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DEVELOPMENTS IN GROUND WARFARE FROM 1939 TO 1948
AND FUTURE POTENTIALITIES

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Developments in ground warfare from 1939 to 1948 and future potentialities, by Lt Col M. Zais, Inf. Command and General Staff College. 31 May 49.

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TABLE OF CONTENTS

Table of Contents

	<u>Page</u>
Section I SCOPE - - - - -	1
II HISTORICAL BACKGROUND - - - - -	1-2
III CONCEPTS OF WARFARE - 1918-1941 - - - - -	2-5
IV DEVELOPMENTS FROM 1941 TO 1948 - - - - -	5-10
V FUTURE POTENTIALITIES - - - - -	10-11

- ANNEXES: 1 - DIRECTIVE
 2 - SUPPLEMENTAL NOTES
 3 - BIBLIOGRAPHY

DEVELOPMENTS IN GROUND WARFARE FROM 1939 TO 1948
AND FUTURE POTENTIALITIES

Section I

SCOPE

In so small a compass, it is impossible to give more than a bird's eye view of the subject, therefore the treatment will be confined to major developments in concept as they have been effected by the evolution of instruments of war.

Section II

HISTORICAL BACKGROUND

In the nineteenth century the trend in warfare was toward increase in manpower in order to achieve greater firepower. As the rate of fire increased a small force on the defensive could hold back a much larger force on the offensive and the deployment of firepower resulted in purely linear formations. This trend led to greater lateral dispersion and from 1861 to 1914 the distance between men increased from three paces to fifty paces. During World War I, trench lines extended hundreds of miles and flanks were anchored on unassailable barriers. In order to reinstate mobility two methods were resorted to. The first was to neutralize the defender by the use of lethal gases and the second was to neutralize the fires of the defense by bullet proof armor. This second solution led to the invention of the tank which in turn stemmed directly from the invention of the internal combustion engine.¹ What the tank accomplished can be summed up as follows: it increased mobility by substituting mechanical power for muscular power; it increased individual protection for the soldier by providing armor protection and it increased offensive power by relieving the soldier from carrying his weapon or the horse from hauling it. It secured the soldier statically while it allowed him to fight dynamically.² Thus the barrier imposed by flankless fronts was eliminated allowing the attacker, protected by his armor, to break through the outer linear barrier and to strike the enemy at his most vulnerable

places--his command and supply system located in his rear. Thus did the "sitzkrieg" (war of position) pass into the "blitzkrieg" (war of rapid movement) and to the war of 1914-1918 may be attributed the blind development from mass toward machine warfare, an all but unconscious progression from the quantity theory of war to the quality theory.

The two outstanding tactical theories that emerged from World War I envisioned an attack on the enemy's command aimed at demoralization of the enemy's fighting forces and attack on the enemy's civil population to disrupt his economy and demoralize his government. These were to be attained by the use of armor and aircraft. From one grew the concept of the employment of armor in mass and the employment of aircraft to place soldiers in the heart of the enemy rear;³ from the other grew the concept of tactical and strategic bombing. The use of airborne troops, although not demonstrated in World War I, was later developed and applied by Russia, improved upon by Germany and exploited by the United States and Great Britain.⁴

Section III

CONCEPTS OF WARFARE, 1918-1941

Developments between 1918 and 1941 were so significant and merged with later developments to such a great extent that a general discussion of warfare as conceived by each of the major powers during this period is essential for a full understanding of the trends that followed.

United States and Great Britain

The United States and British Armies continued to look to the principles evolved in the last war except for a small group of enthusiasts who saw that the invention of the tank and airplane reinstated shock action and mobility and relegated the concept of linear warfare to the past.⁵ Their concept was well expressed as far back as the 1929 edition of the Encyclopedia Britannica:

The decisive point of attack will again become the rear of the enemy's army...The approach will be made rapidly not only by road but across country, consequently the nature of strategy will be changed. Area warfare will replace linear warfare and fronts may be anywhere.

