(2)

Back To The Future: Using Attack Helicopters To Restore Shock To The Battlefield

A Monograph
by

Major Vincent K. Brooks
Infantry

School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

First Term AY 91–92

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	14/12/91	MONOGRAPH

4. TITLE AND SUBTITLE
Back to the Future: Using Attack Helicopters to Restore Shock to the Battlefield (U)

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJ Vincent K. Brooks, USA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Advanced Military Studies
ATTN: ATZL-SWV
Fort Leavenworth, Kansas 66027-6900
Com (913) 684-3437 DSN 552-3437

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

~~See attached~~

14. SUBJECT TERMS
Shock action
Cavalry
Helicopters
Maneuver warfare
Attack helicopters
Armored warfare

15. NUMBER OF PAGES
58

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Vincent K. Brooks

Title of Monograph: Back to the Future: Using Attack Helicopters to Restore Shock to the Battlefield

Approved by:

Randolph B. Wehner

Lieutenant Colonel Randolph B. Wehner, M.A., M.M.A.S — **Monograph Director**

James R McDonough

Colonel James R. McDonough, M.S. — **Director, School of Advanced Military Studies**

Philip J. Brookes

Philip J. Brookes, Ph.D. — **Director, Graduate Degree Program**

Accepted this 24th **day of** December **1991**

ABSTRACT

Back to the Future: Using Attack Helicopters to Restore Shock to the Battlefield by MAJ Vincent K. Brooks, USA, 58 pages.

The introduction of attack helicopters to the battlefield opened a new dimension for ground combat forces. This monograph examines history to identify those characteristics that make an arm effective in the shock role and to assess the modern battlefield to determine if attack helicopters possess these characteristics in a manner which makes them the arm which can be best used in the shock role now and in the future.

Beginning with a definition of terms as a point of departure, the monographs traces the historical development of shock arms, focusing on the evolution of cavalry, to glean the characteristics that make an arm effective in the shock role. The historical examination is divided into three eras -- the era before the sixteenth century, the era from the beginning of the sixteenth century to World War I, and the era from World War I to the present. The discussion of the third era focuses primarily on the development of tanks as successor to cavalry in the shock role.

From the historical analysis three characteristics and two conditions emerge to form the thread of continuity between one effective shock force and another. The three characteristics are superior mobility, ideally orders of magnitude greater than that of any opponent; equal or superior weaponry; and a degree of protection sufficient to permit the other two characteristics to be brought to bear against the enemy. The first of the two conditions is the ability to attack with unexpectedness, that is, at an unexpected time or place or from an unexpected direction. This is vital to multiply the effectiveness of an arm possessing the three characteristics. The second condition is the correct environment, that is, proper tactics and leadership to employ the arm in a way that will optimize its effectiveness. The historical characteristics of a shock arm form the bridge to connect the past with the future. The monograph uses these characteristics to evaluate modern attack helicopters and their potential for use as a shock arm.

The monograph concludes that the ability of a ground arm to operate effectively in the shock role is declining because of an imbalance in the historical characteristics of an effective shock arm. The attack helicopter, though not fully mature in its development, currently possesses the characteristics in a consonance that has not been seen since Genghis Khan's Mongols invaded the west. If shock is to remain a useful aspect of warfare in the future, attack helicopters are the arm that will make the restoration of shock possible. Finally, the monograph predicts how long attack helicopters can dominate the battlefield as the shock arm of the future.

TABLE OF CONTENTS

PART I.

Introduction

"The commander in the field no longer has an element of his force which, although not large in terms of numbers, stands out from the rest in mobility and fighting power."

Generalleutnant Dr. F. M. von Senger und Etterlin[1]

Throughout military history armed forces achieved decisions on dynamic battlefields by applying their most effective arm as an instrument of shock. The effectiveness of the particular instrument tends to rise and fall until it either becomes ineffective as a shock arm through normal evolution, increased vulnerability to other arms, or through compensations which detract from its unique capabilities; or until it is replaced by a more dominant arm. In either case, the application of shock effect becomes very limited. To restore shock to such a battlefield requires recognition of the point at which an arm ceases to dominate and also the existence of another arm which could potentially dominate. The purpose of this monograph is to examine history to identify those characteristics that make an arm effective in the shock role and to assess the modern battlefield to determine if attack helicopters possess these characteristics in a manner which makes them the arm which can be best used in the shock role now and in the future.

To form a common basis of understanding with the reader, the monograph begins by presenting a definition of shock and any related terms that require a definition for clear understanding. "Shock" terms are common to the lexicon of most militaries, but the meanings of these terms are not as commonly understood. The resultant definition applies throughout this monograph.

Once the terminology is clear, the monograph continues with a historical analysis of the development of shock arms. Cavalry will be the focus of the analysis, although some other arms will be addressed whenever they played a role in developing as shock arms. The purpose of this analysis is to glean any threads of continuity that characterize an effective shock arm. Since shock arms do not maintain their effectiveness indefinitely, some additional threads may become apparent by analyzing why arms declined in effectiveness. For ease of focus, the historical analysis will be oriented on three eras -- the era before the sixteenth century, the era from the beginning of the sixteenth century to World War I, and the era from World War I to the present. The discussion of the third era will focus primarily on the development of tanks as successor to cavalry in the shock role. The product of these analyses will be some distilled characteristics which may then be used to evaluate modern attack helicopters and their potential for use as a shock arm.

As is the case with the three phase historical analysis, a review of the development of the attack helicopter should also yield any unique characteristics or limitations. These will help establish the link between the characteristics of the historical shock arms and those of attack helicopters. Technical analysis provides the reader with an appreciation for the system capabilities and limitations, forming the basis for a subsequent analysis of how well or poorly attack helicopters embody the characteristics of shock arm. If an answer to that question is attainable, the focus will shift to how long attack helicopters can be expected to dominate the battlefield as a shock force and what historical problems, if any, will cause them to wane in effectiveness.

To establish the connection between the past (cavalry and the historical shock arms) and the future (attack helicopters), the monograph will show how the attack helicopter embodies the historical characteristics necessary for shock unlike

any other system preceding it in the 20th Century. A consideration of tanks as a shock arm must necessarily be addressed. Finally, the writings of several military thinkers and theoreticians will provide a conception of future conventional warfare which I will use to describe the future of attack helicopters.

PART II.

Definitions and Terminology

The terms "shock effect", "shock action", and "shock" are common to the lexicon of most militaries. The meanings of these terms are not as commonly understood. All connote a similar dynamic and all successfully convey their intended idea, yet definitions are lacking to specifically state what they are. Since there is no single definition for these terms, several interpretations are presented and combined into a single definition which will be used throughout this monograph.

Major General (later Field Marshal Sir) Douglas Haig describes an action in the battle of Custozza in 1866, during the Austro-Prussian War, which reveals something of this undefined effect. He says, "the moral effect, the shock produced by their [Austrian cavalry squadrons] impetuous charge, was such that the whole corps [3d Italian Corps] which was commanded by Prince Humbert was disorganized and paralyzed for the rest of the day. Sixteen squadrons rendered 25,000 immobile."[2] This statement reveals that shock effect is a moral effect which a force lacking superiority in numerical strength may inflict; and it has two symptoms -- temporary paralysis and disorganization.

Richard Simpkin describes shock action as an "extreme concentration of firepower in time and space" which is compounded by surprise and applied when one opponent is off balance, that is, when his commitment and momentum are high, but he cannot react quickly or appropriately.[3]

Used as a noun, shock means an "intense mental, emotional, or physical disturbance resulting from stress" or "the complex emotion aroused by the strange and incomprehensible and especially the awe-inspiring." As a verb, shock means "to strike or to fill with fear or dread."[4] All of these usages are consistent with the traditional view Americans and Europeans take toward shock. The Soviets take a slightly different view toward shock.

One of the Soviet elements of battle is *udar* which is translated into English as both "shock" and "strike," but its meaning has no exact equivalent since the associated military concept is rarely used in Western countries. It is broader than our view and specifically refers to the physical and psychological effect of violence on an enemy. To the Soviets, shock action is the combined effect of violence and surprise. Shock has three forms: nuclear shock (*iadernyi udar*) caused by nuclear weapons, fire shock (*ognevoy udar)* caused by conventional air or ground weapons, and troop shock (*udar voisk*) caused by mobile armored ground forces.[5]

Of the three uses, the last two relate closest to the western view. However, the difference comes in the usage of shock action. Westerners traditionally use shock action to achieve a decision or to complete the defeat of a losing enemy. The Soviets use shock action to break apart enemy units so that other attacking units can later defeat them in detail. Although one can make clear distinctions between the differing concepts, certain aspects are apparent in both and will help to shape the definition I will use.

For the purposes of this monograph, **shock** is defined as the temporary physical and/or psychological paralysis experienced by a military force when an opposing force encounters it under surprising conditions, concentrated in space and time in a way for the opposing force to use its weaponry with devastating effect. This paralysis causes an inability to take appropriate action and often leads to disorganization. **Shock action** is the action taken to induce the paralysis. **Shock**

effect is the combination of the action to cause paralysis, the paralysis itself, and the result of the paralysis. A **shock arm** is a somewhat homogeneous force which can achieve shock effect, and it may have less numerical strength than the force it is affecting. Having thus defined these key terms,the quest begins to discover what gives an arm the potential for becoming a shock arm.

PART III.

The First Rise of Cavalry

To discover the evolution of shock arms one can scour the annals of military history and find many examples in which an arm dominated the events on the battlefield through the timely application of shock. This section traces that evolution through several different arms. The focus, however, will be on cavalry as the *prototypical shock* arm because it clearly is the arm that is historically connected to the term shock.

Cavalry dominated the battlefield for centuries. The period of domination was not uncontested though. A study of cavalry's history reveals the reasons why cavalry held its dominant position for so long. The lineage of shock arms must be traced well back into ancient history.

The earliest example of a developing shock arm is the use of chariots. They were first developed as mobile platforms for archers and spearmen, and continued to serve as transportation until late in the Greek period. As time went on, chariots became the principal shock weapon of most Asian armies, combining mobility, shock action, and the firepower of archers.[6] Their principle use was knocking down or running over opponents. The vulnerability of their horses gave them limited value; but when they were used at the right time and place, they won many battles. Around 1000 B.C cavalry appeared on the battlefield solely to carry

noblemen to and from battle. The chariot was still the principal shock arm and allowed attackers such as the Assyrians to move faster than anyone else engaged in the battle to deliver the most effective weapons of the era. The dominance of the chariot lasted until the Roman Empire rose in power.[7]

From 1000 B.C. until 600 B.C. cavalry continued to be the smallest arm in most armies, serving the sole purpose of carrying the nobility into battle. By 600 B.C., however, cavalry began playing a major role in the central and southwest Asian plains where the Persians and Chinese used them to counter mounted barbarians. By Cyrus' time (538 B.C.), heavy cavalry and mounted archers in Persia were the world's best. In fact by the early Christian era the horse archer dominated warfare in this region. When used against the disciplined masses of Greek, Macedonian, or Roman infantry, however, heavy cavalry could not consistently win.[8] Perhaps the missing ingredient was skillful leadership or discipline in the cavalry. This ingredient was no longer lacking when Philip became King of Macedonia.

The Macedonian army under Philip, and later Alexander the Great, had two heavy cavalry bodies which were used for shock effect. They were the Companion cavalry, so named because it accompanied the king into battle and the Thessalian cavalry, a collection of mercenaries who were excellent horsemen and fought for Macedonia.[9] Both of these bodies had more discipline and cohesion than the rest of the Macedonian army and comparable cavalry bodies in other armies as well. Through their discipline they achieved greater mobility and struck as a more organized entity.

