soviet Union. This fear was put to rest by the Soviet collapse. The second fear was that regional intervention might lead to a quagmire and would produce unacceptable casualties and “collateral damage”. The “new warfare hypothesis” addresses this second concern. And its effect has been to enable the United States to put its military predominance to work.

Despite the bad turn of events in Iraq since May 2003, the idea that American firepower is “clean” persists. And transformation advocates still insist that the “new warfare” hypothesis is generally valid for conventional force engagements. However, if we care to test it, the hypothesis fails even in this narrower sense.

With regard to casualties – including civilian casualties – the first phase of the Iraq war was within the range of many of the strategically significant wars of the past 50 years, including:

The 1956, '67, and '73 Arab Israeli wars;

The 1965, '71', and '99 India-Pakistan conflicts; and

The conventional phase of the 1978 Vietnamese-Cambodian war.

These conflicts involved comparable numbers of combatants. Most also involved similar time frames. And several were comparably “decisive”.

Thus, , contrary to what the “new warfare hypothesis” implies, it should not surprise us if America’s recent wars produce chaos, inspire hatreds, and prompt cycles of revenge as intractable as those produced by the Arab-Israeli and India-Pakistan conflict. Indeed, the death toll in the first month of the Iraq war was at least twice as great as the total number of deaths incurred in 20 years of the Israel-Palestine conflict.

In one sense only has the new warfare hypothesis proved true: as noted above, the ratio of US military to enemy dead in conventional engagements has been remarkably low in recent wars. And this has been critical in building and maintaining a US domestic consensus tolerant of military activism.

Of course, the events of 11 September 2001 and the obvious failures in Iraq after 1 May 2003 have prompted some change in the US transformation discourse. Planners are paying more attention to the threat posed by “non-state” actors and to notions of “post-modern” warfare. There is a new interest in counter-insurgency and urban warfare doctrine and assets. And the challenge of controlling restive populations has renewed the interest in so-called nonlethal weapons. These new concerns have exercised some influence on US military modernization plans, as described in the next section, although enhancement to standoff precision strike capabilities still claim center-stage.

2. US military modernization trends, 2005-2015 and beyond [4]

2.1. Enhancing precision attack: One, two, many Iraq wars?

The most consequential development during the next 5-10 years will be the further evolution of US capacities for standoff precision strike. The boost in capability should be nearly as great as that which occurred between 1991 and 2003.

In qualitative terms, the Pentagon seeks:

- # To significantly increase the number of targets that it can accurately engage simultaneously;
- # To substantially increase the average distance between US platforms and the targets they engage – that is, to increase standoff range; and,
- # To achieve greater speed and flexibility in targeting.

These ends will be served by:

- # Procurement of the “Small Diameter Bomb”;
- # Greater reliance on munitions like the Sensor Fused Weapon, which can engage multiple targets;
- # Greater reliance on aerial drones as well as on glide bombs, powered glide bombs, and cheaper cruise missiles;
- # Improvements in satellite guidance for weapons and greater reliance on autonomous terminal guidance;
- # Increasing the capacity of naval vessels and ground units to attack targets with missiles from ranges of 75-200 kilometers;
- # Increased reliance on space-based reconnaissance and target acquisition assets; and,
- # Better networking within the reconnaissance and fire complex.

Looking forward six or ten years and comparing today’s weapons to tomorrow’s, we should expect US firepower to be able to put four or more times as many targets at risk simultaneously. Average standoff distances should more than double, with few airborne platforms having to engage from (slant) distances of less than 15 kilometers. Maximum distances for many platforms will stretch to 300 kilometers or more. Many more ground based systems should be able to engage from distances in excess of 50 kilometers. Naval platforms will be able to deliver much more firepower than today from distances of 100 kilometers or more.

These quantitative enhancements – more targets, greater standoff range – will multiply America’s strategic options:

- # Far fewer fire platforms will be required to conduct an Iraq-like war, at least as regards air and missile attack – making it easier to prosecute two or three such bombing and missile campaigns simultaneously.
- # Conversely, the bomb and missile campaign for an Iraq-scale war might be collapsed into a single week or less, permitting true “shock and awe” effects and leaving diplomatic efforts at war termination in the dust.
- # Finally, the forthcoming enhancements may allow the United States to achieve destructive effects like those demonstrated in March-April 2003 but against a much larger nation and armed force.