At that time, the use of airborne troops was not considered but the subsequent development of their use added weight to this theory. Even while a small group was thus thinking, the lethargy was so prevalent that prior to 1938 the United States War Department was spending more on horses, mules, harness and wagons than on tanks, arms and armed vehicles.⁶

France

In France the military leaders were even more beset by complacency with the lone exception of De Gaulle.⁷ The small Renault tank armed with a .37mm gun or a machine gun was designed primarily to accompany infantry and the theory of linear warfare as practiced in World War I was retained as the guiding doctrine. Extended fronts and the protection of the individual were designed to develop small arms and artillery power based on the theory that the defense was still the stronger force in ground warfare. No effort was made to develop the offensive power inherent in armor and although the Maginot Line served a valuable purpose it was like a shield in the hands of a fighter without a sword to cooperate with it.

Germany

In Germany, great interest was displayed in the new theory of ground warfare and although production and mobilization were restricted until 1933, the application of the principles of shock action, rapid movement and attack and defense in depth after that date were astonishing.

The German General Staff believed in the concentration of force upon a narrow front. First a weak point was to be discovered by limited attacks in numerous areas; second, a strong assault force was to be rapidly moved against it; third, the assault would derive shock action

from massed armor, and, fourth, a gap having been made additional forces would penetrate the gap, roll up the flanks and attack the enemy in rear. The Germans did not overlook the other arms in perpetuating the principle of shock action in its entirety. Infantry were reorganized to fit the shock action, aircraft were brought into alliance not only in the form of flying artillery but flying personnel and cargo carriers.⁸ All arms were intricately fashioned into one instrument designed to overthrow the enemy in the shortest possible time through speed, fury of attack and relentless pressure until the enemy's resistance was totally smashed.

USSR

Soviet doctrines indicated an awareness of the new trends in tactical problems. Though they were the forerunners in the concept of employment of parachutists and had employed a limited number in Finland the use to be made of them was not yet definite. The trend of Soviet thought was to the effect that depth strategy must take the place of line strategy. They conceived the modern attack as a series of waves which continue with increasing strength to batter against the obstacles to their front. Massed aviation constituted the first echelon, tanks and motorized units constituted the second echelon and behind these followed the battering ram of large infantry units. They challenged the theory of Schlieffen, who stressed strength on the flanks for eventual maneuver, and believed in uniform echelonment in depth to gain penetration and decisive exploitation.⁹

Italy

The Italian concept of war was established in the same pattern as that of the German modified by the natural resources and industrial capability of the nation. The most outstanding, and even to this date, the most controversial trend was expounded by the Italian Giulio Douhet shortly after the conclusion of the First World War. This was to the effect that the vital area of operations was to be discovered in the will of the civil population; for were it to be broken by terror, the whole machinery of government and with it of military direction would

collapse into anarchy. Therefore, by the employment of large masses of aircraft in the role of strategic bombers, the need for a ground army would cease to exist except in the role of police and occupation forces.¹⁰ This theory however was never applied by the Italian nation at war.

Japan

Japanese developments were dictated by the geographical position and the grand strategy of the nation. Emphasis was placed primarily on the training of the soldier and his individual mobility and self sufficiency.¹¹ Excepting aircraft, it was recognized that in jungle warfare, war machines were often an encumbrance rather than an assistance. Supply problems were minimized due to the training, hardihood and dietary habits of the Japanese soldier and as a direct result thereof operations were not restricted to the normal lines of communications. It was the application of this Japanese concept which destroyed the traditional faith placed in natural terrain barriers.

In the field of amphibious warfare the Japanese contributions were more tangible. Although landing operations date back to antiquity, the Japanese pointed the way to the development and use of diversified landing craft and supporting vessels by their early employment in the Yangtse River operations in China, and their later employment in the Philippine Islands. These landing craft, although primitive in nature, led to extensive development within the ensuing three years and established a basis for the application of new techniques.¹²

Section IV

DEVELOPMENTS, 1941-1948

During the period 1941-1948 there were few developments which affected the concept of war as radically as did those developments which were conceived near the close of the First World War and which matured between the two world wars. From 1939 to 1941 the astoundingly successful application of the new concepts were demonstrated by the German army first in Poland and then in Holland, France and Crete. Henceforth, those nations which had lagged in the acceptance

of the new theory feverishly strove to emulate the Germans. The results of these efforts, with the exception of the atom bomb, merely improved arms and equipment or techniques of their application but did little to effect major changes in concept.

