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MODERN WAR IN HISTORICAL PERSPECTIVE

Dr. Richard M. Leighton

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Reviewed by: Colonel Tom W. Sills, USA

Date: 7 October 1960

INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

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Reviewed By: Col Tom W. Sills, USA Date 7 Oct 1960

Reporter: Ralph W. Bennett

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12 September 1960

DR. LEIGHTON: General Mundy, Admiral Patrick, esteemed colleagues, members of the student class: Good morning.

This morning, as we come to the end of our brief survey of modern warfare, I propose to give you an historian's analysis of some of the revolutionary military developments of our own day. After the two-days dosage of technical wisdom you imbibed last week, you may find this a little vague and elusive, because--you may as well know it now, gentlemen--I am not an expert on modern weapons, though I know a little about some ancient ones. I am not even an expert on the horse cavalry.

However, I do have an idea--you might even call it a theory. Suppose I lay it out on the chopping block right now. The introduction of nuclear and long-range missile weapons into weapon systems during the past fifteen years has had a terrific and upsetting impact on established military systems and established ideas about war. Above all, it has produced a revolutionary psychology among experts and laymen alike--a feeling that the evolution of warfare has reached a sharp turning point, and gone off in an entirely new direction--one might add, at breakneck speed. To an historian, this is a familiar phenomenon. There has always been a tendency, in the face of revolutionary developments, to assume that everything about them is new and represents a clean break with the past.

But revolutions, after all, <u>are</u> revolutions only in the context of the past they attempt to break away from, and the most revolutionary of all

conceivable revolutions could only be understood in that context. As a matter of historical fact, no revolution that has ever occurred has succeeded in making a really clean break with the past; and most of them have held on to much more of their inherited luggage than they have managed to discard.

The first point I want to make about the present revolution in military technology is this: This revolution is, it seems to me, an outgrowth and a continuation of technical developments in warfare which have been going on for more than half a century. Their revolutionary character lies, not in a change of direction, but in the speed and abruptness with which they have carried that development forward.

Second, this revolution, which is mainly a revolution in long-range weaponry, has occurred in the midst of a much broader and deeper transformation of warfare in all its aspects--a transformation that began something like a century and a half ago.

Now, I have no intention of belittling the impact of the new weapons on the face of warfare. We might liken it to the test explosion in the Pacific which wiped out a whole island. Yet the broad face of the Pacific Ocean, with only one small wart removed, still looks pretty much the same. We have yet to see what nuclear weapons will actually do to the face of warfare; the atomic battlefield exists, as yet, only in the fertile imaginations of Henry A. Kissinger and Ferdinand Otto Miksche. But I think there are sound reasons to expect that the underlying movements which have been going on for the past 150 years, and which constitute a fundamental

transformation of warfare, are still moving in the same general directions.

Well, that's the theory. The chart over there shows you the order of topics I will follow in developing it. I'll start with some general observations on wars and revolutions; move from there into a brief analysis of the current revolution in firepower in its historical context; then describe the main features of the larger military revolution of modern times, of which the firepower revolution is only one facet. Finally, with some trepidation, I will hazard some conjectures as to the probable course of warfare in the not very distant future.

First, a few words on wars and revolutions in general.

In all the history of warfare, the most revolutionary revolution, I should imagine, must have been the introduction of warfare itself into human society. Of course, we cannot date this revolution very precisely. A lot depends on what we mean by war. War in the broad sense of group combat within a species is far older than man himself, since it has been, and is, waged by many animals. Ants and some of the other social insects practiced war in highly organized forms long before man appeared on earth, and presumably will continue to do so long after he is gone.

But war as a highly organized institution of human societies, with well-defined legal and moral sanctions, codes of conduct, and explicit objectives, is no older than Neolithic man--say, 10,000 years or less. This means that man has been a peace-loving animal for more than 99 percent of his life on earth. There is no real evidence of warlike tendencies in Paleolithic man--that beetle-browed, club-wielding, skin-clothed Old

Stone Age character who dragged his woman along by her hair--warlike, that is, in any sense that permits meaningful comparison with civilized warfare.

At all events, war has proved to be one of the toughest, most viable, most continuous of civilized institutions. No civilization that we know of has managed to get along without it. For our own civilization, Quincy Wright, in his monumental study of war, has listed a total of 305 wars in the little more than four centuries from the end of the 15th century to the outbreak of World War II.

What role war plays in the growth or decline of civilizations is uncertain, and likely to remain so. In the latter part of the last century it was fashionable to regard war as nature's elixir for breeding the masculine virtues, the great natural selector for weeding out the unfit in the contest for survival both among individuals and among nations and civilizations. The latter idea was derived analogically, and, of course, very unscientifically, from Darwin's theory of natural biological selection. It is not very fashionable today. Throughout most of its history, war has been, if anything, banefully selective as a weeder-outer, since its victims have been mostly the cream of society's young, strong, adult manhood. In the 20th century, of course, the selection has become much less discriminating.