Of course, the size of America's ground forces will limit its capacity to exploit multiple or larger campaigns like those outlined above. But the 2001 Afghan war and the 1999 Kosovo war provide other, less "troop intensive" models for applying American power.

2.2. Dependence on space power; advent of strategic cyberwar

For all US forces, data bandwidth requirements will grow exponentially during the next decade – probably 100 fold – and all the services will become much more dependent on satellite communications and space assets. This dependency will become the military's most obvious Achilles heel – and it will take determined steps to shield it.

The United States will also mature its capabilities for attacking adversaries' national information, communications, and electrical power grids. This will involve digital, kinetic, and microwave weapons as well as purpose built bombs, such as the CBU-102, which coats transformer stations with conductive fibers. For the near term, the microwave weapon of choice will be the so-called "E-bomb," which uses a conventional explosive to drive a microwave generator. For the future: One version of the planned X45 combat drone is to be equipped with a directional, high-power microwave weapon.

2.3. Drones, robots, and directed energy weapons [5]

Microwave weapons are among the more exotic developments that have gained public attention. Some of the others are robots, laser weapons, and a few of the so-called "nonlethal weapons." So what does the United States intend with regard to these?

Drones and robots:

- # Most notably: The next ten years will see airborne drones assume an increasingly prominent role in US operations – including attack roles.
- # Sea drones for reconnaissance and short-range mine-clearing tasks will also be deployed within the next ten years.
- # The role of ground robots in this time frame will remain more limited – mostly involving tethered transport, short-range reconnaissance tasks, target designation, and the disposal of mines and munitions.

Turning to combat lasers and other directed energy weapons:

- # The future of the Airborne Laser is in doubt. Should it continue forward, no type of capability suitable for missile defense is likely before 2012.

- # Much shorter-range, less powerful chemical lasers for purposes of tactical defense against rocket and artillery rounds could soon be available – but their cost, reliability, bulkiness, and logistic requirements, among other things, makes them impractical. These tactical applications will have to await advances in solid state lasers, and this probably defers deployment to after 2015
- # Of course, small truck-borne solid-state lasers generating up to 25 Kw are already available for destroying mines, improvised explosive devices, and unexploded ordinance. These have effective ranges of between 300 meters and 1 kilometer.
- # Portable microwave weapons for detonating IEDs also have been successfully tested and may also soon be deployed – that is, within a two-year time frame. And Raytheon is preparing to market an “airport protection” microwave system it says can defeat some types of portable SAMs.

Finally, let me mention a few so-called “nonlethal” directed-energy weapons meant for crowd control:

- # The first is Raytheon’s Active Denial System, which uses millimeter waves to cause unbearable skin pain at distances up to 700 meters. Although 14 of these weapons were slated for fast-track deployment to Iraq, controversy has slowed their deployment.
- # By contrast, the Long-range Acoustic Device already has been deployed. This is a highly-directional loud speaker system which can produce 100 decibels at 1 kilometer – the sound of a pneumatic hammer. 115 decibels is possible at 100 meters and up to 150 at closer ranges. 130 decibels marks the pain threshold, and 150 is 9 times louder than that.
- # Slated for deployment as early as 2007 is the Pulsed Energy Projectile system, which uses a laser pulse that generates a burst of plasma when it hits a target. This can knock a person down while also overstimulating the pain receptors and causing temporary paralysis. Effective range is about 2 kilometers.

These and other nonlethals, deployed and under development, pose new challenges for arms control, which I will address in the final section. But first I would like to draw back, look again at the big picture, and ask:

What fundamental arms race and arms control dynamics have the recent strategic and military transformations set in motion?

3. Arms race and arms control dynamics

3.1. Re-militarization, re-polarization, and “the end of arms control”

The transformation that most affects arms control is the geostrategic one – that is, the emergence of a unipolar military system. This development has utterly altered the context and prospects for arms control, significantly dimming its prospects.

Nations are most interested in negotiated arms control under conditions of intractable military parity and stalemate. This is especially true if they perceive themselves to be perched on the edge of a high-cost, high-risk conflict with uncertain outcome.

By contrast, in situations of extreme inequality, the dominant are tempted to preserve their position, while others seek to erode or balance against it. In such situations, arms control efforts, if they advance at all, can become subordinate to strategic competition.

We should expect the negative effect on arms control to be especially strong if the dominant powers put their military advantages to use for purposes other than purely defensive ones. This would intensify other nations’ desire to develop a counter-balance. And it might loosen customary constraints on military activism generally.

