

# Field Artillery and Firepower

J. B. A. Bailey



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## Foreword

Major Jonathan Bailey is a serving officer in the Royal Artillery who has researched and written this book in his spare time over the last few years. During this period he has served with the Commonwealth Monitoring Force in Rhodesia, with 5 Brigade in the Falklands, in Northern Ireland and, latterly, as a battery commander with the British Army of the Rhine. He has, therefore, a wide experience of conventional operations and has taken a deep professional interest in the history and current developments of his own Arm, the Royal Artillery.

In his introduction, the author states that "it is *hard* to find a book which presents the principles of field artillery tactics, how these have developed with experience against a background of changing strategy and technology, and what the future may hold as a consequence". I have found it impossible!

There are books which cover some ground similar to Bailey's, although the majority have historical slants. Chris Bellamy's *Red God of War: Soviet Artillery and Rocket Forces* deals with territory similar to Bailey's chapters on the Second World War and NATO. B.P. Hughes's *Open Fire* considers how artillery was handled in battle in the eighteenth and nineteenth centuries only. Shelford Bidwell's *Gunners at War* is a tactical study of the Royal Artillery, mostly in the two World Wars, and covers similar ground to Bailey's chapters on the development of fire support, as does Kenneth Brookes's study *Battle Thunder*. Finally, Shelford Bidwell and Dominick Graham's *Fire-Power* is an excellent historical/tactical treatise, but it uses an historical approach and does not trespass on Bailey's territory. From this it follows that I agree with Jonathan Bailey when he states that he has identified a gap in the "literature concerned with field artillery", and I commend him for identifying this and producing such a scholarly *magnum opus*.

Throughout his book the author traces the ebb and flow of the importance of artillery through the centuries. He rightly states that "at different periods of history artillery has been seen either as the decisive arm on the battlefield or, more often, as the arm which merely supports the front-line troops who will decide the outcome of the battle". After reading his analysis, certain conclusions become evident. Artillery when used in penny packets fails. When used in concentrated fashion at the crucial point of a battle it produces shock action than can neutralise, paralyse and destroy the enemy and weaken his will to win. As Montgomery said, "the concentration of artillery and mortars is a battle-winning factor of the first importance". Artillery produces the firepower of fire and manoeuvre at formation level; it allows one's own side to close right up to the enemy or conversely prevents the enemy from closing up to you. The more you have, the greater the chance of success. Artillery can be used to gain tactical surprise, or as an aid to deception. It is inherently flexible and can be used in all weathers, day and night. In time of war, a commander always demands more artillery than he is allocated and, sadly, in times of peace the value of artillery and the lessons learned through history are nearly always forgotten.

One of the most interesting parts of the book is the author's glimpse into the future and his emphasis on the deep battle. Not every reader will agree with his contentions that "the significance of the deep battle will soon be comparable with that of the close battle of forty or seventy years ago; and artillery will be judged in future primarily by its performance in this engagement, not in close support". I think Bailey is right to highlight the increasing importance of the deep battle, now that sophisticated target acquisition devices are entering service combined with missile systems which can destroy armour. It is clear that if indirect fire, including air-delivered munitions, can prevent an enemy re-inforcing his troops in contact, then friendly forces engaged in the contact battle have a much greater

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chance of achieving success. That said, an army will always need to hold or seize ground, and to that end the requirement still exists for properly balanced all arms battle groups with access to substantial artillery support. The difficulty facing all Western armies is the need to balance the resources required to fund weapon systems for both the contact and the deep battles. It is certain that money will not be available for everything and, in terms of the future of artillery, Bailey has come down firmly on the side of the deep battle. He may well be right, even though some Gunners from the past may either disagree or have reservations.

I hope his book will be enjoyed by a wide field of readers encompassing professional soldiers, academics and civilians alike. I would venture to suggest that Bailey has done for Artillery what Richard Simpkin did for Armour in his excellent book *Tank Warfare*. I can give no higher praise or greater commendation.

J.H. Learmont CBE  
Major General  
Commandant, Staff College  
Camberley

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J. B. A. Bailey

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# PART I: OPERATIONAL CONCEPTS

# Chapter 1: INTRODUCTION

## Purpose

Many books have been published on military subjects, and demand for them shows little sign of abating despite the times of relative peace in which we live. Yet little of this literature is concerned with field artillery which, this book will argue, has been the primary means of combat over the last hundred years.