An excellent example of ancient cavalry being used effectively as a shock arm is in the battle of Adrianople in 378 A.D. When Roman auxiliary archers prematurely opened fire on a Visigoth negotiating party which was sent to buy some time, the battle began with neither side ready. The Romans were only

partially deployed when Valens, Emperor of the East Roman Empire, ordered a general attack which caused the two opposing forces to become locked in fierce combat.

At about that time, the main force of the Gothic cavalry arrived on a piece of high ground overlooking the battle area. The Gothic cavalry, summoned from a foraging expedition, then attacked at its fullest speed on the Roman right wing cavalry and swept them from the field. The Gothic cavalry charge was so violent and powerful that it threw the entire Roman army into disorder. The Gothic cavalry continued against the Roman left flank cavalry. The Visigoths then counterattacked against the Roman infantry. The Roman cavalry was routed and left the infantry flanks exposed. The Roman infantry was then forced against its own center. Wedged together and still not fully deployed out of march column, the Romans were crushed and unable to use their weapons or to flee. The Roman losses were catastrophic. Valens the Emperor, his chief officers and approximately forty thousand men were killed, leaving only a thousand Romans to escape the battlefield.[10]

The weapons used at Adrianople were not new, but their employment in combination with the full use of mobility multiplied their effects enormously. Colonel Trevor Dupuy puts forth four elements which decided the outcome of the battle. They were, "maneuver (which brought the mass of cavalry from a distance toward the enemy's flank), surprise, a flank attack, and the violence of the lancer's charge."[11] Colonel Dupuy's analysis gives the first set of clues as to what might give an arm the ability to operate as a shock force, since these elements formed the basis of cavalry tactics for the next ten centuries.

By the beginning of the sixth century, heavily armored Roman cavalrymen carrying lance, sword, shield and bow came to be known as *cataphracts* which became the mainstay of the Byzantine armies for centuries and were arguably the

most reliable soldiers of the Middle Ages. The cataphract combined firepower, discipline, mobility, and shock action capability.[12] Once again these characteristics are visible in a cavalry force. The cataphract's combination of lance, sword, and bow gave it the weaponry to attack with "stand-off", at close range, and at long range, respectively. Like the Macedonian cavalry, the cataphract's discipline allowed it to move and attack cohesively. The mobility advantage provided by horses is clear. Together, these attributes coupled with surprise gave the cataphract a great shock capability. This type of organization became the developing trend in the early Middle Ages.

As the Middle Ages progressed, little changed in European cavalry with the exception of the temporary increase in discipline and efficiency during the reign of Charlemagne. After his death, the European cavalry was given a new reason to improve -- the invasion of Vikings from the north and Magyars from the south. Both invaders initially met with some successes, but rapid improvements in European cavalry eventually negated those successes. The professionalization of European cavalry allowed heavy cavalry to use its greater mobility and shock power to fight the Vikings on equal or better terms, even outnumbered. The Magyars presented different challenges to the European heavy cavalry.

The Magyars were Asian horsemen who raided like Asian horsemen had for centuries. Their mobility was superior to that of European cavalry and their use of the bow gave them an advantage by allowing them to encircle the slower European cavalry and harass them until casualties, exhaustion, and frustration combined to cause gaps in the cavalry formation. These gaps were then immediately exploited by the Asian raiders. The Magyars conducted long raids, relying on speed and rapid changes of direction to avoid European cavalry concentrations with the expressed desire of avoiding a decisive fight. Eventually, European heavy cavalry improved its effectiveness and mobility and the raids became ineffective.[13]

This segment of history further reveals that the force with the greatest mobility and most effective weaponry can dominate even when outnumbered. It also shows that when the difference in mobility is reduced, the ability to achieve a shock effect is also reduced. A connection must exist, therefore, between the degree of mobility difference and the effectiveness as a shock arm. Perhaps the best illustration of this connection is the Mongol conquests.

In the late twelfth and early thirteenth centuries, Temuchin, son of Yekutai, (commonly referred to as Genghis Khan) developed a new kind of mounted force that swept away the Persian empire and eventually conquered large parts of Europe. No significant weaponry innovations accompanied Genghis Khan's Mongols; yet their successes captured an empire which stretched from Armenia to Korea and from Tibet to the Volga.[14]

The advantage came in the simplicity of their organization and their use of existing weaponry. A typical Mongol army was roughly forty percent heavy cavalry for shock. The horsemen and their horses, were equipped with leather armor and armed with the lance, supplemented by a scimitar or a mace. The army's remaining sixty percent was light cavalry for reconnaissance and security.[15]

To enhance the army's already extraordinary mobility, each Mongol trooper had one or more spare horses. The horses were somewhat smaller than European horses, but were faster as well. This combination of speed and redundancy let the Mongols move at unprecedented rates and distances.

Mongol discipline was far higher than any other army of that era. The troopers were trained well enough to fire accurately while on the move. The horses were unusually adaptable and could sustain themselves for extended periods of time, thus adding even more range. Naturally, this freed the Mongol armies from needing heavy trains to follow their movements. Even the burden of siege artillery

was kept to a minimum by training engineers to construct the weapons from local materials whenever they were needed.

As a product of all these measures, the Mongols possessed a mobility that was orders of magnitude greater than that of any army from that time forward well into the twentieth century. The Mongols exploited their mobility through the use of a singularly well-developed intelligence system and reconnaissance that operated as much as a hundred miles ahead of the fighting force.[16] This allowed the Mongols to move dispersed and concentrate forces and arrow fires at decisive points.[17]

The Mongolian tactics were simple. Once the reconnaissance or intelligence located the enemy, the Mongols would converge on the enemy force. Light cavalry would bombard the enemy force with deadly arrows and javelins to get it off balance and then surround it as much as possible. On a synchronized signal, heavy cavalry would attack the enemy center and light cavalry would attack from all sides.[18] The result was usually a rout.

To the great fortune of Europeans, Genghis Khan's death and the subsequent council to select his successor required the Mongol leaders (and their hordes) to return to the east, whence they came. The unexpected withdrawal of the Mongol hordes is all that spared Europe from unfathomable slaughter. No one ever found a way to stop Genghis Khan's armies which embodied an almost perfect combination of firepower, shock action, and mobility.[19] The lessons one can draw from the Mongol conquests are consistent with those that were identified by earlier examples, but are perhaps brought into better focus.

Mobility differential, more so than mobility in general, is the first key ingredient for a shock arm. The second ingredient is an effective means of delivering blows to the enemy that takes advantage of the mobility differential. This is more important than just having better weaponry, since, as the Mongol example shows, common weapons delivered by a force with considerably more mobility can

have a devastating effect. The third ingredient is the ability to attack unexpectedly from any direction. The possession of all three ingredients to an extraordinary degree accounts for the unusual success the Mongol armies enjoyed.

The rise of cavalry as a shock arm reached its zenith in the Mongol conquests, but the resurgence of the infantry had already begun in the middle of the thirteenth century. Two sets of developments, all technological, led to the decline of the cavalry and the restoration of infantry as the dominant arm on the battlefield.

In the first set of developments, three old infantry weapons -- the crossbow, the longbow, and the pike -- improved to the point which deprived the cavalry lance of its supremacy and caused the cavalry to seek greater protection. In the second set, the need for more armor protection found satisfaction in a shift from chain mail to plate armor (entirely missing Genghis Khan's example of lighter weight leather armor). Horses, also armored, carried roughly 150 pounds of additional arms weight as well as the rider's basic weight.

To complicate matters, the horse breeds which the Crusaders created by blending European and Arabian stock became diluted and then dwindled in numbers. In other words the horses simply were not up to the task. Both of these cavalry related developments caused the cavalry to slow significantly and destroyed the mobility advantage that provided cavalry with its means of domination on the battlefields of the thirteenth century. Mobility was sacrificed for protection even though mobility was the essential characteristic of the cavalry.[20]

The battle of Crecy in 1346 marks the clear culmination of the cavalry as a shock arm and the ascendancy of the infantry into the vacated position. In this battle, English longbowmen as the critical element of a dismounted army defeated the most formidable of French cavalry. Following the ascendancy of British bowmen at Crecy, the Swiss further demonstrated the decline of cavalry by

repeatedly defeating first Austrian, then Burgundian cavalry over a period of a century and a half.

The Swiss, armed principally with pikes and halberds gained unusual mobility for a foot force. They used small flexible formations which were easily maneuvered while marching to a cadence (one of the earliest examples of this). This speed and flexibility allowed them to attack their opponents before the enemy's lines could even form. Their weapons were extremely lethal, even to armored warriors. No other infantry of the day could equal the momentum and speed the Swiss could muster. They returned shock to the ground and made infantry an offensive arm for the first time since the Roman legions yielded to cavalry.[21]

This example reveals more clues about the nature of an effective shock arm. The forfeiture of mobility for protection narrowed the advantage the cavalry held over the infantry. The improvement in infantry weaponry further deteriorated this advantage. Accordingly, the ability of an arm lacking these ingredients to operate as a shock arm is exponentially diminished. The example of the Swiss infantry further confirms the need to combine a mobility differential with lethal weaponry. It seems to imply a balance between these two characteristics as well. Namely, if the mobility differential is not significant, then a greater advantage in weaponry is necessary for a force to produce a shock effect. If the mobility differential is great, then ordinary weapons well-used are sufficient to achieve the same effect.

Cavalry could very easily have been eliminated at this point. Clearly, it had become an obsolescent arm for shock purposes. Fortunately, some westerners observed the effectiveness of relatively lightly armed cavalry used during the fifteenth century Turkish Wars in eastern Europe, which combined the discipline and shock power of heavy cavalry with the mobility and flexibility of light cavalry. This recognition began a series of transformations in the European cavalry which

did not really come to fruition in the form of regained battlefield effectiveness until the seventeenth century.[22]

PART IV.

The Return of Cavalry

In the first half of the seventeenth century, European cavalry, like that of Oliver Cromwell, was unable to produce a shock effect. The cavalry charge was essentially a mutual approach to pistol range, followed by a sword against sword engagement. In this environment, numbers decided the outcome of battles and no shock ever occurred. The true spirit of the cavalry suffered as a result.[23] Lieutenant General Frederick von Bernhardi described this effect in his 1909 book Cavalry in Future Wars. He says, "In the power of holding the balance correctly between fire power and shock, and in the training for the former never to allow the troops to lose confidence in the latter, lies the real essence of the cavalry spirit."[24]

Between Cromwell and Frederick, cavalry sunk to an all-time low. Infantry enjoyed confidence in its abilities and in its improved weapons. Charges against infantry came at a moderate canter or trot and often failed. The Turks in the meantime did not lose the cavalry spirit. They still charged recklessly at full gallop and generally sabred all they encountered. The Austrian infantry greatly feared the Turks as a result.[25] There must be some reason why the Turks, facing the same weaponry as cavalry in Europe, could still deliver a shock while European cavalry could not. Apparently, the effectiveness of a force as a shock arm lies in the way in which it is employed. That is, in the exploitation of the characteristics that make it a shock arm.

When Frederick ascended to the Prussian throne he found his cavalry lacking in efficiency. He criticized them for being big men on big horses that could

neither maneuver nor fight. In Frederick's opinion, they were no faster at maneuver than grenadiers and were accordingly of no use before the enemy because they always arrived too late.[26] By 1757 Frederick had restored cavalry to its previous effectiveness by changing tactics to exploit the strengths of heavy, medium, and light cavalry when used as a shock force. At the battle of Roßbach, Frederick restored shock to the battlefield when it was not supposed to be possible.[27] The actions of Frederick's cavalry under Seydlitz proved that a force possessing the characteristics needed to produce a shock effect, applied in a way which takes full advantage of those characteristics, could achieve that shock effect even against fresh cavalry and unshaken infantry. The few examples of cavalry being well-used include Marengo, Aspern, Eylau, and Borodino.[28]

After the Frederician era and throughout the Napoleonic era cavalry declined in its effectiveness. Though there are many examples of gallant cavalry action during Napoleon's campaigns, there are few examples of cavalry being well used as a shock arm. For the most part, Napoleonic cavalry was only effective against infantry that was already shaken by artillery fire.