Unattended, this dynamic implies a gradual remilitarization of international relations, as players on all sides seek to escape their arms control obligations and preserve or improve their military position. Today, this trend is evident in the reversal of the peace dividend globally. Global military expenditure reached its low point in 1997. It has grown by 28 percent since then. Much of this is due to the United States, but increased spending by Russia, China, India, and Pakistan is also significant. Indeed, average real expenditures are up in all regions except Central America and Western Europe.

The exercise of predominance can also prompt global re-polarization, which can add impetus to remilitarization. One indication of incipient repolarization is the formation and expansion of the Shanghai Cooperation Organization (SCO), which includes as full members China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. Observer status has been afforded to India, Iran, Mongolia, and Pakistan. This reflects an instance of “hard balancing” against the United States. The impediments to the US effort in Iraq put up by several other states – Germany, France, and Turkey – represent instances of soft balancing, which does not imply polarization so much as it indicates varying degrees of alienation from US purposes.

The SCO is a geopolitical alliance based on converging national interests *vis a vis* an activist United States; it has no evident cultural or ideological component. However, global repolarization can also fall along cultural, ethnic, or religious “fault lines”. And, indeed, it is developing along these lines, although separately from the SCO process. This second form of repolarization is evinced by the collapse of positive feelings toward the United States throughout much of the Arab and Muslim world, where pro-US sentiment now registers in

the single digits. This is best understood as reflecting policy conflicts and not “civilizational” ones, although ideologues – including Bin Laden and America’s neoconservatives – may promote a “clash of civilizations” reading of current conflicts. The aim may be to facilitate social mobilization by tapping issues of group and personal identity. Once the “civilizational clash” framework gains broad adherence, it can become self-sustaining, distorting national political discourse and limiting the prospects for diplomacy. By this pathway, interstate conflicts or conflicts between discrete actors – like the United States and Al Qaeda – can rapidly escalate horizontally.

3.2. Specific arms race dynamics

No nation is yet attempting or can afford a symmetrical or “mirror image” response to US capabilities – although Russia and China may try in the future. Any future development along this path could produce a highly unstable, “hair-trigger” configuration.

Consider two info-tech militaries confronting each other: each would be oriented toward early deep attack – strategic attack – by both physical and digital means, with the aim of quickly disabling the others’ centers of national and military power. Both would be very dependent on vulnerable space assets and digital nets. This is a configuration that invites preemption.

Regardless of who fires first, however, neither would emerge from the first day of combat with their digital nets intact. And both sides would likely suffer substantial damage to their national infrastructures. Thus, “the day after” would be characterized by social chaos and by scattered battles between disconnected, intermingled military units. This scenario I call a “slow-burn apocalypse”.

For the near-term, however – meaning the next 15-20 years – the more likely competitive response to US and Western capabilities is asymmetric adaptation, not comprehensive emulation. Developing along asymmetric lines, competitors would seek to neutralize the advantages of the advanced military powers. Specifically they might aim to:

- # Disable and disrupt US military information systems;
- # Impede access to staging areas;
- # Impede the mobility of US forces; and
- # Attack rear areas and support assets.

In addition to (or as an alternative to) these asymmetric warfighting objectives, adversaries could pursue a capacity for horizontal escalation – that is: a capacity to attack high-value US or allied assets outside the immediate theater of conflict. The aim could be either deterrence or retaliation.

Unfortunately, weapons of mass destruction would serve most of these ends decisively. So would remotely piloted vehicles and ballistic and cruise missiles with ranges exceeding 1000 kilometers. Together these might be considered the pre-eminent “poor man’s” counter to advanced conventional military capabilities – especially to standoff precision strike. Although development along these lines is most worrisome to the West, it hardly exhausts the options available to adversaries:

- # Rapidly-emplacable land and naval mines provide another useful counter to advanced intervention capabilities. Future developments might include missile- and rocket-delivered systems that could be used to “pepper” US ground forces as they advance.
- # Adversaries also may increase their investments in electronic warfare capabilities, especially those targeting GPS guidance systems and satellite communications. Dedicated means for attacking GPS signals already exist; Reportedly, some were employed by Iraq in the 2003 war.
- # Crude radiowave weapons could meet some other electronic warfare requirements; Simple versions might be built for as little as a few thousand dollars.
- # Those nations with space launch capabilities could develop “pop-up” anti-satellite weapons – for instance, maneuverable “space mines” – to degrade US space-based reconnaissance and communication networks.
- # Cyberwar capabilities – that is, digital weapons – might offer poorer nations a strategic attack option. As suggested earlier, an annual investment of \$100 million might within a decade yield a considerable ability to attack well-protected computer networks.
- # Finally, following Iraq’s example, adversaries might increase their investment in light and paramilitary forces meant to harass troops both during and after the main conventional phase of a war. Some of these might be deployed secretly in very small units to other countries to enable a degree of strategic retaliation (through terrorist action) or to disrupt staging areas. Another option would be to pay (or otherwise resource) independent terrorist groups or criminal organizations to fulfill these same extra-territorial functions.

It is worth noting that, to the extent conflicts are broadly perceived as reflecting a “clash of civilizations”, the appeal and latitude of radical non-state actors, such as Al Qaeda, also increases. Moreover, practices such as strategic bombardment and urban warfare, which can incur significant civilian casualties, may increase the impetus to terrorist activity.

What the above analysis suggests is a dynamic relationship between:

1. A lowered threshold for US military activism (which has been partially enabled by precision strike capabilities and by the propagandistic notion of a “new warfare”), and

2. An increased interest among potential competitors in new modes of warfare and, more immediately, an increased demand for weapons of mass destruction and missiles of increasing range and sophistication.

This should substantially impede arms control progress in those areas of greatest interest to the West. The dynamic is obvious in the explicit linkage that North Korean leaders make between dismantling their nuclear program and attaining a “non-aggression” guarantee from the United States. It also is implied in Iranian desires for a security guarantee as part of any agreement limiting their development of nuclear materials.

More generally, since the 1991 Gulf War, military establishments worldwide (and especially those of Russia, China, India, and Pakistan) have been vigorously debating the implications of the US military-technical revolution, including possible responses. One consequent development was a shift in Russian nuclear doctrine in 2000 to clearly specify first use “in response to large-scale aggression involving conventional weapons in situations that are critical for the national security of the Russian Federation and its allies.” This doctrinal shift followed the Kosovo war and occurred in the context of NATO expansion. Of course, retrograde motion is also and more generally evident in many nations’ policies regarding weapons of mass destruction and missile modernization, as detailed in the next section.

3.3 Retrograde motion: WMDs, missiles, and UAVs [6]

During the past 20 years there has been substantial progress in reducing and controlling global holdings of ballistic missiles and nuclear, chemical, and biological weapons. And the number of countries that are producers, developers, or holders of these weapon types has declined. However, there have been countervailing trends and, in recent years, progress has slowed, stalled, and even reversed in some areas.

Since the end of the Cold War, two new nations have joined the nuclear club (Pakistan and perhaps North Korea), several nations have been undertaking nuclear modernization, and a handful have accelerated efforts to acquire nuclear, chemical, or biological weapon capabilities. Concerning ballistic missiles: Since the late-1980s, France and the United Kingdom have graduated from intermediate-range to intercontinental range missiles, North Korea and Iran have shown some interest in missiles of this range, several other nations have newly deployed or are developing intermediate range missiles (India, Iran, Israel, North Korea, and Pakistan), and five countries have newly joined the medium-range club (India, Iran, North Korea, Pakistan, and Saudi Arabia).

All told, as many as 35 nations have at least short-range ballistic missiles (70-1000 km). About 17 of these countries have no missiles of any type exceeding 300-km in range; another seven have no missiles exceeding 1000-km in range. Mostly, these short-range arsenals involve missiles of older types. While some countries are dropping out of the ballistic missile club altogether as their systems obsolesce, at least six nations in the global South are attempting modernization of their short-range systems.

Thus, the overall ballistic missile picture is one of reduced global holdings and fewer “players” – but some of these players are vigorously pursuing modernization, including systems of greater range and sophistication.

Turning to the cruise missiles: as many as 75 countries may have one variety or another of these systems in their inventories, although most have only short-range antiship versions. Nineteen of these countries are producers, including 12 who produce land-attack versions. Arsenals are growing in both size and sophistication, and more nations are joining the club of those who possess land-attack versions. Notably, during the 2003 Iraq war, US forces were attacked for the first time with cruise missiles – Chinese-made HY-2 Seersucker missiles that Iraq had modified for land-attack purposes.