There are, it is true, a number of historical works which offer a "snap-shot" of artillery over a limited period; there are histories tracing the development of a particular nation's artillery over the centuries; and there are also technical reference books which catalogue equipments and their capabilities. It is, however, hard to find a book which presents the principles of field artillery tactics, how these have developed with experience against a background of changing strategy and technology, and what the future may hold as a consequence. This book attempts to provide such an analysis.

Its purpose is to explain why artillery is the most important branch of a field army and why it will remain so for the foreseeable future. As procurement "lead times" for funding and technical development grow longer, it becomes even more important that the roles of different arms and technologies are seen in a substantiated perspective. Without this, the case for commensurate manning and equipment may be lost by default.

This book is directed at the military and civilian reader alike; and therefore treads the narrow path between an explanation of the commonplace and an assumption of prior knowledge. It is intended both to inform and, through its extensive footnotes and bibliography, to aid in further research.

## Organization

Part One will outline the development of equipment and munitions, the nature of firepower and deployment on the battlefield in different theatres. Part Two deals with what have loosely been termed "ancillary services", comprising command, control and communications (C3), logistics and training. Part Three studies the specialized artillery missions and operations in special environments. Finally, Part Four traces the development of artillery support over the last hundred years and into the 21st century.

This study is concerned with modern field artillery practice, based on the principles and experience of the past and the opportunities of the future. It examines the many functions of gunnery which have changed in fashion as politics, strategy and tactics have jerked in and out of step with the burgeoning of technology and the ability to exploit it. It is a large field and the study must be focused at the expense of a number of important subjects.

Some omissions may seem severe. Although the term artillery is often taken to include air defence (AD), the latter is not considered here in its own right. In some armies, such as the British Army, air defence units form an integral part of the artillery organization. In most other armies of note this is not the case. Air



defence is generally a separate arm which, while closely integrated with other arms at a low level, is more clearly identified with the broader scope of the air battle than the problems of field gunnery. But while air defence is not treated here as a discipline in itself, the suppression of enemy air defences (SEAD) by field artillery is discussed in Chapter 10.

No attempt is made to state the precise battlefield deployments and missions of artillery formations around the world. Such details date rapidly, detract from the attempt to identify changes in ideas and arguments, and may have been overtaken by events by the time of publication, such is the speed of technological and strategic developments.

Neither does this constitute a tactical *aide mémoire* for the breast pocket of artillery officers in the field. Nor is there a systematic specification of artillery equipments, save where this helps to illustrate a significant concept in artillery practice. This is not a history of particular units or national forces, and historical episodes are used only to illustrate principles. Inevitably the forces and thinking of NATO and the Warsaw Pact (WP) attract the most attention, but from these studies points of broader international interest should emerge.

This is essentially a study of modern field artillery practice; yet even within that description there are other omissions, namely chemical and nuclear gunnery. The advent of chemical warfare was one of the most significant developments in artillery and in warfare as a whole during the First World War. While the subsequent use of chemical weapons has been limited, their threat has remained constant and is a major factor in the design of modern equipment, in the training of soldiers and in the planning by all sides in conflicts around the world. In particular, chemical weapons would be likely to play an important part in a future war in Europe. While their relevance and consequence is therefore not disputed, their effect on the conduct of field artillery tactics is probably marginal. Along with aircraft, artillery may be the means of delivering chemical agents, but aside from the narrow functions of planning chemical strikes and surviving them, field artillery practice is not significantly affected.

Just as the advent of chemical weapons in the First World War marked a new era in land warfare, so the atomic bomb in 1945 and its rapid development into artillery weapon systems was the Second World War's awesome contribution to the military matrix. Nuclear gunnery has its own procedures of target acquisition, fire planning, weapon release, survivability and logistics. It is also the subject of serious controversy, which by its nature blends tactics, strategy, politics and morality. Conventional warfare should equally be considered in the light of politics and morality, but these arguments, while scarcely less profound, have been well rehearsed over two thousand years. Nuclear issues are by contrast relatively novel, the stakes are higher and the debate is more acerbic.