Armor

The most notable trends in tank development during this period were improved mobility, armor and armament. Prior to the Libyan Desert Campaign the mechanical development of the tank had received priority of attention however it was here demonstrated that to defeat a tank successfully, an antitank gun must be at least as mobile as the tank and its gun crew must be protected against fire from the tank in order to deliver accurate fire against such a mobile target. A weapon designed to meet these requirements would be, simply, another tank.¹³ Therefore, the emphasis changed from mechanical development to armor and armament of tanks. Here started the gun versus armor battle and each succeeding gun, more powerful than the previous model, resulted in an increase in armor. Here also was revealed for the first time the descendency of the battlefield supremacy of the tank by virtue of the development of a counter weapon. When opposed by a like number of tanks, the shock action, mobility and armor protection of the tank was neutralized. Based upon the experiences of the war therefore, the concept of employment of tanks accorded major emphasis to gun power and mobility, in that order, with armor protection a secondary, though important consideration.

Anti-Tank Weapons

Another development which minimized the earlier ascendancy of tanks was the rocket launcher which manned by an individual soldier was capable of penetrating twelve inches of armor at one thousand yards. The recoilless rifle, also developed during this period, in addition to supplementing the assault fire of the infantry, was capable of inflicting severe damage on the lighter tanks.

Balance

The improved anti-tank weapons and the resultant need for close-

in protection led to a reallocation of the ratio of infantry to tanks in armored formation. In 1940, infantry battalions were outnumbered about three to one by tank battalions, however, the ratio gradually increased until a figure of approximately one to one evolved.¹⁴

Air

The close-in support of ground troops by aircraft developed more in technique than in theory during this period. Communication, control, coordination and target identification were the prerequisites for the successful application of this concept and they were effected through the development of improved radios, the establishment of closer liaison between ground and air and the integration of personnel of each arm within the other. Aircraft were utilized by ground forces for extensive flank protection; as forward reconnaissance; supplementation and extension of artillery support and for photographic missions.

The use of large masses of troop carrier aircraft to transport the ground soldier deep into enemy territory effected the concept of ground warfare to a greater extent than any other development throughout the period and logistical support by cargo aircraft rendered an ever increasing supplementation to the conventional methods of supply and evacuation.¹⁵ During the war, troop carrier aircraft were adaptations of commercial versions and it was not until after the war that aircraft were designed and produced for the specific purpose of transporting troops and cargo. Developments from the close of the war until 1948 progressed rapidly and included the production of light, medium and heavy troop carrier aircraft with increased cargo capacity and range and improved landing capabilities.

Communications

Communications were improved considerably during this period. Contact within large and small units was facilitated thus providing the control necessary for increased mobility and flexibility.

Amphibious

It was during World War II that a situation was reached, sufficiently serious in its imperative requirements, which forced the

construction of special landing craft in conformity with the requirements of modern amphibious operations. There existed a need, in general terms, for structures that could make landings possible independent of harbors, on practically any type of coast except the most precipitous. Hence there were developed flat bottomed, motor propelled craft that allowed the carrying of landing troops to the shore at great or medium speed. This enabled early, or simultaneous landing of heavy weapons, artillery and tanks, in order to meet on equal terms an enemy who possessed them, or to overwhelm him with their help if he did not. Such craft in addition supplied fire power during the assault and provided for the maintenance of an initial supply system. By the time of the Normandy invasion in 1944 the American Naval constructors, having pooled their ideas with the British, had worked out more than sixty variants of landing craft and escorts.¹⁶

A direct result of the successes achieved in this mode of warfare was the continuation of the trend toward global employment of ground troops. The need for ground troops to be trained to fight in all climates and all geographical areas of the world was emphasized. Not only did developments in amphibious warfare expand the area of operations but they lent greater flexibility to the offense by enabling the ground commander to employ sea power for bypassing, enveloping or turning an enemy position.

Atomic, Biological and Chemical

The use of the atom bomb in 1945 was a projection of the theory of strategic bombing employing an explosive force equivalent to the detonation of 20,000 tons of TNT. In the minds of many authorities this development along with the improvements in biological and chemical agents rendered the role of ground armies obsolete. There has been no conclusive proof that such is the case although the employment of detection and protective devices and the need for even greater dispersion in movement, concentration and deployment for combat by ground troops was reemphasized. In addition, it became imperative

that all ground troops be capable of rapidly massing for counter attack in order to seize the bases from which such attacks emanated.¹⁷

Guided Missiles

Guided missiles armed with atomic war heads or conventional explosives created the same requirements for dispersion and protection as other weapons differing only in manner of propulsion rather than effect. Since they could be launched and directed from great distances, and since interception methods had not been developed, the most suitable counter-measure was seizure of the launching sites by ground troops thus reemphasizing the vital role of ground troops in modern warfare.