The United States, Russia, China, France, Germany, Sweden, Italy, Israel, South Africa, and Taiwan all have new land-attack cruise missiles under development. In recent years India and Russia have co-developed the PJ-10 supersonic “Brahmos” Anti-Ship Cruise Missile (ASCM), which can be modified for land attack. It will be available for export with a range limit of 280 kilometers. In addition, India has reportedly purchased the Russian SS-N-27 cruise missile for land and sea use. Also co-developing ASCMs are China and Iran – both of which also reportedly received Soviet Kh-55SM missiles from the Ukraine. And the United Arab Emirates (UAE) have reportedly ordered 250 “Black Shahine” (SCALP-EG/Storm Shadow) air-launched cruise missiles from France. Perhaps most noteworthy is Pakistan’s August 2005 announcement that it had built and tested a new land-attack cruise missile, the Babur.

Regarding Uninhabited Aerial Vehicles (UAVs): These represent the greatest prospect for rapid proliferation of new military airpower capabilities. Effective, reusable models can be built at relatively low cost to fulfill a wide variety of roles, military or civilian. Indeed, surplus aircraft can be converted to a UAV configuration for as little as \$50,000. Low cost and flexibility are two reasons that a diverse global production base and market already exist. Today, 43 countries produce UAVs of 600 types or models – the large majority with a flight radius exceeding 150 kilometers. Perhaps 90 countries currently have UAVs in their inventories and there are a few hundred new models of UAVs under development worldwide. This represents a significant growth in market activity since June 2003, according to *Aerospace America*, journal of the American Institute of Aeronautics and Astronautics.

The current development surge is focused on improving range, reliability, navigation, and military applications – including attack capabilities. Although the United States leads the UAV field, many nations – France, Germany, Italy, Japan, and Israel, among them – have well-developed UAV industries and markets. China is rapidly developing its production capabilities, while Russia is resuscitating its considerable base. Singapore, Taiwan, Pakistan also have respectable production capacities and growing fleets. (In the case of Pakistan, this includes eight production facilities and two dozen models – many for export.) Until recently, India has lagged as a producer – relying on Israeli imports – but is now

moving ahead with serial production of several indigenous models, including the turbojet Lakshya, which can carry a 350-kilogram payload 600 kilometers.

4. An arms control counter-offensive?

To re-establish a supportive context for arms control and to revitalize broad support for nonproliferation requires that advocates act to limit military activism and raise the threshold for conventional war. Even if unsuccessful, making a dedicated effort to dampen military activism is critical to preserving the integrity of arms control. Otherwise the practice will be viewed increasingly as little more than an instance of strategic competition “by other means.”

Arms control advocates and the scientific community can help raise the threshold for war by acting to raise the political cost of war. Positive steps along these lines include:

- # Addressing and exposing the “new warfare” hypothesis as false in its most important particular: the unsupported assertion that technology has carried us across the threshold into an era where “clean wars” are possible;
- # Investing more time, energy, and resources in substantiating the human cost of war – as it occurs -- including its secondary or “down stream” effects: economic, health, and environmental;
- # Acting to further deligitimize the practices of conventional strategic bombardment, bombardment of cities, and attacks on political and dual-use targets; and
- # Redoubling efforts to deligitimize the use of cluster bombs as insufficiently discriminate. Along these lines we might also draw critical attention to the use of incendiary weapons and to the increasing reliance on autonomous weapons (which may exhibit unacceptably high error rates).

In these ways we can remind the world that war – no matter how it is waged or for what purpose – remains itself an instrument of mass destruction.

4.1. Initiatives regarding specific weapon types

A variety of initiatives might be undertaken to address emerging capabilities of special concern, such as cyberwarfare, directed energy weapons, and nonlethal weapons.

4.2. A Strategic Cyber-Defense Initiative

Offensive strategic cyberwar – that is, digital attack on institutions vital to the life of a nation and its people – should be considered a practice of counter-civilian warfare. In some

instances, it entails a capacity for mass destruction. But no conventions yet exist for limiting the development and use of these capabilities. The *Convention on Cyber Crime* of the Council of Europe, for instance, has no provision curtailing cyber-attack by state parties. Developing an international protocol against cyberwarfare or “the weaponization of cyberspace” (as suggested by Russia and the World Federation of Scientists) would be worthwhile, but its effect would be felt only *ex post facto* – which would provide little comfort in the case of a large-scale cyber-assault. Negotiated controls on capabilities would be more useful, if adherence could be reliably verified – but it cannot be.