This reliance on artillery lessened the spirit and discipline of the cavalry. It fed the suspicion that cavalry could not shock unshaken infantry, even though the actions of the Prussian cavalry at Roßbach deny the veracity of the suspicion. By Waterloo, however, this suspicion was accepted as fact. By the time of Napoleon's invasion of Russia, French cavalry was no longer effective as a shock arm. A brief analysis of both French and Prussian cavalry yields some reasons that explain why they fell into ineffectiveness. The reasons are similar to the reasons that led to the first decline of cavalry.

The French cavalry lost its effectiveness as a shock arm because it lost its mobility advantage. Recall that the previous decline of European cavalry was also due to the loss of mobility advantage or mobility differential, but it stemmed

primarily from excessive armament. In this case the loss of mobility differential relates directly to the poor care and conditioning of the French army horses.[29]

The Prussian cavalry declined for several reasons. First, the horses were not well trained and neither were the riders. According to Marwitz, a renowned Frederician cavalry officer, the cavalry was practically useless because it was "neither vehement in shock nor rapid in its movements."[30] Second, the true cavalry spirit deteriorated within the arm itself. Third, the Prussian cavalry suffered a humiliating defeat in the field in 1806 at Jena and Auerstadt. Fourth, overcentralization and poor organization occurred, placing control of the mounted arm in the hands of people who were not trained to understand their weakness or their strength. When the Prussians split up cavalry among infantry divisions, commanders could not mass enough force to use them as a shock arm.[31] This requirement to concentrate in space and time is an important lesson for any practitioner of the military art who attempts to employ a shock arm.

The end of the Napoleonic era and the decline in effectiveness did not eliminate cavalry from the battlefield. On the contrary, shock action was still possible but its occurrence was far less frequent. When commanders properly employed the arm it achieved the desired effect. The improvements in infantry and artillery made proper employment more difficult or at least reduced the opportunities for proper employment, but given the proper conditions (disciplined troops, proper terrain, correct timing, and an enemy not under control), cavalry still had an effect.[32]

Major General Douglas Haig describes how such a thing can occur when cavalry seemed to have no further value as a shock arm. In his words, "cavalry is in jeopardy when it has no leaders who understand how to train it; it recovers itself as soon as at its head it finds chiefs who have a clear perception of its rôle and proper mode of employment."[33]

In the latter half of the nineteenth century cavalry became less and less effective as a shock force. Considerable debate ensued over the future of cavalry -- namely whether or not it had a future and if so what would its role be. Some argued that cavalry's use as a shock arm was outmoded by the time of von Bredow's charge in the Franco - Prussian War in 1870. Much of the debate revolved around the use of cavalry for raiding and conducting operational maneuvers. This stemmed from the use of cavalry in the American Civil War and equated primarily to using the horse to rapidly transport riflemen to the decisive point.[34] The debate over the usefulness of cavalry (the mounted arm that fights mounted) versus mounted infantry (the mounted arm that dismounts to fight) raged at the close of the last century in a way similar to the debate at the close of this century surrounding M2/M3 Bradley equipped infantry. When the issue came down to shock, mobility was more important than firepower. Dismounting only negated the very mobility advantage that mounting provided in the first place.[35]

The British experience against the Boers toward the close of the century kept this debate alive. In the Boer War the British could not use their cavalry for shock because the Boers could assemble and disperse to evade decisive combat much faster than the British could bring force to bear.[36] British authors in the early twentieth century were full of excuses and 'what ifs', but the bottom line was mobility differential. For example, F. N. Maude, a British cavalry officer who served in the Boer War and wrote extensively about the changing nature of warfare at the close of the nineteenth century, believed that if the British had approximate numerical equality with the Boers but an increment of mobility greater, due to discipline and acclimation of the horses, then the British would have had the advantage. From the British capture of Paardeberg in 1900 onwards, the British did gain a fraction of true cavalry mobility by conducting relentless pursuits, and the Boers could not make a stand. Nevertheless, many opportunities for shock or

decisive action were lost for lack of speed.[37] An increment of mobility advantage is not sufficient to enable a shock arm because incremental advantages are near equality and are easily offset by one of the other characteristics. This condition creates the belief that when armies of equal mobility encounter one other, and both are resolved to gain a decision at any cost, tactics become key and victory goes to the side with superior disciplined courage.[38]

Even though the British gained some measure of increased mobility, by early 1902 the Boers abandoned their heavy guns and ox carts. This greatly increased Boer mobility and allowed them to move easily and concentrate for a combined effort against vulnerable points as only one freed from all encumbrances can do. Instead of creeping forward dismounted, they began to gallop forward still mounted.[39] Had the Boers been properly armed and trained to use the arms effectively the British would certainly have been the recipients of shock effect and the Boers might have resembled the Mongols of Genghis Khan.

By the beginning of the twentieth century, the cavalry lost its effectiveness as a shock force because it possessed weaponry inferior to the infantry and was extremely vulnerable to infantry and artillery weapons. As a result, cavalry could not take advantage of the mobility differential that still existed. This created a situation in which the battlefield was without an arm that possessed all the characteristics of a shock arm. The absence of a shock arm historically made a war of entrenchments inevitable.[40] That it happened again in World War I is well known.

PART V.

World War I to the Present

The first step toward restoring shock to the battlefield occurred in 1917 at the battle of Cambrai with the first use of the tank (so named by the British for security reasons[41]) in massed formations. Leading a general offensive that planners originally intended to conduct as a raid, 378 of the slow tanks, formed in three brigades of two battalions each, achieved a breakthrough of roughly four miles in a war which measured successes in yards. Cavalry was the only arm which inherently possessed enough mobility to exploit the penetrations made; but because its inability to move forward through the remaining wire belts -- and perhaps also because of the loss of the cavalry spirit -- the cavalry did not take advantage of the opportunity.[42]

The tank in this battle was relatively invulnerable to infantry's most effective weapons and possessed weaponry which compared to the infantry's. The arrival of the tank on the battlefield in massed formations was certainly unexpected, but the fact that the tank was not much faster than a running man and not as fast as a charging horse -- in other words, the lack of mobility differential kept it from being effective as a shock arm.

The tank was to be used as a mobile armored pillbox to cross no-man's land in the face of fire while unencumbered by obstacles. In its design, obstacle crossing ability was more important than firepower, and protection was more important than speed.[43] Nevertheless, thinkers like Gifford Martel and J. F. C. Fuller recognized the potential possessed by the tank, originally designed to defeat the obstacles and machine guns of trench warfare. They believed that the tank

might not only develop into a mechanized cavalry, but further as a shock arm that would restore mobility to the battlefields it would dominate.[44]

In the meantime both sides used airplanes directly against ground forces and introduced yet another arm with potential as a shock force. Still, nothing filled the void left by cavalry when it ceased to function as an effective shock arm.

Internecine quarrels and inertia stood in the way of those who saw the tank's potential. Between the end of World War I and the beginning of World War II, the cavalry and the infantry both resisted the notion of an all-tank arm. Cavalry, however, realized that it might be useful to adopt armor since its own effectiveness seemed to be at an end. Typically, a debate ensued over the future of the tank and its employment. The extremists on one hand envisioned an all tank force operating as a shock arm, breaking through the enemy lines like heavy cavalry used to do. Extremists on the other hand believed the tank had a limited future because of expected improvements in anti-tank weapons. They felt that tanks would only be effective as a system to support infantry and should only be as fast as the fastest infantryman.[45]

The two poles caused divergent tank design eventually leading to tanks being categorized as light, medium, and heavy just as cavalry had been. Nevertheless, attempts by the "apostles of mobility" (a term used by Field Marshal Lord Michael Carver to describe the military theorists in the first forty years of the twentieth century who recognized that tanks were the modern successor to heavy cavalry) to form tanks into independent units to operate as a shock arm were repeatedly thwarted in Europe and in the United States.[46] By the beginning of World War II this was no longer true. Mass production of automobiles and more efficient motors led to faster tanks in greater numbers.

The Germans, led by General Heinz Guderian, pursued a more specific direction. Guderian stated his priorities in tank design to be mobility, firepower,

protection, and communications in order.[47] The units produced by Guderian's direction were called *Panzertruppen.* Their *raison d'être* was not the exploitation of the tank per se. Rather, it was the value of a small, potent force possessing mobility that was orders of magnitude greater than most of the army.[48]

Given the characteristics of a shock arm as revealed thus far, General Guderian was clearly forming the potential successor to the cavalry. Blitzkrieg became the term which described shock action by armored forces. The best example of Blitzkrieg was the attack by a concentrated armored and motorized army through the Ardennes Forest to the channel coast of France in 1940. Tanks ruptured the enemy front by shock action and dashed westward, severing lines of communication and frightening all who encountered the force in such a way that all resistance vanished.[49]

After this revolutionary use of armor there were few other examples in World War II of tanks being used with such effect as a shock force. Most of the battles involved tanks operating in concert with infantry. In other words, the tanks were not used in a way which exploited the mobility differential they then possessed. There are some notable examples, however, in which tanks in the hands of a skilled commander who understood their potential, that confirmed that tanks were the only shock arm on the battlefield.

Two of the examples are from action in North Africa. In the first example, the British 7th Armoured Division under the command of Major General Richard O'Connor, attacked the Italian Tenth Army in December 1940 at Sidi Barrani. The British force had 36,000 men and possessed 155 light tanks, 45 infantry supporting heavy tanks, and 75 medium tanks. Only the medium tanks had the characteristics of a shock arm. The Italian force had 250,000 men, possessing 60 medium tanks and 240 light tanks. The initial attack against Sidi Barrani was so successful that the British exploited their advantage and captured Tobruk with ease. This caused

the Italians to begin a general withdrawal from Cyrenaica without the forces there being threatened. The British again exploited, this time with only 32 medium tanks and 53 light tanks. Moving with much greater speed, the British cut off the remainder of the infantry predominant Italian Tenth Army and achieved a moral effect which led to the Italian surrender at Beda Fomm on 7 February 1941.

The second example occurred in the same area, but this time the British received the shock. After Rommel forced the British back to the frontier and recaptured Tobruk in late May 1942, he dashed on against the British with only 44 tanks in an attempt to overcome the retiring British. Rommel virtually bypassed the British and through sheer speed of movement threw them into disorder, paralysis and chaos.[50]

World War II did introduce large tank forces which had the potential for developing into a shock arm, but the trend by the end of the war actually led away from all-tank forces fulfilling this role. In the American and British armies from 1943 to 1945, armored divisions were actually reduced in number and the doctrine returned to its focus on tanks having the limited role of supporting infantry. Before the Normandy invasion, for example, the number of armored divisions dropped from eleven to five.[51]

The need for ground forces in general came into question in the 1950's with the advent of potential nuclear war and its associated doctrines. The development of armor stagnated with the primary attention being given to limited protection from nuclear effects. What armored development did occur seemed to be concentrated in armored personnel carriers and infantry fighting vehicles. The development was a continuation of post World War II efforts to perfect the armored instrument. It also fit well with the designs of planners who were trying to minimize the vulnerability of units while maximizing their ability to disperse and concentrate to take advantage of nuclear results. As the potential for conventional warfare became more thinkable

under the strategy of flexible response, the race to perfect armored warfare resumed.[52]

Paralleling this path of development was a race to perfect the methods of destroying armor. Anti-tank weapons ranging from tank destroyers to anti-tank guided missiles (ATGM) pushed armor development in a direction away from the balanced characteristics of a shock arm. The improvements in anti-tank weapons increased the need for armor protection which led to a further increase in the effectiveness of the tank's weaponry to defeat the better protected tanks. This became the cycle for the further development of tanks.