Radar and Proximity Fuse

Radar which was first applied during World War II served a multiplicity of needs in fire direction and control, detection of targets, and control of missiles in flight. The supremacy of aircraft was counteracted through the use of radar by providing ground troops with early warning of the approach of aircraft and by increasing the accuracy of anti-aircraft weapons. The development of the proximity fuse also increased the effectiveness of anti-aircraft fire and improved efficiency in the field of conventional artillery.

Logistics

In the vast field of logistics the trends followed in the wake of strategic and tactical doctrine. As a result of the increased complexity of ground warfare, more supplies, more transportation, more service and more management were needed to support the mechanized, mobile, global armies of the period. The technical and complicated weapons and equipment of war precluded the armies from living off the land and the lines of communication were thus extended and swollen to an unprecedented degree. Zones of interior were completely mobilized to support the war effort and large, complex communication zones were required to support ground operations. Greater emphasis was placed on logistics than ever before in the history of warfare.

Section V

FUTURE POTENTIALITIES

A study of the history of war reveals that though the means of attack and defense change out of all recognition, the form of attack and defense remain constant. ¹⁸

Airborne Warfare

Probably the greatest change to be expected in the conduct of ground warfare will be the use of aircraft to fly troops and cargo anywhere in the world on short notice. Only through flight can a future war be waged in accordance with the principles of surprise, mass and economy of means. Through air transportability can be combined complete dispersion in defense with the ability to rapidly mass for the attack or counter attack. Roads and cross country movements will be dispensed with as necessity dictates and battles will no longer be fought over areas alone, or in lines but in cubic spaces. Armies of the future will be prepared to defend themselves or initiate the offensive in all directions.

Pattern for the Future

Despite the fact that war is more complex and in spite of aircraft, decision will still be gained on the surface of the earth. Although the forms of attack remain constant, advances in the field of technology and technical science will effect the future concept of tactical and strategic employment of ground troops. The predictions which follow are governed by those changes which are apparent on the basis of developments which are presently considered practicable.

Speed, mobility, shock action, dispersion and flexibility will rule the battlefield. Infantry weapons, artillery weapons, armored vehicles and all of the various accoutrements of war will be decreased in weight. Increased firepower in light weapons will neutralize much of the shock action of tanks, Artillery will be self-propelled and all personnel carriers and supporting transportation for infantry and armor will possess greater cross country mobility in order to support the movement and deployment of ground forces regardless of road net and terrain barriers. Television and improved communication facilities

will allow greater dispersion without complete loss of control and will enable any component of a fighting team to communicate by organic means with any other component of the team. Radar, in addition to the functions previously discussed, will afford isolated units protection from surprise and will facilitate increased night operations. Units will operate on broad fronts but will be massed quickly for decisive action against vital objectives. They will be more self contained for logistical support and the concentration of large stocks of supplies in compact rear areas will be precluded. Supply will be effected to an increasing degree by air. The un-essentials of war will be eliminated and emphasis will be placed on the supply of ammunition and those minimum essentials necessary for the conduct of war. Individuals will live off the land to a greater extent and there will be an increased requirement for independent, self sufficient soldiers. Small unit leaders will be required to display initiative to an unprecedented degree and the task of large unit leaders will be complicated by the loss of personal contact inherent in dispersed operations. Organization, equipment and tactics will reflect variable geographical considerations and will allow for deletions of standard equipment, modifications to be made thereto and equipment prescribed in lieu thereof, for desert, tropical-jungle, mountain and arctic warfare.

Ground warfare will be mobile, global and dispersed and the vision of military leaders must be as spacious and varied as the universe which will be the next theater of war.