As for the causes of war, it has been blamed on everything from original sin and malevolent spirits to culture lag, imperialism, militarism, economic greed, innate aggressiveness of human society, the machinations of wicked men, and the cussedness of human nature. Particular wars, of

course, are always blamed on the enemy.

Finally, just a reminder, perhaps unnecessary, that there have been many earlier revolutions in warfare before those of the 19th and 20th centuries which constitute my major theme this morning. Perhaps the most pertinent observation to be made is that there have been long periods without revolution--for example, the five or six centuries during which the Roman legion dominated warfare, or the period of the 11th to the 14th centuries, when mailed cavalry ruled European battlefields, or the century of formal, professionalized, limited warfare that preceded the French Revolution.

Change has usually come slowly in human affairs, and in none more slowly than in the modes of warfare. In retrospect, we can perceive that a particular event--the slaughter of the French chivalry by English bowmen at Crecy, or the curiously undramatic victory of the French Revolutionary conscripts at Valmy--marked the beginning of a period of significant change. But the actors in the drama, who hadn't got the Word, usually stumbled on in their old-fashioned conveyances in the old-fashioned way, and only gradually and fortuitously found the paths that, to us, seem so clearly marked out for them by earlier events.

The immense increase in firepower--and I now move to my second topic--is, it seems to me, the central and overriding fact in the current military revolution. Without going into technicalities, about which you, in any case, know considerably more than I--let me try to analyze what appear to me to be the implications of this modern weaponry in the light of

historical trends in firepower.

The essence of this revolution, let us say, lies first in the destructiveness of the new weapons, and second in their speed of delivery over great distances.

Now, note the qualifications and limitations implicit in this statement. Neither speed of delivery nor distance--that is, range--is in itself a significant advance over the weaponry of World War II or even earlier. Only when the two are combined in a long-range ballistic missile do we get a really new factor in warfare. Nor, strictly speaking, do the new weapons provide a notably greater capability for destruction than earlier weapons and modes of warfare. Cities and their populations have been destroyed before, and quite as thoroughly as Hiroshima. The difference is, before it took longer, and it required more effort. It is the ease and rapidity with which man can now destroy--through the speed of delivery of the weapon, and the instantaneous release of immense energies--that characterize today's revolution in warfare.

My point is that if we attempt to characterize the essence of the probable impact of the new weapons on warfare, we can hardly do so in terms of destructiveness. The new weapons will not necessarily make warfare more destructive than it has been in the past. Even if we grant the possibility of obliterating, say, eighty percent of the population of a continent, and reducing the survivors to savagery, then we must also assume the possibility, which is no more nor less speculative, that a series of old-fashioned non-nuclear wars, on the scale of our recent two world

wars, might, over a period of, say, a century, produce precisely the same result. This is far from fanciful. The Mongol conquests in southwestern Asia in the 13th century, the religious wars of the early 17th century in central Europe, and the Taiping Rebellion in China in the last century, all caused devastation on a local and regional scale of this general order of magnitude. In short, what makes wars destructive is not primarily the capabilities of weapons, but the manner in which men use them.

(CHART - Firepower I)

I daresay you have all seen this kind of thing before. I show it to you merely to refresh your memories. It portrays the development of firepower through the ages in terms of the energies used.

As you can see at a glance, there's not an accurate measurement on it. However, I think it conveys the point I have in mind--that firepower depended for thousands of years on the limited force of muscle power and mechanical power. Beginning about the 15th century of our era, gunpowder provided a much more potent energy. High explosives, coming at the end of the 19th century, augmented this by several factors. Finally, nuclear energy has multiplied high explosive force by--shall we say--a factor of a million?

(Chart off)

But have you ever thought of the growth of firepower in terms of efficient use of energy? By efficiency I mean both economy in the use of force, as related to the purpose, and accuracy in striking the target.

(CHART - Firepower II)

If we look at it this way, we see a progressive development in each of the first two "energy eras"--missile power and gunpowder, that is--as the science of warfare achieved more and more effective killing power under the fixed ceilings of the energy available. From this point of view, the development of firepower reached a high plateau toward the end of each of these two eras--with the perfection of missilery and siegecraft in the classical period, extending with little or no further development into the Christian era, and with the perfection of rifled firearms in the late 19th century.

I see no way to measure the degree of perfection in each case, but it seems to me that the two plateaus represent very nearly the same level of achievement. Both the English longbow of the 14th century and the modern rifle are ultimate weapons, or very nearly so, in terms of economy of force and accuracy of delivery.

But the 19th century brought two revolutions in firepower. One was the development of rifled firearms, as just mentioned. The other was the refinement of the technique of bringing explosive force directly to bear on the target, instead of using it to propel an inert projectile which struck the target. Gunpowder had, of course, been used earlier as an explosive, but it was not very effective as such until its introduction into naval warfare in the first half of the 19th century, when shell-fire, using ordinary black powder as an explosive, made the unarmored wooden warship obsolete. That was the real significance of that black day for the Union, in April, 1862, When the Confederate ironclad, Virginia, made a shambles

of the Federal warships blockading Norfolk--the day before the Monitor arrived on the scene.