From World War II to the present, progress in the armor world has been primarily measured in terms of increased firepower or protection. A quantum leap offered by high pressure guns and anti-tank guided missiles (ATGM) gives current systems a high probability of first round kill at four times the maximum range of 1950's era systems and twice the range of 1960's systems.[53] The jump in firepower is matched by a similar jump in armor protection with a corresponding jump in weight. The sequential development of systems between the Warsaw Pact and NATO reflects this phenomenon very clearly (see Appendix A).

Mobility has not enjoyed the same emphasis. Increases in mobility differential during this period were only marginal. In the case of the Soviets, the same basic power train that drove the original T-44 tank in World War II drives the T-62. The Israeli Army intentionally sacrificed mobility for crew survivability (read protection), in the Merkava which moves at a top speed of twenty-eight miles per hour (45 km/hr). This is only three miles per hour (5 km/hr) faster than Walter J. Christie's 1919 tank, a mere increase of twelve percent. The American M60 tank has a top speed of fifty kilometers per hour on paved road, an increase of twenty-five percent over Christie's 1919 design.[54] The Soviet T-54, T-55, and T-62 also have a fifty kilometer per hour top speed on roads. The Soviet T-72 offered an

improvement in mobility with a top road speed of sixty kilometers per hour, a fifty percent increase over Christie's design.[55] There are two primary exceptions to this trend of limited advances in mobility which have potential for putting tanks back on track as a shock arm, at least in the near term.

The Soviet T-80 tank and the American M-1 tank family use gas-turbine engines which produce significantly more horsepower than diesel engines used by all other tanks. These turbine engines provide a substantial increase in speed over other tanks. The T-80 has a top road speed of eighty-five kilometers per hour.[56] This marks a 112 percent increase over Christie's tank and a forty-two percent increase over it's predecessor, the T-72. The M-1 has an unofficial speed of ninety kilometers per hour on roads and fifty kilometers per hour cross-country.[57] This is a 125 percent increase over Christie's 1919 tank; an eighty percent increase over the M-60 tank on roads; and, perhaps most importantly for the purposes of shock, a 257 percent increase in cross-country mobility over the M-60.

Given the highly lethal weaponry and armor protection of the T-80 and the M-1 tank, coupled with the mobility differential just quantified, both tanks seem to possess the characteristics required in a shock arm, more especially so in the M-1. It is not enough, however, for tanks to be significantly faster than those of all preceding generations. Rather, tanks must have a speed of movement significantly greater than that afforded to the arms against which tanks will maneuver. This is the vital mobility differential. The M-2/M-3 Bradley Fighting Vehicle or the German Marder or the Soviet BMP or BMD each possesses sufficient speed to match any tank formation except an M-1 formation. Even in that case the difference is not significant. The BMD, for example, has a top road speed of eighty kilometers per hour.[58] This is six percent slower than the T-80 and eleven percent slower than the M-1. Keeping up with an M-1 formation is easily within the capability of these systems. Now the infantry in armored vehicles has as much

mobility as the tank; therefore, the mobility differential is greatly reduced and is insufficient to routinely qualify tanks as a shock arm.

This places tanks in a condition not unlike the cavalry's in its decline at the end of the sixteenth century and again at the end of the nineteenth century. Namely, shock action is only possible when the conditions are right and the opponent is already weakened, immobile, or inferior.

Tanks were the successors to the cavalry and remain the centerpiece of ground combat. Despite their formidable capabilities, tanks lost their effectiveness as a shock arm when their development caused an imbalance in the characteristics of a shock arm. In Major General James Gavin's words, "Cavalry is supposed to be the arm of mobility. It exists and serves a useful purpose because of its mobility differential -- the contrast between its mobility and that of other land forces. Without the differential, it is *not* cavalry."[59] Tank development has focused on achieving significant advantages in weaponry and protection but not in mobility differential over other modern mechanized arms. Accordingly, replacing Gavin's "cavalry" with "a shock arm" again reveals the thrust of this monograph's argument. Perhaps the quest for a modern shock arm should turn to a different dimension, the air.

PART VI.

The Attack Helicopter

The use of aircraft against ground targets in World War I opened a new era in warfare. The airplane embodied a mobility differential that was orders of magnitude greater than anything on the ground. As airplanes developed through the twentieth century the ground attack role received less emphasis than air to air combat and bombing roles. With this direction of development aircraft retained the significant mobility differential, but lacked proper weaponry to affect ground action

as a shock arm. On the ground, tanks continued to develop but the developmental focus alternated between improvements in firepower to defeat armor protection and armor protection to reduce the effects of firepower. Consequently, improved armored weapons systems retained the weaponry advantage and the protection of armor but failed to retain a significant advantage in mobility.

As early as the 1940's and 1950's serious discussion began about the use of helicopters to move forces around on the battlefield. Of all battlefield vehicles and weapons, the helicopter enjoyed the most rapid improvements after World War II. In many ways helicopter development pursued a course which sought a solution to restoring the advantages once held by cavalry and horse mounted riflemen. Additionally, precise delivery of troops by helicopter seemed to be a natural extension of the airborne concept. A heliborne force would provide for closer integration with armored forces while keeping the mobility and aggressive character of airborne forces.[60]

There are examples of people considering armed helicopters in the 1940's. One visionary in particular, Colonel H. F. Gregory, in 1944 saw many uses for the helicopter including armed combat. He believed helicopters armed with rocket guns, which were light but packed a wallop, were a distinct possibility. He said helicopters thus equipped and slow enough to sight targets would be deadly against ground installations. They would also provide an element of surprise by appearing from "out of nowhere" to operate as an "Indian fighter," attacking from behind large hills or other obstacles.[61]

In the late 1940's the Marine Corps began an aggressive program of helicopter development. Their initial focus was on utility duties like torpedo tracking, radar alignment, rescue operations at sea, patient movement, and medical supply movement.[62] By 1950 the Marines experimented with arming helicopters. Engineers designed a special bazooka rocket launcher mount to attach to the skid of

a Bell helicopter. The rocket could be controlled and fired from within the cockpit of the helicopter. On August 29 the Marines succeeded in firing a 3.5 inch rocket from the helicopter.[63]

Helicopters had their first combat testing in the Korean War. There were many firsts in this arena but most of them involved command and control, reconnaissance and observation, casualty evacuation, or troop movement.[64] Despite the difficulties encountered, the Army tested the helicopter in these roles but did not ignore the prospect of arming helicopters. In 1955 the Army studied a "helicopter gunship" concept which yielded fabrication and testing of different types of helicopter armament.[65] The objective of this project was to provide responsive suppressive fire support for troops being transported by helicopter, particularly at the time of landing when they were most vulnerable. Weapons inaccuracy caused by the helicopter's instability proved to be the most difficult problem to overcome. The Army achieved outstanding results in 1958 when it loaded an H-34 helicopter with forty 2.75 inch and 2.5 inch rockets, nine machineguns, and two 20 mm cannons.[66]

The helicopter took more evolutionary steps toward the modern attack helicopter during the French - Algerian War. The French, like the British in Malaya, found the use of helicopters to be very beneficial in counterinsurgency operations. The French, though, believed that the only way to provide sufficient protection from small arms fire during the landing of assault troops was to improve both armament and armor protection. The weaponry suppressed the ground fire while the armor protected the crew and the aircraft. The French used the results of the U.S. Army tests of 1958 as the basis for their armament, eventually mounting two .30 caliber machine guns and seventy-two 37 mm rockets. The French also experimented with anti-tank missile systems starting in 1958. The French believed that the tank presented a larger target silhouette to an aerial platform which in turn

permitted a wider array of angles for attack.[67] The French began arming one in every six helicopters.[68] Once armed, these helicopters carried no troops and focused solely on providing close air support to an assault landing.

The French also made new developments in armor protection. They used a new form of heavy fiberglass plastic [now called plexiglass] to protect certain engine components and the cockpit. This protection could deflect a .30 caliber bullet except when fired straight into the armor at point blank range. Additionally, the French used a combination seat and groin shield to provide further protection to the pilots.[69] The lessons of the French - Algerian War showed the helicopter entering a new phase of development. Suppressive fire capability materially reduced combat losses and provided more responsive fire support to assaults than did artillery.

The U.S. involvement in Vietnam marked a real acceleration in helicopter development. As early as 1962 U.S. Army UH-1A helicopters armed with two fixed 2.75 inch rocket pods and two fixed .30 caliber machine guns flew combat missions which had an immediate effect of suppressing enemy fires in landing zones.[70]

These results convinced all observers that a new era was dawning. The combat successes in Vietnam coupled with the change in U.S. military strategy from a defensive posture of massive retaliation to flexible response led to renewed interest in the mobility of ground forces. Secretary of Defense Robert McNamara ordered a study to examine the entire arena of mobility and make recommendations on the force structure needed. This study failed to meet its purpose and Secretary McNamara convened a select panel called the Army Tactical Mobility Requirements Board.

This board, commonly referred to as the "Howze Board" after its chairman General Hamilton H. Howze, examined the role of Army aviation and its

application to the concept of "airmobility" in general.[71] The formulation of the First Cavalry Division (Airmobile) and the subsequent reorganization of the 101st Airborne Division into an Air Assault Division is a well-known product of the Howze Board's findings. Some lesser known findings include the recommendation to form an Air Cavalry Combat Brigade (ACCB) which would operate as "an air fighting unit which destroys or punishes the enemy by aerial maneuver, surprise and heavy application of firepower delivered from rotary wing, light attack helicopters, air delivered riflemen and tank killer teams."[72]

Secretary McNamara, addressing the House Armed Services Committee in February 1963 discussed the potential use of the ACCB. His words best describe the envisioned use of attack helicopters as a shock arm. He said,

> The air cavalry brigade, like the air assault division, would also be equipped with a large number of helicopters and would perform a role much like the horse cavalry of earlier years. Because of its great mobility, it would be very useful for attacks on the flank or rear areas of the enemy. It would also be highly effective against armored penetrations as it would have large numbers of anti-tank weapons including missiles mounted on the helicopters.[73]

The next step was a further progression of armed helicopters toward attack helicopters to meet the vision of McNamara, Howze and others.

The escalating war in Vietnam demanded more and more firepower to support operations. In 1966 the UH-1B, a modified utility helicopter, had the most formidable armaments. It provided good support but could not satisfy the perceived need for a dedicated helicopter gunship, designed solely for that mission. In response to this need the Army ordered the first true helicopter gunship, the AH-1 Cobra. The AH-1 had one turbine engine and supported several different weapon arrays. Unlike other helicopters, it was highly maneuverable and its fuselage,

designed to carry only a two person crew, presented a very small target when attacking head on.[74]

The first AH-1 helicopters arrived in Vietnam in 1968 for the Army and in 1969 for the Marine Corps. Their arrival dramatically improved the firepower available to support ground or air mobile operations. The AH-1 marked a significant transition in helicopter design that supports the evolution of helicopters as a potential shock arm.