An alternate approach might emphasize global defensive and preventative measures. A subset of global actors – a consortium of advanced technology nations, commercial enterprises, and independent scientific associations – might cooperate under UN auspices to augment defensive capabilities across the globe. This, with the aim of complicating the prospects for successful cyber-attack by any party against any other party without exception. Less ambitiously, a similar body might attempt “cooperative surveillance” of the field, reporting on emerging capabilities and on those convergences of talent and resources that might indicate cyber-weapon development efforts. This, together with an international protocol against cyberwarfare, might bring significant political pressure to bear on those states pursuing cyber-attack capabilities.

4.2. Directed Energy Weapons (DEWs)

Control efforts regarding DEWs are only marginally more advanced than those addressing cyber-attack. The use of laser weapons specifically designed to cause permanent blindness is prohibited by the Fourth Protocol of the *Convention on Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to Have Indiscriminate Effects*. This does not preclude from use the many laser weapons that can easily blind but are not specifically designed to do so. Nor does it address other effects and other DEWs that might warrant scrutiny under this protocol.

Advocates of DEWs insist – and, so far, they are doing most of the talking – that we are on the cusp of a Directed Energy Weapon revolution. What is sorely lacking, however, is critical, independent assessment of the overall impact that the broad adoption and use of these weapons might have on human populations and their environments, both built and natural.

Presently, laser weapons enjoy a positive image. Nothing conveys a sense of surgical precision better than a beam of coherent light. But, subjective impressions aside, the overall effects of DEWs may not be discrete – not in the zone between projector and target, nor in the area surrounding the target nor, for that matter, around the DEW firing positions. Unintended effects may abound. And, of course, some types of DEWs are not “directed” nearly as well as lasers. It would be worthwhile to computer model a protracted battle involving numerous DEWs of various types on both sides in a populated urban area – with an eye toward incendiary, radiation, and other collateral effects. At minimum, we need to know

more about how these weapons – both low- and high-power varieties – injure and kill. What types of wounds do they produce? When the smoke clears, directed energy warfare may prove to be no more discriminating than the use of fire bombs.

4.3. So-called “non-lethal” weapons [7]

The putative promise of “non-lethal weapons” is that they can open new avenues for forceful action by reducing the destructiveness of military operations. According to their advocates, they may be especially valuable in maintaining mission legitimacy when armed forces face the task of managing restive or resistant civilian populations.

But will these weapons work as advertised? What inadvertent or secondary effects are likely, if any? The answers remain unclear despite 15 years of interest in these weapons. Most remain untouched by any truly critical, independent, and comprehensive cost-benefit analysis. Indeed, the discourse on “nonlethals” remains largely dominated by advocates, manufacturers, and procurement establishments.

For practical purposes we can think of the “non-lethals” as constituting two general categories: anti-material devices and anti-personnel devices.

Anti-material devices include:

- # Radio frequency weapons that can destroy, disable, or degrade electronics;
- # Chemical weapons that foul engines and switches, render roadways too slippery or too sticky for use, or that have super-caustic effects;
- # Microbiological agents that can immobilize vehicles, destroy rubber or plastic parts, or ruin goods in storage; and,
- # Various types of barrier, entanglement, and tire bursting systems.

Anti-personnel devices include:

- # Directed energy and stun devices meant to temporarily disable or cause pain, including Tasers, microwave and laser weapons, and plasma weapons such as the “Taser Cannon”;
- # Acoustic devices meant to cause pain, disorient, or have other psychological or psycho-physical effects;
- # Chemical agents and gasses meant to incapacitate, calm, or cause anxiety, nausea, panic, depression, fear, or euphoria;

- # Blunt impact kinetic munitions such as rubber and wooden bullet systems (guns, mines, and grenades);
- # Various types of foams and chemicals meant to entangle people or otherwise impede mobility; and,
- # Explosive devices meant to stun or dazzle.

Several of these new weapons clearly involve a Faustian bargain. For instance, several types violate existing protocols on chemical and biological warfare, which would have to be weakened to allow their use. Once begun, where would the retreat from these protocols end? Certainly, a weakening of these protocols is at odds with rising concerns about chemical and biological weapon proliferation.