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REFERENCES: Foertsch, The Art of Modern Warfare; von Caemmerer, The Development of Strategical Science during the Nineteenth Century; Nickerson, The Armed Horde, 1793-1939; de Gaulle, The Army of the Future; Limpus, Twentieth Century Warfare; Johnson and Haven, Automatic Arms: Their History, Development and Use; Williams, Air Power; DeWeerd, Great Soldiers.

NOTE TO STUDENTS:

1. The references above are furnished to give the student enough material with which to begin his research. It is anticipated that the student will make use of all other available sources in order to give adequate scope to his subject and, when appropriate, to complete development of the subject to date.

2. The scope suggested below is intended as a guide only, and is not to be construed as a limitation on the student's perusal of the subject.

SCOPE:

1. The most important single factor influencing the new warfare is the internal combustion engine.

2. The internal combustion engine as used in the tank, a mobile and armored machine gun and artillery platform, which in great numbers combines the effect of fire power with the shock of heavy cavalry.

3. Mechanized conveyances for troops, weapons, and supplies have affected both the tactics of armies and the strategy of war.

a. Trucks and motor highways supplement the railways for strategic purposes.

b. Concentrations of manpower and weapons may be effected on the battlefield by gun carriers and troop conveyances.

4. Attack columns propelled by internal combustion engines have not eliminated the need of orthodox artillery preparation or the use of ground-holding infantry equipped with infantry weapons.

5. The aerial and tank forces of a modern army are a powerful supplement to the offensive strength of infantry and artillery arms but are in themselves incapable of rendering the decision.

1. Fuller interprets the impact of new inventions generally as follows:

At the turn of the last century the inventions which were to revolutionize land warfare first appeared in practical form. They were the internal combustion engine and wireless telegraphy which went far beyond anything accomplished by gunpowder or steam power. The internal combustion engine, leading to the solution to the problem of [improved land propulsion and] flight raised war into the third dimension whereas wireless telegraphy virtually raised it into the fourth; for the wireless transmission of energy, to all intents and purposes, annihilated time.

Warfare Today, Major General J. F. C. Fuller. p. 6.

2. Ibid, pp. 17-18.
3. A Confederate doggerel of the Civil War, still repeated at the beginning of the century said:

If you want to see tankers
Just tremble with fear,
Tell them that Jeff Davis
Has got in their rear.

4. Airborne Warfare, Maj Gen J. M. Gavin, 1947. In the introduction, p. VII, Maj Gen Wm C. Lee states:

By 1927 different armies of the world had carried out experiments by dropping equipment by parachute and transporting small numbers of fighting men by aircraft. In Texas the following year, the United States Army dropped a small number of men by parachute with weapons and ammunition. In 1930 the Red Army dropped a group of military parachutists with equipment, and in 1936 it was reported that the Russians had dropped over five thousand parachute troops in a single operation during maneuvers at Kiev. By 1938 the Command and General Staff School of the U.S. Army was beginning to touch on airborne warfare in its theoretical tactical instruction. And, finally, in the Russo-Finnish war of 1939, came the significant report that Russian parachute troops had been dropped in actual combat.

5. Foreign Affairs, vol. 19, p. 34, Oct 1940, The New American Army, Hanson Baldwin discussed the conflicting concepts of mass versus mobility and speed versus mobility. His conclusions were:

Many of our present tactics stem from an age that is gone; the dead hand of tradition still lies heavily upon our military thought processes. We must renovate our thinking, for our final citadel is the citadel of the mind. It must be broad and spacious and strong,

receptive of new ideas.

6. National Defense Plan or Patchwork, *ibid*, vol. 19, p. 1, Lindsay Rogers. In relation to the new concept Fuller says:

Though, little by little, the ideas of this school roused some interest in the United States and British Army, the pacific mood into which politics had fallen prevented the new yeast from raising the old dough.