With the advent of high explosives later in the century, explosive firepower came into its own in land warfare, and the age of high explosives can properly be dated from this time. In the present century, despite the parallel challenge of the machine gun, explosive firepower in shells and aerial bombs had become the dominant force in warfare even before that August day fifteen years ago when the awful explosive force of nuclear energy carried the firepower revolution into the wild blue yonder.

But from the standpoint of economy of force, the most conspicuous feature of this era of firepower is waste and overkill. I wonder if anyone has tried to calculate how much of the blast and thermal effect of an H-bomb, accurately exploded over, say, Times Square, would be wasted on the air space between victims and buildings, or expended in vaporizing, liquefying, and pulverizing targets which, for practical purposes it would have been amply sufficient merely to kill or demolish. How efficiently, by contrast, a single old-fashioned TNT bomb expends its modest energy! And how much more efficient still is a single accurately aimed rifle bullet! This is why, gentlemen, I call this the age of overkill; and why this trend line plunges down to zero.

(Chart off)

And this is also why I date the beginning of the age of overkill, not fifteen years ago, when nuclear weapons were introduced into warfare, but more than half a century ago, when high explosives reversed the trend toward

increasing efficiency in the use of firepower energy.

There is a remarkably close analogy, I think, between the present situation and that existing at the beginning of the age of gunpowder. Then, as now, the energies available seemed titanic, boundless, uncontrollable. To professional soldiers trained in the sophisticated weaponry of missile power, the inaccuracy and overkill of the first cumbersome bombards and hand-guns of the 15th and 16th centuries must have seemed almost ludicrous. And yet the differences between the two situations are equally significant. Potent though gunpowder was, it was not a power to be wasted. From the beginning it presented a double challenge--to increase the output of energy, and to improve the efficiency of its use.

But nuclear energy offers an embarrassment of riches. It is difficult to find uses for its energy output which will not overreach the ultimate aims that can be envisaged for it, and, more to the point, which will not recoil upon the user himself. The challenge of nuclear explosives is, in short, one of reducing, not increasing, the yield. Progress has been made, of course, in developing low-yield weapons; but there is little incentive to improve efficiency, since the upper limits of destructive power remain so far above and beyond any conceivable use to which mankind can put them--except to destroy his own species.

Topic III. The revolution in firepower which bequeathed us the age of overkill was part of a larger movement. The past century and a half has witnessed probably the most fundamental revolution in warfare that man has experienced since war became an organized activity of highly organized

society.

Like most long revolutions, this one is actually composed of a series of four overlapping and interrelated lesser revolutionary movements.

(CHART - Military Revolution 2)

First, a revolution in manpower, which produced the modern phenomenon of mass armies--and, on a lesser scale, navies and air forces--the "armed horde," so-called, which so distressed Mr. Hoffman Nickerson a few years ago. To this revolution, a by-product of population growth, modern nationalism, and the modern centralized nation-state, Mr. Walter Millis has attached the ironic label, the democratization of war.

(CHART - Military Revolution 2)

Second, an economic, primarily industrial, revolution, based on a new technology of machines and power. Through the successive discovery and control of new sources of power--steam, electricity, internal combustion fuels, nuclear energy--and by harnessing these energies to machines, this revolution has mechanized industrial and agricultural production and transportation. Mechanization, in turn, has made it possible to produce in massive quantities the munitions, food, clothing, and other commodities needed in war, and to move them over immense distances. And, through the energy of electricity, we have acquired the power of virtually instantaneous communication over even greater distances. In short, the hallmarks of this economic-technological, or industrial, revolution are power, mass production, mass movement, and the annihilation of distance.

(CHART - Military Revolution 3)

Third, a scientific-technological revolution in weapons--really a

by-product of the economic revolution I have just described, but so devastating in its impact that we may legitimately think of it as a separate movement. Its major characteristic, as I have already shown, has been a massive increase in firepower.

(CHART - Military Revolution 4)

Fourth, and finally, a revolution in the techniques of management and organization. Operating in both the military and the civil spheres, this revolution has enabled modern nations to mobilize their material and human resources and to coordinate their use in what is sometimes loosely referred to as total war. In effect, it has enabled societies to maximize their war-making effort.

So, our military revolution consists of--

A revolution in manpower, which has democratized war;

An economic-technological revolution, which has mechanized and quantified war;

A revolution in weapons, which has multiplied firepower; and

A managerial revolution, which has maximized war effort.

(Chart off)

Now, these four revolutions did not occur all at once, and they have developed unevenly. It was the manpower revolution that had the most immediate and marked impact on war. What most impressed 19th century observers about the changing state of the art was the size of the armies, actual or potential, that could now be fielded by the major military powers.

This was something new in history. Except for the Mongol armies that

overran parts of Asia and eastern Europe in the 13th century, forces of more than 100,000 have been virtually unknown before the 19th century. Most of the figures cited by classical and medieval chroniclers have been proved to be pure fantasy. The most famous case is Herodotus' description of the army of Xerxes in the invasion of Greece in 480 B.C. For this force Herodotus tallied up with great precision a total of 2,641,610 fighting men, and about the same number of camp followers and servants. The German historian Hans Delbruck has pointed out that if a force of this size marched into Greece from Sardis in Asia Minor via the Hellespont, as Herodotus says it did, the van would have reached Thermopylae before the tail could even clear the starting point back in Sardis.