In the 1970's the Soviet Army possessed a clear numerical advantage in tank systems. NATO nations realized the numerical gap could not be closed because of slower development cycles and prohibitive costs. This realization changed the focus to seeking qualitative superiority to offset the numerical disadvantage. Much of the effort in this quest focused on anti-tank guided weapons and their various delivery platforms.[75] When the U.S. started arming AH-1 Cobra gunships with TOW missiles, many recognized that armed helicopters could compensate for quantitative disadvantages through superior mobility and a qualitative edge in armament. Since its design basis was completely different from anything that preceded it, the AH-1 began the era of designing unique helicopters for specialized purposes.

All gunships prior to the AH-1 were armed helicopters, that is, general purpose helicopters designed to carry troops or cargo, fitted with armaments. The AH-1 does not meet this definition. The intentional absence of a means of transporting troops or cargo makes it something more than just a different kind of armed helicopter. This forms the crux of the design difference between an armed helicopter and an attack helicopter. At the same time, the AH-1 was not originally designed to operate as an independent attack system (although subsequent modifications give it this capability now). Rather, it was designed to provide fire support to some other kind of combat action. As such, it is best considered to be an

intermediate step between the armed helicopter and the attack helicopter whose primary purpose is independent attack. The difference between an armed helicopter and a primary purpose attack helicopter seems subtle but it is actually quite significant. If one accepts Richard Simpkin's analogy, an attack helicopter is to an armed assault helicopter what a tank is to an armored infantry fighting vehicle.[76]

Currently, the world's only attack helicopters are the American AH-64 *Apache*, the Soviet Mi-24 E and F *HIND*, the Italian A-129 *Mangusta*, the Soviet Mi-28 *HAVOC*, and the American AH-1T. Others which are are entering service now are the South African CSH-2 *Rooivalk* and the French - German cooperative PAH-2/HAC/HAP *Tiger/Tigre* (given the difficulty in finding an acceptable designation, the level of cooperation seems to be at question). Three light attack helicopters are still in development including the American LHX or YAH-66 *Comanche*, the Soviet Kamov *HOKUM* (which will probably have the sole purpose of attacking attack helicopters), and the Anglo - Italian *Tonal.*[77]

All of these attack helicopters possess a significant mobility differential over ground systems. Using the M-1 tank as the base example of the best ground mobility available, the differential is readily apparent (data is available at Appendix B). As the discussion of tanks in Part V addressed, the M-1 has a top speed of ninety kilometers per hour on roads and fifty kilometers per hour cross-country. The slowest of the second generation attack helicopters (everything after the AH-1), the A-129 *Mangusta*, has a maximum cruising speed of 250 kilometers per hour. This represents a mobility differential of 178 percent in the best case and a differential of 400 percent when the tank is operating cross-country, since the helicopter has no cross-country limitations. Bear in mind that the greatest advantage to the M-1 is in its cross-country mobility, in itself 257 percent better than that of its predecessor.

If an average speed is used for the attack helicopters, the differential is even greater. The best case comparison of average attack helicopter cruise speed to M-1 top road speed represents a 228 percent differential. The average cruise speed to cross-country speed comparison represents a 490 percent differential. Comparing the fastest attack helicopter is not necessary to further illustrate the point. Clearly, attack helicopters possess mobility that is orders of magnitude (i.e., multiples) greater than the most mobile of ground systems.

All modern attack helicopters have versatile armament. On each system, the primary weapon is a guided anti-tank weapon. The most commonly used ones include the American TOW, the French HOT, the American HELLFIRE, the Soviet AT-6 SPIRAL, and the European TRIGAT. The following table shows the characteristics of each weapon. All of these have ranges that exceed the maximum range of any tank main gun.[78]

Table 1 Missile characteristics

	TOW	HOT	HELLFIRE	SPIRAL	TRIGAT
Country	U.S.	Europe	U.S.	U.S.S.R	French
Max range (m)	3750	4000	5500	5000	4500
Time of flight (s)	21	17	?	11	17
Flight speed (m/s)	179	235	?	455	265
Weight (kg)	18	23.5	43	31	40
Guidance	Wire	Wire	Laser	Radio	IR Homing

After the primary weapon, attack helicopters have secondary weapons systems which are generally rocket systems with varying munitions and some type of rapid firing guns with armor-piercing ammunition. Most attack helicopters also can carry auxiliary weapons like air to air missiles for protection against other aircraft. This versatility allows attack helicopters to apply the right weapon at the right time, while taking advantage of the benefits of mobility. Advanced optics and target acquisition systems like the Apache Target Acquisition Designation Sight &

Pilot Night Vision Sensor (TADS/PNVS) provide an integrated system that joins night vision systems, laser range finders, and laser target designators. The TADS/PNVS is slaved directly to the helmet of the gunner and the pilot as well, creating a true man-machine weapon system.[79]

The Apache is the attack helicopter with the most sophisticated optics and acquisition system. Other attack helicopters have somewhat less capable systems because of an inability to integrate the technology (the Soviet Mi-24F for example) or because the cost of such a system is prohibitive (each TADS/PNVS costs $890,000).[80] The Franco - German PAH-2/HAC/HAP *Tiger/Tigre* designers had to take this into account. The French always intended to equip the helicopter with European "visionics" while their German partners wanted to equip the Tiger with Martin Marietta's TADS/PNVS, the same as the Apache. To meet the German design would have meant exceeding the planned budget.[81] The European visionics are very similar to the American system but they lack some of the integration.

Given the advanced optics and target acquisition capability of modern helicopters, coupled with the most lethal direct fire armament on the modern battlefield, attack helicopters have a considerable advantage over any single ground system. Further, these attributes make a single attack helicopter equivalent in weaponry to a combination of several different ground systems.

All of the attack helicopters derive their protection from a combination of direct and indirect measures. The direct measures include the use of armor plating and composite materials for ballistic protection against anti-aircraft guns and small arms. Also, attack helicopters provide direct protection to crews by increasing crashworthiness. This includes measures like shock absorbing wheel structures and break-away rotor systems.

The indirect protection measures include the use of low-observable paints, compounds, and structures in the aircraft design; maneuverability through a wider

envelope of G-forces; greater capability to operate in certain periods of adverse weather, including darkness; and the protection afforded to "he who moves fastest." The performance specifications of the AH-1F Cobra, the AH-64 Apache, the A-129 Mangusta, the Mi-24 Hind, the CSH-2 Rooivalk, and the Mi-28 Havoc are displayed in tabular form at Appendix C.

PART VII.

Synthesis and analysis

In the U.S. and the Soviet Union, at least, the attack helicopter is becoming well-established next to the tank and the infantry fighting vehicle as a key basic weapon system in combined arms combat.[82] Attack helicopters, still in a nascent stage of development, have evolved from ad hoc weapons platforms toward fully integrated weapon systems capable of operating in day, night or certain adverse weather conditions. Like chariots, horsemen, and tanks, attack helicopters were not originally conceived for use as shock weapons. Now that they are on the battlefield, imaginative use of them may well give commanders the kinds of advantages previously provided by cavalry, and then tanks, in achieving surprise and shock effect.[83] If one accepts Richard Simpkin's hypothesis that full integration of any military innovation occurs thirty to fifty years after the introduction of the innovation,[84] then the understanding of how to best use attack helicopters is still many years away. However, if we apply the historical characteristics common to shock arms as a framework for analysis we can determine today whether or not the attack helicopter has the potential for use in this role.

Attack helicopters clearly possess excellent mobility, but more importantly, a significant mobility differential over any ground combat system. Mobility

differential is what made Genghis Khan's Mongols extraordinary. Even more than the Mongols, attack helicopters possess mobility which is orders of magnitude greater than that of the force they will be applied against. In Simpkin's words, "rotor is to track as track is to boot."[85] The mobility of ground systems like the M1 Abrams tank and the M2 Bradley infantry fighting vehicle should not be discounted. They possess an effective mobility differential over most other ground systems. The difference is in the magnitude of the differential.[86]

Freedom from the encumbrances which limit mobility gave the Boers unquestioned advantages over the British. Attack helicopters are free of the greatest encumbrance -- connection to the ground. This is a technical aspect of mobility but one which makes attack helicopters unique in combined arms operations. Speed and movement are simply easier and more economical above rather than on the ground. Moving dispersed and converging at the point of attack are also easier when a force is free of the ground. Attack helicopters may be compared to the Boers in their unencumbered mobility, but the comparison ends when weaponry is the basis.

The Boers did not possess weaponry that was as effective or more effective than the opposing British weaponry. Consequently, they were incapable of operating as a shock arm. This is not the case with attack helicopters. Whether they are armed with anti-tank missiles, cannon, rockets, grenades or machine guns, attack helicopters possess weaponry greater than most ground fire systems and sufficient to destroy any target they may be required to attack. In terms of weapons effectiveness, then, attack helicopters are at least equal equal to the opposing tanks.

The Soviets consider the attack helicopter, for all intents and purposes to *be* a tank.[87] A weapon like Hellfire is certainly more powerful than a tank because of the effective range and probability of kill once fired. The attack helicopter's other direct fire systems are more lethal than the complementary systems on most modern

tanks. The effectiveness of attack helicopter weaponry in Operation DESERT STORM attests to the power current systems possess. An example of battle damage assessments from two days of AH-64 Apache combat is at Appendix D.

As a means of mobile firepower the attack helicopter is nonpareil. It can carry a broader variety of weapons to a target, faster than any ground system. With its excellent communications capability it can undertake tasks while on call for others in completely different areas of the battlefield as long as its endurance will permit.[88]

The examination of cavalry showed that mere possession of a mobility differential and weaponry at least equal to the opponent's is not enough to make an arm effective in producing a shock effect. The two fundamental characteristics must be coupled with an element of surprise or unexpectedness. Attack helicopters achieve this element of surprise or unexpectedness in some of the same ways Genghis Khan's Mongols achieved it.

Attack helicopters can operate in adverse weather or any time of the day. They can use their exceptional agility to selectively avoid contact with enemy formations that are not desirable targets. They can use their mobility to move dispersed and concentrate in time and space to attack targets that are not postured for defense and are thus more vulnerable to attack. Their ability to operate at a faster tempo than ground forces allows them to attack and move off to another task before the ground force can take appropriate actions.[89] Finally, for as long as helicopters enjoy the ability to "stand-off" while engaging ground targets beyond the range of the effected ground weapons during periods of limited visibility, they will be able to reap the benefits of an unexpected attack.

The third key characteristic is possession of sufficient protection to advance to the distance where mobility and weaponry can have optimum effects. This particular characteristic is the one which has had the greatest impact on shock arms.

Historically, the difficulty comes in striking the balance between too much protection (which invariably leads to reduced mobility) and too little protection (which negates the advantages of mobility and hinders the effective employment of weaponry). The European cavalry of the fifteenth century, or perhaps modern tanks, illustrate the former extreme while horse cavalry in World War I illustrates the latter. Genghis Khan's Mongols once again serve as an excellent example of "how to do it right." Protection of attack helicopters is a heavily debated issue.

Critics of attack helicopters focus on the issue of vulnerability. That a helicopter is vulnerable to fires is a certain truth; that it is more vulnerable than any other combat system is debatable. Attack helicopters reduce their vulnerability through direct and indirect protection.[90] Direct protection includes light armor protection, laser and radar warning devices. Indirect protection is what makes the attack helicopter so unique and what has the greatest effect on reducing vulnerability. It includes speed and agility, tactics, elusiveness, stand-off range, all-weather capability, and excellent optics for ignoring periods of limited visibility.[91]

One other aspect of vulnerability which seems to have been overplayed is the perceived ease of shooting down an attack helicopter. Modern attack helicopters are designed with composite materials, armored skin, and titanium spars in rotor systems to withstand direct hits from anti-aircraft fires up to 23 mm. Clearly, attack helicopters, like all aircraft, are vulnerable to anti-aircraft missile fires once acquired. As with the armored horseman and the tank, the degree of protection must be balanced with performance to avoid reaching the point where attack helicopters are so well protected that they lose effectiveness as a shock arm.[92]

The last aspect that makes an arm effective as a shock weapon is the impact of environmental effects like discipline, training, tactics, and knowledgeable leadership that understands the capabilities as well as the limitations of the arm.