(Warfare Today, Maj Gen J. F. C. Fuller, p. 31).
7. The Army of the Future, General De Gaulle.
8. Armored Warfare, *Armored Cavalry Journal*, vol. LVIII, p. 7, January-February 1949. General Heinz Guderian states that the need for cooperation between air and armor was so evident that it occupied the thoughts of the leading officers, however, contrary to popular thought, little practical results were achieved in training and it was not until the war was in progress that cooperative effort was achieved through early recognition of the requirement by all branches of the service.
9. Twenty Million Reds, Lt Col Charles A. Willoughby, *Infantry Journal*, vol. XLVI, January-February 1939. p. 58.
10. The Command of the Air, Giulio Douhet, 1927, Brig Gen Billy Mitchell, US Army, and Sir Hugh Trenchard of Great Britain were also leading exponents of strategic bombing aimed at destruction of industry and large centers of population.
11. In jungle warfare, the attack dominates the defense. In this fighting the deciding factor is man and not the machine. Not tanks, artillery or armored cars, though at times they were useful; instead snipers, machine gunners and mortar teams. Tanks are useful on the roads and aircraft invaluable in the open spaces; but in the jungle itself it was the self reliant, lightly equipped soldier who triumphed.

The Second World War, J. F. C. Fuller, p. 145.
12. Landing Operations, Dr. Alfred Vagts, 1946.
13. General Adna Chaffee, US Army, during the Plattsburg Maneuvers of August 1939 expressed this thought although at the time it received little consideration.

Trends in Tank Development, Colonel H. H. D. Heiberg, *Armored*

Cavalry, January-February 1949, p. 19.

14. Tin Can Doughboys, Lt Col Morgan G. Roseborough, Armored Cavalry Journal, March-April 1949, p. 18.

Armored Warfare, General Heinz Guderian, Armored Cavalry Journal, p. 4.

15. By 1945 the use of Troop Carriers was to play so important a role that the drop of airborne troops across the Rhine River by a United States Airborne Corps involved the use of 1595 troop-carrier planes, and 1347 gliders supported by five thousand ^{fighters} and three thousand bombers.

Airborne Warfare, Maj Gen James M Gavin, 1947, p. 133.

16. Landing Operations, Dr. Alfred Vagts, 1946, p. 630.

17. General Omar N Bradley in a speech to the Military Order of World Wars, New Orleans, April 1948, expressed the following opinion:

There has been so much emphasis on the atomic bomb that one hears wild speculation that another war need not last longer than 30 minutes. The last war needn't have lasted any longer than that. Britain could have surrendered in less than 30 minutes following Dunkerque; the Germans were amazed that the British didn't. We could have surrendered to Japan 30 minutes after the devastation of Pearl Harbor. Even the Germans didn't seem to realize that they could have surrendered 30 minutes after we landed in France. The last war was not won until we had ground soldiers standing on the enemy's ground. And any future war, in my estimation, would not be over until our soldiers occupied, at least, key areas of the enemy country-- or until enemy soldiers were similarly established on our home soil. While I hope that an enemy would give up 30 minutes after a war started, I pray that we would never bow to an aggressor--in 30 minutes or 30 years.

18. The classic example of the penetration was demonstrated by Alexander at the battle of Arbella, October, 331 B.C., and of the envelopment by Hannibal at the battle of Cannae, August, 216 B.C. J. F. C. Fuller says:

On first thought it may seem that the introduction of aircraft introduced a new form of attack and defense -- namely the vertical. But this is not so. In its day the Roman testudo was as important a means of defense against vertically falling projectiles as anti-aircraft fire and concrete shelters are now. And when at the Battle of Hastings, on 14 October 1066, William the Conqueror ordered his archers to fire their arrows into the

sky so that they would fall vertically on Harold's army, in an elementary way he was doing nothing more than what bombing aircraft now do.

The Second World War, Major General J. F. C. Fuller, 1949, p. 46.

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DEVELOPMENTS IN GROUND WARFARE FROM 1939 TO 1948
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Section I

INTRODUCTION

Perhaps the most significant revelation to be gleaned from a study of ground warfare from 1939 to 1948 is the fact that few, if any, radical changes in concept were developed during the period.

Those changes which have been popularly ascribed to the second world war were in reality a continuation of the unconscious progression from mass to machine warfare. The seed was planted through the invention of the internal combustion engine and wireless telegraphy at the turn of the last century. The stem was revealed through the introduction of motorized transportation, tanks and aircraft during the first world war and the flower blossomed forth between 1939 and 1941 when the Germans in their successive attacks on Poland, Holland, France and Crete demonstrated to the entire world the principles of mechanized warfare.

Section II

DEVELOPMENTS FROM 1939 TO 1948

From 1939 to 1941 the astoundingly successful application of the new concepts by the German army stimulated the energies of all the armies of the world. Those nations which had lagged in the acceptance of the new theories feverishly strove to emulate the Germans. The results of these efforts merely improved arms and equipment or the technique of their application but did little to effect major changes in concept.