There is little doubt that the armies engaged in the final stages of the Napoleonic wars, in 1812, '13, and '14, were the largest known to history up to that point. Napoleon led 650,000 troops into Russia in 1812, and mustered almost as many for the Leipzig and Dresden campaigns the year following. Perhaps a million Frenchmen were conscripted in 1813 and 1814. What made this possible was the power centered in the revolutionary government of France and consolidated by Napoleon, supported by the patriotic popular fervor born of successful revolution, military victories, the threat of foreign invasion, and, more generally, the emotional force of French nationalism.

Let me read you part of the decree of the revolutionary French Republic in 1793 announcing the first levee en masse, or general conscription. "Henceforth," reads the decree, "until the enemies have been driven from

the territory of the Republic, the French people are in permanent requisition for army service. The young men shall go to battle; the married men shall forge arms and transport provisions; the women shall make tents and clothes, and shall serve in the hospitals; the children shall turn old linen into lint; the old men shall repair to the public places, to stimulate the courage of the warriors and preach the unity of the Republic and hatred of kings."

You will perceive that this has a somewhat different emotional flavor from another, more recent document we can all remember, which begins: "Greetings! A board of your friends and neighbors..." Some of you also may have noticed that the French Republic was conscripting only young and unmarried men. In our own day we do the job more thoroughly, and also more matter-of-factly.

Yet the idea of a nation in arms was a radical idea in 1793. It contains the germ of all our modern systems of conscription and selective service, under which nations in the 20th century have put 10 percent, 12 percent, and even larger proportions of their total populations into military service. It foreshadowed, too, the even larger mobilizations of civilian populations in wartime.

As the 19th century advanced, the manpower available for war uses swelled to immense proportions. In 1800 the population of Europe was about 188 million. By 1950 it had grown to 550 million. Actually, during the century between 1815 and 1914, there was relatively little mobilization of this growing manpower reserve. Our own Civil War, in which the North

put about 2.5 million men in uniform, and the South mobilized about 15 percent of its small white population, was an aberration in a period of generally short and limited wars.

This century also witnessed two quite different types of warfare--almost continuous conflict in colonial areas between small professional European troops and primitively armed native forces, and a considerable development of guerrilla warfare. Meanwhile, after 1870, most of the European powers adopted peacetime conscription and began to build up constantly larger reserves of trained military manpower, ready for instant mobilization. It remained for the world wars of this century to reap the harvest.

The economic-technological revolution spread rapidly through Europe and parts of North America during the century following Napoleon's downfall in 1815. In our own century, as you know, it has continued to spread through Asia, Africa, and Latin America. About the middle of the 19th century a revolution in weaponry also got under way--with the introduction of rifled firearms and field artillery, heavy siege and naval ordnance, and ironclad, steam-powered warships. All these played a part in our own Civil War, which also felt the first impact of the economic revolution--for example, in the military use of railroads and telegraph, and in mass production of infantry weapons, uniforms, shoes, and food.

Yet the scale of warfare remained generally limited through the 19th century, as compared to the tremendous latent war-making potential that the economic revolution was generating. Down to 1914 few suspected the

explosive energies that were building up beneath the surface. Those who did were led to conclude, like the Polish banker and economist Jean de Bloch, or the British journalist Norman Angell, that war under conditions of modern technology would be so fantastically destructive and expensive that it had become literally unthinkable. It simply would not pay.

But when in 1914 the industrialized societies of the Western World did plunge into war, the reality surpassed the most nightmarish predictions. As Winston Churchill has written in one of his most moving passages: "Events passed very largely outside the scope of conscious choice. Governments and individuals conformed to the rhythm of the tragedy, and swayed and staggered forward in helpless violence, slaughtering and squandering on ever increasing scales, till injuries were wrought to the structure of human society which a generation will not efface, and which may conceivably prove fatal to the present civilization..."

In the two world wars of this century, we see for the first time the impact of all four component movements of our revolution in modern warfare--manpower, production-transportation-communication, weapons, and management. In many respects, it was the revolution in management that catalyzed the other three.

I think you are all more or less familiar with the military side of this managerial revolution, because it has come to full flower in your own generation. It began toward the end of the 19th century with the appearance of permanent professional staff systems. Most of them--and I know this is painful to you Navy types--took as their basic model the German

general staff system, which grew out of the Prussian Great General Staff and was widely regarded as the key to German victories in 1866 and 1870. In the present century, of course, the managerial revolution has reshaped every aspect of military administration.

But it is in the civil sphere that the really central and catalytic development has taken place. Its typical manifestation is the wartime "super agency," as we used to call it back in World War I, with virtually absolute powers for coordinating large areas of civilian activity. The important point is that the subordination of private interests to public in time of national peril, and the regimentation of the activities of society in order to maximize the entire collective effort--these, in our own day, are developments of method and technique, not of principle. The principle was inherent in the powers of the centralized nation-state long before the method was dreamed of and before modern war made it necessary.