Most of these involve the employment of the arm. There is of course no way to predict whether or not these effects will receive due consideration in attack helicopter operations in the future, for as Christopher Bellamy concludes, "there are no technological panaceas -- only intelligent, studied and laborious adaptation of tactics and operational art to new means of warfare."[93]

PART VIII.

Conclusions and Implications

The quest for understanding what makes an arm effective as a shock weapon must begin with a study of military history. Military history is awash with examples in which possession of either superior weaponry or superior mobility on one side led that side to successful operations and in many cases victory in war. Examples of one side possessing both advantages are far less frequent. In these few cases, though, overwhelming victories have been a common result.[94]

As one looks more closely, three characteristics and two conditions emerge to form the thread of continuity between one effective shock force and another. The three characteristics are superior mobility, ideally orders of magnitude greater than that of any opponent; equal or superior weaponry; and a degree of protection sufficient to permit the other two characteristics to be brought to bear against the enemy. The first of the two conditions is the ability to attack with unexpectedness, that is, at an unexpected time or place or from an unexpected direction. This is vital to multiply the effectiveness of an arm possessing the three characteristics. The second condition is the correct environment, that is, proper tactics and leadership to employ the arm in a way that will optimize its effectiveness.

Following the repeated rise and fall of shock arms through history shows the need for balance among the necessary characteristics. When any particular

characteristic increases in importance at the expense of one or both other characteristics, the arm begins to lose effectiveness and will probably wane into obsolescence or extinction. Analysis of the modern battlefield shows one arm (tanks) declining in effectiveness as a shock arm because of a lack of mobility differential. It also shows a new arm emerging to succeed the declining one. If Richard Simpkin's fifty year cycle theory[95] is even partially correct, attack helicopters are still immature in their development. Nevertheless, they already clearly possess the characteristics in proper balance. In fact, attack helicopters possess a consonance that resembles that possessed by Genghis Khan's Mongols, reputedly the most effective shock force in history.

If the attack helicopter does become the dominant arm on the battlefield, how long can it hold that position and what if anything will cause it to lose that dominance? Attack helicopters can be expected to dominate for as long as they keep consonance between the three characteristics of a shock arm -- a large mobility differential over ground combat systems, weaponry powerful enough to destroy any potential adversaries, and sufficient protection to allow it to deliver the shock.

Currently the United States is one of the only countries in the world which possesses the technical capacity to further the design of primary purpose attack helicopters as well as the economic strength to afford the fielding of such systems at the leading edge of technology, without external assistance. Financial costs and reducing budgets may become too significant even for the United States to overcome. Already nations are forming cooperative ventures to share the cost burden of buying second-best technology. This will get worse before it gets better. This financial constraint will actually prolong the development of attack helicopters on an evolutionary path instead of the revolutionary path that the full exploitation of costly technologies could open.[96] These implications have great significance to

United States forces which will be in a position of great tactical advantage for as long as the attack helicopter dominates and the relative economic strength remains.

The effectiveness of the attack helicopter as a shock arm will wane if anything causes any one of the three characteristics to fall out of balance or if the dimensions of the battlefield of the future are significantly different. If the armies of most modernized countries become "airmechanized," a la Tukhachevskii, von Senger und Etterlin, and Simpkin, all arms will move with the same speed as the attack helicopters and the mobility differential will disappear. This will leave attack helicopters in a predicament similar to that of the modern tank. If ground systems achieve a degree of protection which renders the weapons of the attack helicopters powerless or at least significantly less effective, the weaponry characteristic will move out of balance and shock effectiveness will wane. If attack helicopters cannot maintain a degree of protection from the enemy's weapons necessary to get close enough to affect the enemy, the ability to achieve shock effect will decline significantly.

Finally, if the physical dimensions of combat action change from land, sea, and air to air and space only, the attack helicopter will immediately lose its ability to produce a shock effect against anything but other attack helicopters. Indeed it will be like the current infantry soldier; located at the bottom of the "combat food chain," affected by all other arms, but, without enhancements, only able to affect other infantry soldiers or other like forces.

All of these changes address what will cause attack helicopters to lose their effectiveness as a shock arm, but a shock arm may simply be replaced before it becomes ineffective. Replacing an arm is different than reducing the dominance or even the usefulness of an arm. To replace the attack helicopter, a new arm must come into being which possesses a significant mobility differential over attack helicopters. It must possess weaponry that is equal to or greater than that

possessed by attack helicopters. Additionally, it must possess sufficient protection that allows it to approach and use its weaponry against all other arms, including attack helicopters.

The arm which replaces attack helicopters as the dominant shock arm could be either a ground arm or an air arm. A ground arm would require the ability to move for sustained distances at speeds of 200 mph or more and to attack with at least the same kind of weaponry and protection as attack helicopters. For a ground combat vehicle to move at such speeds with and without the benefit of roads requires either identifying a new technology or applying current methods of nearly frictionless motion, such as air cushion technology or electromagnetic motion technology.[97] Since attack helicopters operate in the air and since current high performance aircraft technology permits speeds that are many times greater than those achievable by attack helicopters, the new arm will most likely be an air system.

As we in the United States Armed Forces look into the future to project areas of strength and weakness, we must recognize that it is to the attack helicopter arm we must turn if shock is to return to the future battlefield in the tradition of the cavalry. We can maintain our advantage in this arena by recognizing its emergence, and by looking to the past to find lessons that will help us not fail to recognize when the attack helicopter loses its effectiveness as a shock arm because it is no longer suited to the task or because it has been replaced by another arm.

Appendix A

Escalation of tank main gun sizes:

Period	System	Gun size	Remarks
Mid 1940's	Soviet T-34	85mm	
Early 1950's	American M-48	90mm	Eventually 105mm
Mid 1950's	Soviet T-55	100mm	
Early 1960's	American M-60	105mm	
	British Chieftain	105mm	
	German Leopard I	105mm	
	Soviet T-62	115mm	
Late 1970's -	American M-1	105mm	Eventually 120mm
early 1980's	German Leopard II	120mm	
	British Challenger	120mm	
	Israeli Merkava	105mm	Eventually 120mm
	Soviet T-72	125mm	
	Soviet T-80	125mm	

Appendix B

Speed/Mobility Comparisons

SUMMARY	Max speed	Cruise speed
Highest speed:	365	330
Lowest speed:	259	250
Average speed:	325	295

System	Max speed (km/hr)	Cruise speed (km/hr)
AH-64	365	297
Mi-24	335	310
A-129	259	250
CSH-2	314	268
Mi-28	300	280
Ka-? (est. cruise)	350	330
AH-66 (est. cruise)	351	330
PAH-2		

Mobility Differentials	Cruise vs. road	Cruise vs. xcntry
Highest speed:	267%	560%
Lowest speed:	178%	400%
Average speed:	228%	490%

Appendix C

Comparison of Performance Specifications

	AH-1F *Cobra*	AH-64 *Apache*
Engine Power	1,800 shp	2 x 1,696 shp
Main rotor diameter	13.41 m (44 ft)	14.63 m (48 ft)
Fuselage length	13.59 m (44 ft 7 in)	15.24 m (50 ft)
Fuselage width	0.99 m (3 ft 3 in)	2.03 m (6 ft 8 in)
Wing span	3.28 m (10 ft 9 in)	5.23 m (17 ft 2 in)
Height (to rotor head)	4.09 m (13 ft 5 in)	3.84 m (12 ft 7 in)
Operating empty weight	2,993 kg (6,598 lb)	4,881 kg (10,760 lb)
Max gross weight	4,535 kg (10,000 lb)	9,525 kg (21,000 lb)
Max level speed	227 kph (141 mph)	297 kph (185 mph)
Range (internal fuel)	507 km (315 mi)	482 km (300 mi)
Maneuver envelope		+3.5 G to -0.5 G
Vertical climb from in ground effect hover		7.4 m/sec (1,450 ft/min)

Performance Specifications (continued)

	A-129 *Mangusta*[98]	Mi-24 *Hind*
Engine Power	2 x 825 shp	2 x 2,200 shp
Main rotor diameter	11.9 m (39 ft 1/2 in)	17.3 m (56 ft 9 in)
Fuselage length	12.275 m (40 ft 3 1/4 in)	17.5 m (57 ft 5 in)
Fuselage width	0.95 m (3 ft 1 1/2 in)	1.7 m (5 ft 7 in)
Wing span	3.2 m (10 ft 6 in)	6.65 m (21 ft 10 in)
Height (to rotor head)	3.35 m (11 ft)	3.97 m (13 ft 3 in)
Operating empty weight	3,529 kg (5,575 lb)	8,450 kg (18,629 lb)
Max gross weight	4,100 kg (9,039 lb)	11,500 kg (25,353 lb)
Max level speed	259 kph (161 mph)	335 kph (208 mph)
Range (internal fuel)	575 km (357 mi)	450 km (280 mi)
Maneuver envelope	+3.5 G to -0.5 G (<3400 kg wt) +2.8 G to +0.5 G (>3400 kg wt)	
Vertical climb from in ground effect hover	10 m/sec (1,970 ft/min)	

Performance Specifications (continued)

	CSH -2 *Rooivalk*[99]	Mi-28 *Havoc*[100]
Engine Power	2 x 1575 shp	
Main rotor diameter		17.2 m
Fuselage length		16.85 m
Fuselage width		
Wing span		
Height (to rotor head)		4.81 m
Operating empty weight		
Max gross weight	7,200 kg	
Max level speed	170 kt	300 km/hr
Range (internal fuel)	4.59 hr	
Maneuver envelope		
Vertical climb from in ground effect hover	11 m/sec (2,250 ft/min)	

Appendix D

Battle Damage Assessments from

Selected Attack Helicopter Missions on 26 and 27 February 1991

during OPERATION DESERT STORM[101]

DATE	UNIT(S)	BDA
260200Feb91	4-229 AV (VII Corps)	28 tanks, 19 APC, 10 MTLB, 18 Trucks, 7 "soft skinned" vehicles, 1 ammo carrier, 1 observation post, 1 air traffic control tower, 1 bunker, 46 KIA
27????Feb91	2/6 Cav (VII Corps)	145 T-55 tanks, 12 T-72 tanks, 23 bunkers, 4 engineer vehicles, 4 towed artillery pieces, 1 MTLB, 43 trucks, 6 37mm AA guns, 2 ZSU 23-4 AA guns, 1 jeep, 1 fuel truck, 1 S60 AA gun, 14 APCs, 1 artillery bunker, 26 BMP, 2 SP artillery pieces, 1 commo vehicle
271130Feb91	2-4 Cav and 1-24 AHB	1 130mm howitzer, 4 APC, 2 1/2ton trucks, 4 ADA systems, 1 jeep, 16 KIA
271430-1830Feb91	12 Av Bde	37 tanks, 4 APCs, 2 BMP, 6 BRDM, 2 Mi-8, 2 ZSU 23-4, 1 ASC with radar, 2 ZSU-2
272125Feb91	3-227 AHB (XVIII Abn Corps)	2 155mm howitzers, 2 Mi-8, 1 ammo dump, 20 trucks, 1 MTLB

Endnotes

[1]Richard E. Simpkin, Tank Warfare, (London: Brassey's Publishers Limited, 1979), p. 11.

[2]Douglas Haig, Cavalry Studies: Strategic and Tactical, (London: Hugh Rees, Ltd., 1907), p. 16. Hereafter referred to as Cavalry Studies.