Armor

The most notable trends in tank development during this period were improved mobility, armor and armament. Prior to the Libyan campaign the mechanical development of the tank had received priority of attention but it was here demonstrated that the most successful anti-tank weapon was simply another tank. Therefore, the emphasis

changed from mechanical development to armor and armament of tanks. Here was revealed for the first time the descendency of the battle-field supremacy of the tank for when opposed by another tank the effect of each was neutralized. Based upon the experience of the war, therefore, the concept of employment of tanks at the close of the period accorded major emphasis to gun power and mobility, in that order, with armor protection a secondary, though important consideration.

Anti-Tank Weapons

Other developments which minimized the earlier ascendancy of the tank were the rocket launcher which, manned by an individual soldier, was capable of penetrating twelve inches of armor at one thousand yards and the recoilless rifle which was capable of inflicting severe damage on light tanks.

Balance

The improved anti-tank weapons and the resultant need for close-in protection of tanks led to a reallocation of the ratio of infantry to tanks in armored formations and the pendulum swung from a ratio of three to one to approximately one to one.

Air

The technique of air ground cooperation was advanced considerably during the period through improvements in communication, control, coordination and target identification.

The use of large masses of troop carrier aircraft to transport personnel and supplies deep into enemy territory and to render logistical support to troops anywhere in the world effected the concept of ground warfare to a greater extent than any other development throughout the period.

Amphibious

The Japanese pointed the way to improved amphibious operations during their island-hopping operations early in the war. Their employment of landing craft which enabled early or simultaneous landing of

heavy weapons, artillery and tanks with troops stimulated developments by the American Naval constructors and by 1944 having pooled their ideas with the British they developed more than sixty variants of landing craft and escorts. This led to a continuation of the trend toward global employment of troops and made available to the ground commander a means for bypassing, enveloping or turning unassailable enemy flanks through the use of sea power.

Atomic, Biological and Chemical

The development and use of the atomic bomb in 1945 and the improvements in biological and chemical agents emphasized the need for employment of detection and protective devices and for greater dispersion in movement, concentration, and deployment for combat. In addition it became imperative that all ground troops be capable of rapidly massing for counter attack in order to seize the bases from which attacks emanated. Einstein summarized it neatly when he said, "the atomic bomb has created no new problems; it has merely made it more mandatory that we solve some of the old problems."

Guided Missiles, Radar, Proximity Fuse

The use of guided missiles created the same requirements for protection and dispersion as other weapons however the most suitable counter measure was seizure of the launching sites by ground troops thus reemphasizing the vital role of ground troops in modern warfare.

Radar served a multiplicity of needs in fire direction and control, detection of targets, and control of missiles in flight, and neutralized to some extent, the effective employment of aircraft.

The proximity fuse also increased the effectiveness of anti-aircraft fire as well as that of conventional field artillery.

Logistics

In the field of logistics, more supplies, transportation, service and management were needed to support the mechanized, global armies. Large complex communications zones and completely mobilized zones of interior were thus established.

Section III

FUTURE POTENTIALITIES

Probably the greatest changes to be expected in the conduct of ground warfare will be the increased use of aircraft to fly troops and cargo anywhere in the world on short notice. Only through flight can a future war be waged in accordance with the principles of surprise, mass and economy of force. Through air transportability can be combined ~~combined~~ complete dispersion in defense with the ability to rapidly mass for the attack or counter attack. Roads and cross-country movements will be dispensed with as necessity dictates and battles will no longer be fought over areas alone, or in lines but in cubic spaces.

Speed, mobility, shock action, dispersion and flexibility will rule the battlefield. Infantry weapons, artillery weapons, armored vehicles and all of the accoutrements of war will be decreased in weight. Increased fire power in light weapons will neutralize much of the shock action of tanks. Artillery will be self propelled and all personnel carriers and supporting transportation for infantry and armor will possess cross-country mobility.

Units will be more self contained for logistical support and the concentration of large stocks of supplies in compact rear areas will be precluded.

Ground warfare will be mobile, global and dispersed and the vision of military leaders must be as spacious and varied as the universe which will be the next theater of war.