The most conspicuous phenomenon of the two world wars of this century, in which our military revolution reached maturity, was quantitative--the enormous amounts of material used and consumed. In the First World War this development caught almost everyone by surprise. The French general staff had planned on a daily requirement of 13,600 rounds for 75-mm. guns, and hoped the factories could reach this rate of output in about three months. Seven weeks after the war broke, the requirement was upped to 50,000 rounds--a rate that the factories were unable to reach until the following March--but long before then the general staff was demanding 150,000 rounds. All the belligerents experienced similar difficulties; and this, mind

you, was before the real holocaust of positional warfare began.

This factor of quantity is partly a result of the manpower revolution. If you mobilize ten million men instead of one million, you are going to need ten times as much food, clothing, rifles, and bayonets. But in other categories the increase went much farther.

Take firepower. Here the increase was partly a matter of heavier projectiles and more rapid fire by individual weapons, partly a higher ratio of weapons to men; and both these increases were multiplied by the larger numbers of men mobilized. In Napoleon's armies the ratio of artillery pieces to men had averaged three, sometimes five, to a thousand men. During the 19th century the average remained at about three. But by the beginning of World War I the armies on the Western Front had raised the ratio to six per thousand, and in some of the later offensives of that war it ran as high as twenty. Add the accompanying increases in weight of projectiles and rapidity of fire, the development of mortars and rapid-firing small-arms, and, in World War II, the development of air bombardment and rocketry, and you get some notion of the huge tonnages of metal involved in the growth of modern firepower. In World War I British and French forces on the Western Front expended in one average month more than twice as much artillery ammunition as did the Northern forces in the entire four years of the Civil War.

Mass and quantity are related directly to the destructiveness of the world wars of this century. The revolutions in manpower, production, transportation, and management served, in effect, to feed and multiply

the firepower inherent in the new weapons. It is worth noting, however, that the rounding-out of the whole military revolution in World War II reversed, to some degree, the trend toward destructiveness. With the return to mobility and more effective defensive weapons, the level of battlefield carnage dropped far below that of World War I. Cities and populations suffered more, through air bombardment, but this was more a result of overwhelming strength on the part of the attacker than of any inherent weakness of defensive weaponry and armament. And in World War II, despite mobility, strategic air power, and the open battlefield, defense on the whole retained its inherent and historic supremacy over offense--not merely through defensive weaponry, but more generally because of the immense quantities of mechanized armament, ammunition, and fuel needed to sustain offensive movement and firepower.

And now, the murky crystal ball.

The most significant feature of our present stage of military development is, it seems to me, the lack of harmony between our horrendous new weapons and the military systems on which they have been superimposed--systems that evolved and matured under earlier, less violent forms of warfare. What a contrast, for example, with the balance in technological development that was achieved in the 19th century, when destructive new weapons were complemented by the new technologies of production, movement, and communication. In short, we are experiencing an unbalanced, lopsided revolution, one which has threatened to upset the relatively stable system of war making that emerged in World War II.

But before we get all upset, let's look at some of the underlying continuities. Take, for example, the classic conflict between offense and defense. Historically, increases in firepower have tended to strengthen the defense, simply because firepower used defensively and supplemented by fortifications and defensive armament has usually been more effective than firepower used offensively. This trend has been given a curious new twist. Defense must now rely more than ever before on evasion, mobility, and dispersion, relatively less on weapons, armor, and fixed defenses. Even so, in land warfare, it seems to me, the new weapons have, on the whole, strengthened, not weakened, the defense through their power of inflicting crippling losses on attacking forces and smashing their communications and rear-area administration.

In air warfare, by contrast, the modern missile is almost as difficult to prevent from striking its target as missiles have always been. Until we get an effective anti-missile missile--a bullet to stop a bullet--the problem will be, as it has always been historically, to get the target out of the way of the missile, or to put some kind of barrier in its way. With a big, soft, fixed target like a city this is a little difficult to manage. But missile and air bases can be dispersed and "hardened," and launching platforms can be made mobile, and thus made extremely difficult to hit.

In fact, we are told, a modern strategic air force, unless caught with its defenses down, is virtually proof against total annihilation in a single surprise attack. Defense can still ensure, against offense, survival of the power to strike back. And in this assured retaliatory capability,

directed against almost defenseless cities, lies the deterrent power on which both we and the Soviets rely for survival--an interesting resurrection, by the way, of the ancient system of exchanging hostages. In this sense, it can be argued that, even in air warfare, nuclear firepower has strengthened the defense, since the power to deter attack is a more effective defense than the power to repel attack. And even if the deterrent fails, and retaliatory firepower is unleashed against cities, is this not merely a modern variant of the old-fashioned use of defensive firepower against the massed reserves and communications of an attacker?