[3]Richard E. Simpkin, ANTITANK: The Airmechanized Response to Armored Threats in the 90's,(London: Brassey's Publishers Limited, 1982), p. 238. Hereafter referred to as ANTITANK.

[4]The Big Thesaurus™ by Deneba Software, (Miami, FL: Deneba Systems, Inc., 1986-1988).

[5]William P. Baxter, Soviet Airland Battle Tactics, (Novato, CA: Presidio Press, 1986), p. 111.

[6]Christopher D. Bellamy. The Evolution of Modern Land Warfare: Theory and Practice, (London: Routledge, 1990), p. 7. Hereafter referred to as Evolution of Modern Land Warfare.

[7]Trevor N. Dupuy, The Evolution of Weapons and Warfare, (Indianapolis/New York: The Bobbs - Merrill Company, Inc., 1980), p. 5.

[8]Ibid., p. 36.

[9]Ibid., p. 37.

[10]Ibid., pp. 38 - 40.

[11]Ibid., p. 40.

[12]Ibid., p. 41.

[13]Ibid., pp. 46 - 47.

[14]Harold Lamb, Genghis Khan, The Emperor of All Men, (Garden City, NY: Doubleday & Company, Inc., 1956), p. 10.

[15]Dupuy, The Evolution of Weapons and Warfare, p. 71.

[16]Ibid. pp. 74 - 80.

[17]Bellamy, Evolution of Modern Land Warfare, p. 197.

[18]Dupuy, The Evolution of Weapons and Warfare, p. 80. Bellamy, Evolution of Modern Land Warfare, p. 198.

[19]Bellamy, Evolution of Modern Land Warfare, p. 198.

[20]Dupuy, The Evolution of Weapons and Warfare, p. 66 and pp. 81 - 82.

[21]Ibid., p. 84.

[22]Ibid., p. 88.

[23]F. N. Maude, Lieutenant Colonel, Cavalry: Its Past and Future, (London: William Clowes & Sons, Limited, 1903), pp. 34, 80.

[24]Frederick von Bernhardi, Lieutenant General, Cavalry in Future Wars, Ed. trans. Charles Sydney Goldman, (London: John Murray, 1909), p. 90.

[25]Maude, Cavalry: Its Past and Future, pp. 67 - 68 and p. 81.

[26]Ibid., p. 93.

[27]Ibid., pp. 104 - 106.

[28]Ibid., p. 259. Haig, Cavalry Studies, p. 16.

[29]Maude, Cavalry: Its Past and Future, p. 140.

[30]Ibid., p. 156.

[31]Ibid., p. 175.

[32]Ibid., p. 220.

[33]Haig, Cavalry Studies, pp. 15 - 16.

[34]Bellamy, Evolution of Modern Land Warfare, p. 44.

[35]Maude, Cavalry: Its Past and Future, p. 268.

[36]Ibid., p. 231.

[37]Ibid., p. 271.

[38]Ibid., p. 127.

[39]Ibid., p. 272.

[40]Ibid., p. 15. The situation was similar to that which occurred in the Thirty Years' War, in Austria after the Seven Years' War, again in America in the latter part of the Civil War, and yet again in Europe in the Russo - Turkish campaign of 1877.

[41]Len Deighton, Blitzkrieg: From the Rise of Hitler to the Fall of Dunkirk, (New York: Ballantine Books, 1982), p. 105. Hereafter referred to as Blitzkrieg.

[42]Bellamy, Evolution of Modern Land Warfare, p. 77. Deighton, Blitzkrieg, pp. 106 - 108. Michael Power Carver, Field Marshal Lord Baron, The Apostles of Mobility: The Theory and Practice of Armoured Warfare, (New York: Holmes & Meier Publishers, Inc., 1979), pp. 28 - 30. Hereafter referred to as Apostles of Mobility.

[43]Deighton, Blitzkrieg, p. 113.

[44]Carver, Apostles of Mobility, p. 99.

[45]Deighton, Blitzkrieg, pp. 116 - 118.

[46]Carver, Apostles of Mobility, p. 44. Guy Hicks and George Pickett, "Airland Battle, Helicopters and Tanks: Factors Influencing the Rate of Innovation", unpublished paper, 9 August 1988, pp. 4 - 11. Hereafter referred to as "Airland Battle, Helicopters and Tanks".

[47]Deighton, Blitzkrieg, p. 129.

[48]Simpkin, ANTITANK, p. 234.

[49]Deighton, Blitzkrieg, p. 179.

[50]Carver, Apostles of Mobility, pp. 76 - 77.

[51]Paul A. Dyster, "In the Wake of the Tank: The 20th-Century Evolution of the Theory of Armored Warfare", unpublished Ph.D. dissertation, (Baltimore: The Johns Hopkins University, 1984), p. 374. Hereafter referred to as "In the Wake of the Tank."

[52]Ibid., pp. 409 - 411.

[53]Simpkin, ANTITANK, p. 41.

[54]The Editors of Time-Life Books, The Armored Fist, New Face of Battle Series, (Alexandria, VA: Time-Life Books, 1990), pp. 90 - 103. Dyster, "In the Wake of the Tank", p. 534.

[55]U.S. Department of the Army (DA), The Soviet Army: Troops, Organization, and Equipment, Field Manual (FM) 100-2-3, (Washington, D.C.: U.S. Government Printing Office, June 1991), p. 5-44. Hereafter referred to as FM 100-2-3.

[56]Ibid, p. 5-44.

[57]Dyster, "In the Wake of the Tank", p. 534.

[58]DA, FM 100-2-3, p. 5-30.

[59]James M. Gavin, Major General, "Cavalry, and I Don't Mean Horses", Harper's Magazine 208(1247), (New York: Harper & Brothers Publishers April, 1954), p. 54.

[60]Ibid., p. 59.

[61]H.F. Gregory, Colonel, Anything A Horse Can Do: The Story of the Helicopter, (New York: Reynal and Hitchcock, 1944), p. 242.

[62]Lynn Montross, Cavalry of the Sky: The Story of U.S. Marine Combat Helicopters, (New York: Harper & Brothers Publishers, 1954), p. 55.

[63]Ibid., p. 105.

[64]Ibid., p. 167.

[65]Howard A. Wheeler, Attack Helicopters: A History of Rotary-Wing Combat Aircraft, (Baltimore: The Nautical and Aviation Publishing Company of America, 1987), p. 45.

[66]William R. Fails, Lieutenant Colonel, USMC, Marines and Helicopters 1962-1973, (Washington, D.C.: History and Museums Division, Headquarters, U.S. Marine Corps, 1978), p. 85.

[67]Ibid., p. 53.

[68]Wheeler, Attack Helicopters: A History of Rotary-Wing Combat Aircraft, p. 52.

[69]Ibid., p. 55.

[70]Ibid., p. 62.

[71]Ibid., p. 62.

[72]James E. Simmons, Major, "The Attack Helicopter Battalion: Ready for the 60's or the 90's?", (Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College December, 1989), p. 6. Hamilton H. Howze, General, President, Tactical Mobility Requirements Board Final Report, (Fort Bragg, NC: United States Army, 1962), p. 40.

[73]Robert S. McNamara, "The Prospects for Army Air Mobility", Army, 13(8), (Washington, D.C.: Association of the United States Army, March 1963), p. 20.

[74]Wheeler, Attack Helicopters: A History of Rotary-Wing Combat Aircraft, p. 65.

[75]Farooq Hussain, Ian Kemp, and Philip McCarty, "The Future of the Military Helicopter", (London: Royal United Services Institute for Defence Studies, 1986), p. 1.

[76]Richard E. Simpkin, "Flying Tanks? -- a tactical - technical analysis of the 'main battle air vehicle' concept", Military Technology, 8/84, (Bonn: Wehr & Wissen Verlag, 8 August 1984), p. 62.

[77]E.J. Everett-Heath, G.M. Moss, A.W. Mowat, and K.E. Reid, "Military Helicopters", Land Warfare: Brassey's New Battlefield Weapons Systems and Technology Series, Vol. 6, (London: Brassey's (UK), 1990), p. 87. Hereafter referred to as "Military Helicopters", 1990. Peter Donaldson, "Rogue Rooivalk", Defence Helicopter, 10(3), (Buckinghamshire: The Shephard Press, June - July 1991), pp. 12 - 17. Emidio Valente, Colonel and Maurizio Cicolin, Lieutenant Colonel, "A-129: The Flying Tank", Revista Militare, Journal of the Italian Army, 4/84, (Rome: Sezione Amministrativa dello Stato Maggiore dell' Esercito, July - August 1984), p. 22.

[78]Everett-Heath, et al, "Military Helicopters", 1990, p. 90.

[79]Doug Richardson, Modern Fighting Aircraft: AH-64, Volume 12, (New York: Prentice Hall Press, 1987), pp. 26 - 28.

[80]Ibid., p. 26.

[81]Peter Donaldson, "Tiger in the Forest", Defence Helicopter, 10(3), (Buckinghamshire, England: The Shephard Press Limited, June - July 1991), p. 18.

[82]Everett-Heath, et al, "Military Helicopters", 1990, p. 125.

[83]Ibid., pp. 90 - 91.

[84]Richard E. Simpkin, Race to the Swift, (London: Brassey's Defence Publishers, 1985), p. 5.

[85]Simpkin, ANTITANK, p. 236.

[86]George S. Webb, Major, "The Flashing Sword of Vengeance: The Force-Oriented Counterattack from a Historical Perspective with Implications for the Airland Battle and Combat Aviation", (Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1985), p. 36. This monograph focuses on comparisons between ground systems and aviation systems for use in large scale counterattacks.

[87]Viktor Suvorov, Inside the Soviet Army, (New York: Macmillan Publishing Co., Inc., 1982), p. 191.

[88]Everett-Heath, et al, "Military Helicopters", p. 12.

[89]Jerry R. Bolzak, Major, "The Role of the Airmechanized Raid in Operational Maneuver", (Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College June, 1990), p. 15.

[90]Simpkin, Race to the Swift, p. 73.

[91]Ibid., p. 73. Everett-Heath, et al, "Military Helicopters", 1990, p. 11. General Dr. F. M. von Senger und Etterlin, "The Air-mobile Divisions: Operational Reserves for NATO", Journal of the Royal United Services Institute for Defence Studies, Brian Holden Reid, ed., Volume 132 (No. 1), (London: The Royal United Services Institute, 1987), p. 28. Hereafter referred to as "Air-Mobile Divisions."

[92]Ibid., pp. 108 - 109.

[93]Bellamy, Evolution of Modern Land Warfare, p. 45.

[94]General Dr. F. M. von Senger und Etterlin, "New Operational Dimensions", Journal of the Royal United Services Institute for Defence Studies, Jennifer Shaw, ed., (London: The Royal United Services Institute, 128(2), June 1983), p. 11. Hereafter referred to as "New Operational Dimensions."

[95]Simpkin, Race to the Swift, pp. 4 - 8.

[96]Hussain, et al, "The Future of the Military Helicopter", p. iii.