Also, chemical and microbiological agents, whether nonlethal in their immediate effects or not, are likely to enter ecosystems. We need to assess their long-term secondary effects, which may be harmful or lethal, and consider the challenge posed by cleanup. This level of caution should be *de rigueur*, given our experience with Agent Orange and depleted uranium.

Of course, there has been some progress in thinking critically about non-lethal weapons: it is now broadly recognized that they are not truly “non-lethal” – although their likely harmful effects under typical conditions of use remain unclear and contested.

The most widely used of the new weapons is the Taser, which is now employed by at least 7,000 agencies worldwide, mostly for domestic law enforcement purposes. Despite their wide use, a 2004 report by Amnesty International (AI) finds that “There has been no rigorous, independent and impartial study into the use and effects of tasers.” One way or another, all of the major studies of the weapon – including one sponsored by the US Defense Department – have been linked to the manufacturer.

On its own, AI has documented 129 deaths in incidents involving Tasers in Canada and the United States between 2001 and 2005. The *Arizona Republic*, a US newspaper, has documented 153 cases since 1999. Tasers also regularly cause unintended nonlethal injuries – broken bones, especially, due to muscle spasms. Police officers in five US states have filed lawsuits against Taser International claiming they suffered serious injuries after being shocked during training.

The deadly effects of some other presumed “non-lethals” are also well-documented. Most distressing was the October 2002 use by Russian authorities of a supposedly nonlethal gas, opiate fentanyl, to overwhelm terrorists in a Moscow theater, which killed 117 of the 800 hostages. And, from my hometown, Boston: a 21-year-old college student was killed in October 2004 when she was shot in the eye with a pepper-spray-filled plastic ball by police during a boisterous celebration of a baseball game victory. An October 2004 study by the National Institute of Justice, which examined 373 incidents in which police used blunt

impact munitions (bean bags, baton rounds, and pepper balls), found a fatality rate of 2.15 percent. (This may prove the use of some of the “less lethals” to be an order of magnitude less deadly than the use of firearms. Of course, how they affect the frequency of forceful action also matters; we already know that police use firearms much less frequently than other forms of force.)

The new directed-energy antipersonnel weapons also can have harmful effects: The Active Denial System – the microwave pain ray, mentioned earlier – risks burns for individuals with coins in their pockets, metal belt buckles, eye-glasses, and contact lenses. Similarly, the Pulsed Energy Projectile system, was shown in some tests to have burned the clothes off target dummies.

Some of the directed-energy devices are easily adjusted for lethal use. Perhaps too easily to be used in a reliably non-lethal way under conditions of stress and threat. One or two serious mishaps resulting in multiple civilian deaths would quickly undo the legitimizing function of these “non-lethals” and worse: they would burden the West with the stigma of unleashing a new high-tech horror on civilians.

In light of the evidence of death and injury, it has become common to speak of the new weapons as “less-” rather than “non-” lethal. This adjustment lowers our expectations concerning the new weapons, which is good. But a more fundamental question remains unaddressed: Why is it spontaneously assumed that these weapons represent an uncomplicated step *down* the escalation ladder? Why are they assumed (even by critical observers) to be uniformly *less violent* than what they will replace? The simple fact is: *We do not yet know what the new weapons will replace, in practice.*

Enthusiasts of the new weapons insist they will substitute for more lethal means. But they might also or alternatively substitute for less lethal or even non-violent means of conflict resolution.

The current discourse implicitly divides the spectrum of tactical options into “lethal” and “less lethal”. This is misleading – especially because much of the recent interest in the new weapon types has to do with applications to civilian populations or in peace, stability, and humanitarian operations. A fuller representation might describe some of the options that are lower on the escalation ladder as “non-violent” and “non-confrontational”. Short of employing physical violence, troops can attempt to manage restive crowds using stratagems of denial, deterrence, dissuasion, persuasion, or reassurance. An example drawn from America’s recent experience in Iraq conveys a fuller sense of the options in play:

In April 2003, a company of the 101st Airborne Division used innovative tactics to defuse a potential confrontation with a hostile crowd outside a Shiite holy site in Najaf. The crowd mistakenly thought the soldiers were about to storm the Tomb of Ali. As tensions escalated, the unit commander, Colonel Chris Hughes, had his troops go down on one knee before the crowd, point their weapons at the ground, and smile. After five minutes, he had the troops walk slowly back to their base, instructing them to point their guns at

no one, but to smile at everyone. Reportedly, the Iraqis then intermingled with the troops, patting them on the back and giving them thumbs-up signs. In the early days of the war, British troops used similar tactics to defuse potential confrontations in Basra.