What about mass armies and mass material? Here, admittedly, modern military systems seem to be moving in the opposite direction. Nuclear firepower makes massed manpower not only vulnerable, but to a large extent redundant as well. And even the evolving tactics of conventional warfare appear to contemplate a degree of mobility, dispersion, and technical diversity that is incompatible with the use of combat forces in large masses. On the material side, high-energy missile weapons tend to reduce quantity both in ammunition and in fuel, and equipment in general is becoming more and more intricate, expensive, and diverse. Every year we travel down this road makes it less likely that we will ever fight a war, to the extent that we fought World War II, with simple, standardized, mass-produced hardware, or squander expendable materials by the millions of tons.

But here, too, there are continuities. When we think of World War II hardware, we usually think of the major standard items used in large numbers--

the Sherman tank, the howitzer, the 2 1/2-ton truck. We may forget that in that war our army procured 900,000 separate items of supply, and not all of them were things like screwdrivers and bayonets. Some fire-control instruments contained as many as 25,000 precision-made parts. In other words, simplicity, standardization, and mass are relative terms, and the trend toward complexity and diversity started long before World War II.

It is well to remember, also, that ammunition has never been one of the major quantity factors in war, even in the present century, when, for the first time in history, ammunition has become heavier than food. In the Civil War, the average daily ammunition requirements of Sherman's army in the Atlanta campaign were only one pound per man, as against three pounds for food. Meanwhile mechanization, one of the basic continuities in the military revolution of modern times, has proceeded at an accelerating pace since World War II, adding weight and bulk not only in hardware, but, what is vastly more important, in fuel. Fuel, and its historical predecessor, forage, have always been the overriding military load factor, the perennial headache of transport quartermasters since war began. Fuel requirements are self-generating, since fuel is needed to transport fuel. In World War II, fuel made up more than half the total weight of resupply and replacement requirements for our forces overseas, not counting fuel for transoceanic shipment.

How far will the reduction of fuel requirements through high-energy misselery offset the increase through mechanization? I have no idea;

perhaps some of you do. But to me, the best hope for a solution to the fuel problem in modern warfare lies in nuclear energy, applied on a large scale to transportation. This would amount to a technological breakthrough comparable to the railroad or the internal combustion engine. We have made a start--with nuclear-powered submarines, surface vessels, maybe aircraft. But it will be a long time before the slow pace of peacetime technological development produces nuclear-powered carriers in sufficient numbers to move military freight on a large scale. And how long will we have to wait for nuclear-powered land vehicles?

On the manpower side, too, let's not write off numbers entirely. The atomic battlefield, when it materializes, is going to be pretty broad and deep, and we may need a fair number of troops, however mechanized and mobile, to cover it. One imaginative military writer recently described the nuclear Armageddon of the future as ranging over the greater part of the steppes of central Asia. Besides, we will have to replace casualties, and man the rear areas and the home front. All that could add up to a lot of people, both in and out of uniform.

Actually, it seems to me that psychology and history alike argue against the probability of large-scale nuclear warfare. My outlook is somewhat cheerier on this score than the one Professor Arnold J. Toynbee offers us--and since this is open season for Professor Toynbee, I may as well have a go at him, too. War, according to Toynbee, is both a symptom and a cause of a civilization's decay. The high incidence of wars in modern Western civilization during the past four or five centuries

is proof, to him, that we have been marching steadily downhill all that time.

The breakdown began, he believes, with the ferocious religious wars of the 16th and early 17th centuries. The exhaustion caused by these wars brought a long interlude of peace and partial recuperation, with infrequent, relatively restrained wars waged as a kind of "sport of kings"; but this came to an end late in the 18th century with the outbreak of the violent nationalistic wars growing out of the French Revolution. The age of nationalistic wars, Toynbee asserts, continued through the 19th century, reached a climax in the world wars of our day, and shows no sign of abating.

This is the pattern of rout-rally-rout that Toynbee discerns in the breakdown and collapse of sixteen earlier civilizations. Of the seven that he recognizes as being now in existence, only our own is really alive and kicking; and Toynbee seems to have little doubt that we, too, are far gone in our "time of troubles." Barring a return to religion, he regards the end as inevitable. It will come either suddenly in a great nuclear Gotterdammerung, or drag out for centuries in the bleak regimentation of a world secular state.

Now, to begin with, this is bad history. The 19th century, which Toynbee describes as a period of increasingly ferocious nationalistic wars, was actually, after 1815, an even more peaceful interlude than the late 17th and 18th centuries, which Toynbee regards a rally between two routs. But why, in any case, must all war be regarded as a symptom of decay?

War, it appears to me, has proved, on the contrary, to be exceedingly useful to mankind, as a means of resolving conflicts between groups and societies for which no other institutional remedy has been effective. Very rarely in history has war been waged without substantial restraints, observed on both sides, which mitigated its inherent violence. Rarely has it been waged without rational and limited objectives on both sides which imposed penalties but not ruin upon the loser. The world wars of this century are disturbing because they have gone so far beyond the traditional limits. We have no guarantee that the next one will not go even farther. But neither is this a foregone conclusion; and I see no reason for accepting a deterministic view of history--such as Toynbee's, or Spengler's, or Karl Marx's--which imposes such a conclusion upon us. To me it seems far more reasonable to expect that governments and peoples, faced with the visible consequences of two destructive world wars and the awful potentialities of a third, will return to traditional, more limited forms of warfare.