[97] Air cushion technology allows vehicles to move on a cushion of air produced by the vehicle itself. Propulsion is achieved by additional horizontal thrust sources like propeller engines or turbine engines. The LCAC used by the U.S. Marine Corps is an example of this technology. For more detailed information see Jane's High Speed Marine Craft and Air Cushion Vehicles 1989, by Jane's Transport Data, (Surrey, UK: Jane's Information Group, 1989). Electromagnetic motion technology is my term to describe motion achieved by the interaction of opposing electromagnetic fields. A nearly frictionless field can be formed between two electromagnets whose common poles are facing each other, i.e. positive to positive or negative to negative. If the opposing force of the field is equal to the weight of the body producing the field, the body (or in this case a vehicle) will "float" on the field. This technology is based upon Faraday's Law which proves that a force is generated perpendicular to the magnetic flux moving between two magnets and an electrical current running perpendicular to the flux (see Diagram 1, Appendix D). Propulsion is imparted by magnetic induction. The relative motion of the magnet attached to the vehicle induces in a conducting sheet currents which are equivalent to a magnet of similar polarity. The result is a virtual magnet which mirrors the actual magnet. The repulsion effect between the real

magnet and the virtual magnet induces the horizontal motion (see Diagram 2, Appendix D). A monorail transportation system is an example of this technology. For a more specific discussion see Transport Without Wheels, by E.R. Laithwaite, (Boulder, CO: Westview Press, 1977).

[98]Everett-Heath, et al, "Military Helicopters", 1990, p. 144.

[99]Donaldson, "Rogue Rooivalk", pp. 16 - 17.

[100]DA, FM 100-2-3, p. 5-211.

[101]Rudolph Ostovich, III, Major General, "Army Aviation's Continuing Story in DESERT STORM", Army Aviation 40(6), (Westport, CT: Army Aviation Publications, 30 June 1991), p. 10.

Bibliography

Books

Baxter, William P. Soviet Airland Battle Tactics. Novato, CA: Presidio Press, 1986.

Bellamy, Christopher D. The Evolution of Modern Land Warfare: Theory and Practice. London: Routledge, 1990.

Bellamy, Christopher D. The Future of Land Warfare. New York: St. Martin's Press, Inc., 1987.

Carver, Michael Power, Field Marshal Lord Baron. The Apostles of Mobility: The Theory and Practice of Armoured Warfare. New York: Holmes & Meier Publishers, Inc., 1979.

Deighton, Len. Blitzkrieg: From the Rise of Hitler to the Fall of Dunkirk. New York: Ballantine Books, 1982.

Denison, George T., Colonel. A History of Cavalry From The Earliest Times. London: Macmillan and Co., Limited, 1913.

Dupuy, Trevor N., Colonel. The Evolution of Weapons and Warfare. Indianapolis/New York: The Bobbs - Merrill Company, Inc., 1980.

Everett-Heath, E.J., Moss, G.M., Mowat, A.W., and Reid, K.E. "Military Helicopters". Land Warfare: Brassey's New Battlefield Weapons Systems and Technology Series Volume 6. London: Brassey's (UK), 1990.

Fails, William R., Lieutenant Colonel, USMC. Marines and Helicopters 1962-1973. Washington, D.C.: History and Museums Division, Headquarters, U.S. Marine Corps, 1978.

Gray, Alonzo, Captain. Cavalry Tactics As Illustrated by the War of the Rebellion. Ft. Leavenworth, KS: U.S. Cavalry Association, 1910.

Grbasic, Z. and Vuksic, V. The History of Cavalry. Lucerne: Motovun (Switzerland) Copublishing Company Ltd., Lucerne and Bessa (Switzerland) Publishing Company Ltd., 1989.

Gregory, H.F., Colonel . Anything A Horse Can Do: The Story of the Helicopter. New York: Reynal and Hitchcock, 1944.

Haig, Douglas, Major General. Cavalry Studies: Strategic and Tactical. London: Hugh Rees, Ltd., 1907.

Harrison, P.G., Everett-Heath, E.J., Moss, G.M., and Mowat, A.W. "Military Helicopters". Brassey's Battlefield Weapons Systems & Technology Series Volume IX. London: Brassey's (UK), 1985.

Jane's Transport Data. Jane's High Speed Marine Craft and Air Cushion Vehicles 1989. Surrey, UK: Jane's Information Group, 1989.

Keegan, John and Holmes, Richard. Soldiers: A History of Men In Battle. London: Hamish Hamilton Ltd., 1985.

Laithwaite, E.R. Transport Without Wheels. Boulder, CO: Westview Press, 1977.

Lamb, Harold. Genghis Khan, The Emperor of All Men. Garden City, NY: Doubleday & Company, Inc., 1956.

Maude, F.N., Lieutenant Colonel. Cavalry: Its Past and Future. London: William Clowes & Sons, Limited, 1903.

Montross, Lynn. Cavalry of the Sky: The Story of U.S. Marine Combat Helicopters. New York: Harper & Brothers Publishers, 1954.

Richardson, Doug. Modern Fighting Aircraft: AH-64 12. New York: Prentice Hall Press, 1987.

Roemer, J. Cavalry: Its History, Management, and Uses in War. New York: D. Van Nostrand, 1863.

Simpkin, Richard E. ANTITANK: The Airmechanized Response to Armored Threats in the 90's. London: Brassey's Publishers Limited, 1982.

Simpkin, Richard E. Deep Battle. London: Brassey's Defence Publishers, 1987.

Simpkin, Richard E. Race to the Swift. London: Brassey's Defence Publishers, 1985.

Simpkin, Richard E. Tank Warfare. London: Brassey's Publishers Limited, 1979.

Suvorov, Viktor. Inside the Soviet Army. New York: Macmillan Publishing Co., Inc., 1982.

The Editors of Time-Life Books. The Armored Fist New Face of War Series. Alexandria, VA: Time-Life Books, 1990.

Truscott, Lucian K., Jr., General. The Twilight of the U.S. Cavalry: Life in the Old Army, 1917 - 1942. Lawrence, KS: University Press of Kansas, 1989.

van Creveld, Martin. The Transformation of War. New York: The Free Press, 1991.

von Bernhardi, Frederick, Lieutenant General. Cavalry in Future Wars. Ed. trans. Charles Sydney Goldman. London: John Murray, 1909.

Wheeler, Howard A. Attack Helicopters: A History of Rotary-Wing Combat Aircraft. Baltimore: The Nautical and Aviation Publishing Company of America.

Zaloga, Steven J. and Balin, George J. Anti-Tank Helicopters. London: Osprey Publishing Ltd., 1986.

Monographs, Manuscripts, Unpublished Papers

Baribeau, Stephen R., Major. "Soviet Attack Helicopters and Their Implications for U.S. Army Division Operations". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1985.

Bolzak, Jerry R., Major. "The Role of the Airmechanized Raid in Operational Maneuver". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, June 1990.

Crawford, Darrell E., Major. "Airmechanization: Determining Its Tactical Viability on the Airland Battlefield". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College.

Dyster, Paul A. "In the Wake of the Tank: The 20th-Century Evolution of the Theory of Armored Warfare". Unpublished Ph. D. dissertation. Baltimore: The Johns Hopkins University, 1984.

Hicks, Guy and Pickett, George. "Airland Battle, Helicopters and Tanks: Factors Influencing the Rate of Innovation". Unpublished paper, 9 August 1988.

Hussain, Farooq, Kemp, Ian, and McCarty, Philip. "The Future of the Military Helicopter". London: Royal United Services Institute for Defence Studies, 1986.

Sharpe, Kenneth W., Major. "Integration of United States Attack Helicopters into the Combined Arms Battle in Europe: An Analysis of Attack Helicopter Anti-Armor Employment Doctrine For A NATO Defensive Environment". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1986.

Simmons, James E., Major. "The Attack Helicopter Battalion: Ready for the 60's or the 90's?". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, December 1989.

Webb, George S., Major. "Prescription for the Counterstroke: The Airmechanized Division at the Operational Level of War". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1986.

Webb, George S., Major. "The Flashing Sword of Vengeance: The Force-Oriented Counterattack from a Historical Perspective with Implications for the Airland Battle and Combat Aviation". Fort Leavenworth, KS: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1985.

Periodicals

Colucci, Frank. "Using LH". Defence Helicopter Volume 10 (No. 3). Buckinghamshire: The Shephard Press, June - July 1991: 6-11.

Donaldson, Peter. "Rogue Rooivalk". Defence Helicopter Volume 10 (No. 3). Buckinghamshire: The Shephard Press, June - July 1991: 12-17.

Donaldson, Peter. "Tiger in the Forest". Defence Helicopter Volume 10 (No. 3). Buckinghamshire: The Shephard Press, June - July 1991: 18-22.

Gavin, James M., Major General. "The Future of Armored Warfare". Armored Cavalry Journal, Nov - Dec 1947: 3-6.

Gavin, James M., Major General. "Cavalry, and I Don't Mean Horses". Harper's Magazine Volume 208 (No. 1247). New York: Harper & Brothers Publishers, April, 1954: 54-60.

Grangier, Mark. "Agusta, the year of the Mongoose". Interavia Volume XXXIX(No. 5/84). Geneva: Aerospace Review, May 1984: 491-493.

Harrison, Benjamin L., Major General (Retired). "AirLand Battle - Future and the Aviation Brigade". Army Aviation Volume 40 (No. 7). Westport, CT: Army Aviation Publishers, 31 July 1991: 17-19.

McGinty, Kenneth, Lieutenant Colonel. "Attack Helicopters and the 6th Cavalry Brigade". Defence Helicopter World Volume 5 (No. 2). Buckinghamshire: The Shephard Press, April - May 1986: 6-10.

McNamara, Robert S. "The Prospects for Army Air Mobility". Army Volume 13 (No. 8). Washington, D.C.: Association of the United States Army, March 1963: 20 - 21.

Ostovich, Rudolph, III, Major General. "Army Aviation's Continuing Story in DESERT STORM". Army Aviation Volume 40 (No. 6). Westport, CT: Army Aviation Publications, 30 June 1991: 8-10.

Quaranta, Paolo. "Attack Helicopters". Defence Today (No. 3-4). Rome: Editorial Group, Publishers & Consultants S.p.A., March - April 1989: 81-86.

Saint, Crosbie E., General. "Central Europe Battlefield 2000: The Combat Helicopter". Army Aviation Volume 40 (No. 1). Westport, CT: Army Aviation Publications, 31 January 1991: 4-7.

Saint, Crosbie E., Lieutenant General and Yates, Walter H., Jr., Colonel. "Attack Helicopter Operations in the Airland Battle: Close Operations". Military Review Volume LXVIII (No. 6). Fort Leavenworth, KS: U.S. Army Command and General Staff College, June 1988: 2-15.

Simpkin, Richard E. "Flying Tanks? -- a tactical - technical analysis of the 'main battle air vehicle' concept". Military Technology. No. 8/84. Bonn: Wehr & Wissen Verlag, 8 August 1984: 62-80.

Valente, Emidio, Colonel and Cicolin, Maurizio, Lieutenant Colonel. "A-129: The Flying Tank". Revista Militare, Journal of the Italian Army. Volume 4/84. Rome: Rome: Sezione Amministrativa dello Stato Maggiore dell' Esercito, July - August 1984: 19 - 33.

von Senger und Etterlin, Dr. F. M., General. "New Operational Dimensions". Journal of the Royal United Services Institute for Defence Studies. Ed. Jennifer Shaw Volume 128 (No. 2). London: The Royal United Services Institute, June 1983: 11-18.

von Senger und Etterlin, Dr. F. M., General. "The Air-mobile Divisions: Operational Reserves for NATO". Journal of the Royal United Services Institute for Defence Studies. Ed. Brian Holden Reid. Volume 132 (No. 1). London: The Royal United Services Institute, 1987: 23-30.

Government Publications

Howze, Hamilton H., General. Tactical Mobility Requirements Board Final Report. Fort Bragg, NC, 1962.

U.S. Department of the Army. "Field Manual 100-2-3". The Soviet Army: Troops, Organization, and Equipment. Washington, D.C.: U.S. Government Printing Office, June 1991.

Miscellaneous

Deneba Software. The Big Thesaurus™. (Miami, FL: Deneba Systems, Inc., 1986-1988).