More than tactically clever, this approach is consistent with a campaign strategy that puts a premium on building popular consensus and cooperation, which is pivotal to the success of peace, stability, and humanitarian operations. Of course, use of a “pain ray” to disperse the crowd would have been quicker and less risky for the troops. But it probably would have had a distinctly detrimental effect at the strategic level, undermining relations between the US mission and the Shia majority in Iraq.

Part of the problem with the current discourse on the new weapons is that it masks or distorts the underlying strategic issues by casting the relevant choices as principally between “lethal” and “less lethal” means. This way of bifurcating the issue mis-directs our attention. As a template for action, it can have the inadvertent effect of facilitating escalation from non-violent to violent means, or from less-forceful to more-forceful means – as long as the latter are viewed as “less lethal” than firearms.

This escalatory tendency is already evident in some of the possible use scenarios outlined by advocates of the new weapons. Thus, the head of the US Joint Nonlethal Weapons Directorate, Col. David Karcher (USMC), suggests that the Active Denial System – the microwave pain ray – might be used to control crowds at feeding stations during humanitarian emergencies. How the act of exposing a starving throng to a pain ray might affect the perceived legitimacy of the operation, or how it might alter the relationship between the troops and their supposed clients, does not seem to register in the colonel’s calculus.

Given the above, we should not be surprised if the new weapons, in use, substitute for options both higher *and* lower on the escalation scale. This seems to be case with the US experience in using Tasers for domestic law enforcement:

- # A review of police “use of force” records for Phoenix, Arizona, in 2003 shows that the introduction of Tasers correlate with a one-third drop in the number of people killed by police – down from 13 to 9. However, it also shows a 22 percent increase in the number of incidents in which police used force of some kind – that is, about 160 additional incidents of forceful action.
- # A similar pattern – fewer deaths but more force overall – is apparent in Cincinnati, Ohio, where a court-appointed monitor found that police were often too quick to use the weapon, tending to see it as an option of “first resort”.
- # A review of 536 cases of Taser use in the Seattle area by the *Seattle Post-Intelligencer* found many cases in which the use of any type of force seemed avoidable or inappropriate. Between 75 and 85 percent of the cases involved unarmed individuals. Among them were a handcuffed pregnant woman who had been charged with a

traffic violation and a woman with poor language skills who was shocked 12 times in front of her children for refusing to sign an animal-control citation.

- # The 2004 Amnesty International study also found that Tasers were being routinely used against people who did not pose a serious threat, including unruly schoolchildren, people who did not follow orders, and unarmed suspects fleeing the scenes of minor crimes.

Of course, the exigencies bearing on the use of the new weapons in foreign military operations will be different than those affecting domestic use. The levels of threat differ, the relationship and cultural distance between actors differ, and official attitudes toward collateral damage and civilian casualties differ. In Iraq, at least 2,000 soldiers and marines are equipped with nonlethals, although in situations of high threat they have tended to quickly revert to more traditional and deadly means. It is in Iraq's military prisons that some of the new anti-personal weapons – Tasers, blunt rounds, and pepper fogs – have been used most consistently to quell disturbances, control prisoner movements, and maintain their compliance. How this has affected the perceived legitimacy of US operations is hard to say. As bad as things are, they could be worse.

In sum, many questions about the new weapons and their likely effects and employment remain unanswered. Among these:

- # How will adoption of these weapons affect existing arms limitation protocols?
- # What are their ethical and legal implications of these weapons?
- # What are their health effects and long-term environmental effects?
- # How easily might misuse or error result in serious injury or death?
- # What “employment dynamics” are likely to evolve when these weapons are put in the hands of troops facing restive foreign populations and uncooperative prisoners?

Generally speaking, advocates have tended to over-sell the putative benefits of these technologies, while overlooking their possible inadvertent and secondary effects. Especially worrisome, the discourse on “less lethal weapons” has misconstrued or distorted the strategic issues surrounding the treatment of civilian populations and the conduct of peace operations.

The new weapons may have an important role to play in future operations. Defining that role accurately, however, requires that we attempt a more critical and comprehensive cost-benefit analysis. We cannot afford to surrender this task to enthusiasts, weapon manufacturers, and procurement bureaucracies. So my proposal to the arms control community is a simple one: Let us seize this discourse.

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