Fundamentally, of course, this is more an expression of hope than a prediction. Historians sometimes make bad prophets--or at least unconvincing ones--and war is an especially treacherous field for prophecy. In our own day, if I may borrow a quip from one of my colleagues, war is not only nuclear, but notable unclear.

But the problem was best expressed by the greatest military philosopher of them all--I had to work Clausewitz into this lecture somewhere--who, with unwonted simplicity, said: "War is an unexplored sea, full of rocks which the mind of the general may sense but which he has never seen with

his eyes, and round which he must now steer in a dark night."

Thank you.

CAPT. HYDE: Dr. Leighton is ready for your questions.

QUESTION: There are other methods for mass destruction, namely, chemical and biological. Why is it that you failed to comment on them as accelerating the revolution?

DR. LEIGHTON: Well, it seems to me the two go hand in hand. My whole emphasis was, of course, upon atomic because it seems to me that they are the most conspicuous and significant aspects of the current revolution in firepower. My fleeting reference at the end to high-energy systems was supposed to include that; and I must confess that consideration of time and space has had a large influence upon the selection and emphasis on topics here.

But essentially it seems to me they move in the same direction--that is, speed of delivery, increased range, great destructive power--although they have the immense advantage, both of them, of killing or incapacitating poeple without destroying property.

But, quite frankly, I feel out of my depth in this field of CBR weapons because it is so closely guarded and classified. I am reluctant to try to analyze its implications in an historical context.

QUESTION: In your chart on efficiency you call this the age of overkill and you have the curve dropping down to zero. I notice the curve starts to point upward just a little bit. Are you thinking of changing

concepts, or is that merely due to technological improvements?

DR. LEIGHTON: The latter, I have in mind simply the development of low-yield weapons and improvement in accuracy of delivery--those two facets.

QUESTION: Your feeling is that limited war seems to be the outlook in view of the nuclear capability on both sides. But in looking into your crystal ball do you see the elimination of any kind of active warfare and resort to the United Nations type of settlement of differences?

DR. LEIGHTON: I believe that is the possibility that Toynbee has in mind in what he has to say about the possibility of a universal world state. And he has written, as a matter of fact, upon the possibility of the U.N. evolving in that direction.

My opinion on this I think is not worth particularly much, at least no more than any of yours. I don't think so; no. I don't think there's any real possibility of eliminating war. One the basis of history it seems to me far more likely that we will continue to use war as we have used it in the past up to this century. This century is quite obviously an aberration. It can be only a matter of opinion, and of faith perhaps, that mankind will revoil from the implications of the kind of warfare we have known in the 20th century, at least in the two world wars. Remember, we've had other wars--little ware--in this century besides these two world wars. I think mankind will recoil from this kind of warfare and revert to more limited, traditional forms.

QUESTION: Would you comment on the difference between Spengler's thesis and Toynbee's?

DR. LEIGHTON: Well, we don't have three hours, but I can make one or two points.

Spengler is fundamentally more pessimistic than Toynbee, I believe. At least explicitly. He's more explicitly pessimistic than Toynbee. He believes, and explicitly says so, that our civilization is decadent, that all our great achievements have been in the past. Toynbee doesn't say this quite as emphatically or in as much detail. And he does hold out some hope. He doesn't predict definitely that we are headed for catastrophe. He reserves one grain of judgment on this.

But the main difference between the two, I believe, is that Spengler's conception of civilization is organic. He believes a civilization follows the birth, life, and death cycle of animal organisms. He says this quite explicitly and definitely. Toynbee rejects this altogether. He sees no organic analogy whatsoever. A civilization to him is a congeries of cultures, with emphasis on unifying forces. And many of his critics have said that, even though he doesn't admit it, he really does have an organic conception of civilization. But he denies it, and certainly his conception is not as much so as Spengler's is.

QUESTION: In your discussion of offense and defense I got the impression that you thought that defense had been improved by the increased firepower. I was under the impression that offense was further improved and overcame firepower by mass. I don't think that defense now is in the best position over offense with nuclear weapons. Do you mean that defense has supremacy over offense?

DR. LEIGHTON: With qualifications. It's perhaps a subtle point. On the face of it, offensive firepower has gained a tremendous ascendency. But you always have to remember that, at least by the rules of the game, when you are analyzing the relative strengths of offense and defense, that both sides can use the same weapons. So you have firepower pitted against firepower. And it did seem to me--and this is just an opinion--that in land warfare on the whole the defense preserves its historic ascendancy, because the defender can inflict more damage on an attacker than vice versa.

In air warfare you have a peculiar situation in which firepower is directed not primarily against the forces wielding the weapons, but against their bases and against their supporting establishment--the whole rear area; and that introduces this element of the deterrent, in which it seems to me that as long as there is an assured retaliatory capability, an attacker cannot completely annihilate his opponent in one attack. There will be a capability for striking back. As long as this is the case, the retaliation can be directed against cities, which are in effect held as hostages, and that means that in a sense defense is strengthened because the power to deter attack is stronger than the power to repel. However, even beyond that, if the deterrent fails and retaliation is unleashed against cities, that to me is essentially the same as the historic use of defensive firepower, not against the immediate forces of the attacker, but over his head against his mass communications, his mass reserves, his whole rear area problem.

QUESTION: You have been reluctant to cast yourself in the role of a

prophet, but regarding these remarks and others, are you sufficiently optimistic to believe and suggest that high-yield nuclear weapons will not be used in warfare?

DR. LEIGHTON: Yes, sir; I am. As I say, this is something that can't be proved. In fact, I see little point really in speculating much about it, because the evidence is there on both sides. It's a question of how you personally weigh the probabilities one way or another, and every individual must make his own judgment. That would be just my feeling, intuitive perhaps, that it is unlikely on the whole, in view of our historic experience, that we will resort to large-scale nuclear warfare.

QUESTION: Do you think that we will use tactical weapons, so-called small weapons, and will that lead to a case like the boy that said, "We'll play this game. You slap me and I'll slap you," and one slaps a little too hard and the other says: "Well, if you use a bigger one, we'll use the next size up."?

DR. LEIGHTON: I think all the probabilities point toward the use of nuclear weapons in many sizes short of the ultimate up to some level, and I wouldn't attempt to say where the level lies, even though Mr. Kissinger has tried to, but a level beyond which it is not feasible, or beyond which it is dangerous to go. And I think that is the point on which I think most of his critics have attacked him.

But, more generally, it seems to me it's inevitable that atomics will be used; and every year we move down the path of developing weapon systems and forces which are trained and geared and organized for the use of atomics, the more difficult it is to go back to conventional warfare.

But I don't see any inherent reason why the limited use of atomics should lead progressively to the ultimate catastrophe. That's just an opinion.

CAPT. HYDE: If I may interject: Do you mean that particularly if the person on whom the nuclear weapons are used cannot retaliate in kind?

DR. LEIGHTON: I think it's very unlikely that he will not be likely to retaliate.

QUESTION: Doctor, you mentioned that in all these revolutions there are always many, and may be more, of the old ideas that are not given up than there of new ones accepted. We are spending a great deal of our national effort on the production of firepower. Yet there's a great deal of talk of limited war and, as you have mentioned, clean kill with smaller weapons. Would you say that this clinging to the idea of limited war and of the older weapons is possibly an attempt on our national part to cling to the old order rather than to accept some of the new ideas of this industrial revolution?

DR. LEIGHTON: The traditional element here, it seems to me, the survival of established and old ways of thinking, old outlooks, applies and will apply, in my opinion, to the form and intensity of warfare. That is the reason I think we will have limited and traditional forms of warfare. But this does not exclude, in my opinion, the use of the modern weapons. It supposes, it implies, limited use of these modern weapons. This is what I believe to be possible. In other words, going back to the point or the principle that I think I made--that destructiveness is not primarily a result of the capa-

bilities of weapons, but of the manner in which men use them.

QUESTION: Then does that mean that you do not agree with the national policy of massive retaliation in the event of hostilities?

DR. LEIGHTON: What I'm talking about, sir, is a question of what I regard as probabilities in the light of the historical past, not of what we should do and what should be a matter of policy. In fact, if you recall, my analysis of the probability was based or leaned very heavily on the fact that all-out attack in all probability cannot completely obliterate the capacity to retaliate; and that the assurance of being able to retaliate is the best deterrent against the attack occurring. This is simple arithmetic, it seems to me. It's not a question of the policy at all, it seems to me. It's a matter of what's probable, what's likely to occur.

QUESTION: Referring to the density of population which is growing up in the world today--I don't know whether you touched on it--more and more nations are getting atomic capability and are able to hide their offensive and defensive sites pretty well all over the world. Does this augur that even in limited war we will have many more casualties than we possibly had in the past, considering that there will be tactical weapons or larger weapons all over the globe to knock out a power?

DR. LEIGHTON: It seems likely on the whole that casualties, at least at the beginning of a period of nuclear warfare, would rise, just as they did in the Civil War with the advent of rifled infantry weapons and improved artillery. Until tactics were developed which could counter the increased firepower, the casualties mounted at a terrific rate. And then,

of course, there's the whole matter of the civilian area.

Well, we really have to consider this question in two aspects, don't we? First of all on the tactical, the military side, I think tactics will evolve which will make it possible to keep casualties at an acceptable level.

In the area of population--cities and population centers--there again we simply come back to my original point. As I said, I don't believe that it can be predicted with any assurance on the basis of the evidence, but the matter of where you think, of the basis of long historical tradition, the probabilities lie. They lie, I believe, in a determination by governments and people to prevent war from going to the ultimate limit of mass destruction.

CAPT. HYDE: I think our time has run out. Since this lecture is the conclusion of the series on modern warfare and strategic concepts, I like to hope that you will hold on to such notions you may have gotten, so you can use them in the final problem. And I should like to thank Dr. Leighton for his highly calorific food for thought.

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