The horror of the use of nuclear weapons on the battlefield speaks for itself, and their advent has affected the design of equipment and the deployment of troops. As with chemical weapons, the effects of nuclear warheads on conventional artillery practice are nonetheless slight. Their greatest significance lies in the debate over whether nuclear firepower should take the place of conventional firepower on the battlefield, and whether it has now become inappropriate at some,

or all, phases of a future war. The answer will help to determine the scale and sophistication of resources devoted to improving conventional artillery. So far as this is concerned, therefore, the significance of nuclear weapons is not so much the effect of their possible use on gunnery, as the perception of their comparative importance in peacetime; and this debate is examined in the latter sections of Chapter 18.

## Historical Perspective

Before proceeding, the reader may find it helpful to be given a brief historical perspective of the subject, pointing out the major developments in artillery tactics, and where the substantiating argument may be found in the main body of the text.

Artillery developed as the means by which an enemy could be hit at longer ranges or with a greater effective weight of fire than those which infantry, cavalry and, later, armour could achieve. Artillery has been most prized according to its ability to undertake this task relative to other arms. As a result, at different periods of history artillery has been seen either as the decisive arm on the battlefield or, more often, as the arm which merely supports the front line troops who will decide the outcome of the battle.

From the middle of the eighteenth century to the middle of the nineteenth, artillery is judged to have accounted for perhaps 50% of battlefield casualties. In the sixty years preceding 1914, this figure was probably as low as 10%. The remaining 90% fell to small arms, whose range and accuracy had come to rival that of artillery <sup>(1)</sup>. The development of artillery before 1914 is explained in Chapter 13.

It was not until the First World War, with its mostly static, soft infantry targets, that artillery was transformed through the use of indirect fire, improved target acquisition, C3, and heavy equipments and munitions. This primacy was reflected in the relative allocation of manpower to the artillery and the accounting by artillery for more than half the casualties inflicted in that war <sup>(2)</sup>. The evolution of artillery in the First World War is analysed in Chapter 14.

In the Second World War, artillery still played a major role; but to some extent, the mobility and protection of targets overtook the ability of artillery to acquire and destroy them with concentrated, indirect, high explosive (HE) shellfire. The

<sup>(1)</sup> Dupuy (1983). At the battle of Gravelotte in the Franco-Prussian War, for example, a Prussian battery was destroyed by French machine guns: Bellamy (1982a). The main reason for infantry weapons' ranges increasing to that of artillery was the advance in industrial technology which by 1850 had made a breech-loading rifle possible. A reliable breech-loading gun was not produced until the 1880s. This delay was partly due to an inability to produce a rifled barrel to the required tolerance, and either a screw or sliding breech mechanism which would not seize up during high rates of fire.

<sup>(2)</sup> Strobbridge & Schriever (1978). The British Royal Artillery, at over one million men, grew to be larger than the Royal Navy. Bellamy (1986), pp1-7, cites the percentage of casualties caused by artillery in various theatres since 1914: First World War—45% of Russian casualties, and 58% of British casualties on the Western Front. Second World War—75% of British casualties in North Africa, 51% of Soviet casualties (61% in 1945), and 70% of German casualties on the Eastern Front. Korean War—60% of US casualties (includes those caused by mortars).

most important targets were armoured, and these were eventually mastered by new direct-fire artillery guns. Indirect artillery was losing its relative potency; but its residual importance could nonetheless be seen in the resources allocated to it. In the British Army, artillery, including air defence, accounted for 40% of manpower. In the Soviet Army, the number of guns increased fivefold between 1941 and 1945, and 33% of its men were gunners. Artillery was rightly seen as the Soviet Army's prime means of destruction<sup>(3)</sup>. The development of artillery in the Second World War is examined in Chapter 16. The role of artillery in the limited wars which have occurred since 1945 is discussed in Chapter 17, while developments in Europe after 1945 are explained in Chapter 18.

As important targets became more mobile and heavily armoured in the post-war period, the ability of the little-improved HE shell to do damage decreased, and improvements in range and acquisition were not sufficient to compensate. On the other hand, accuracy did improve, the 155mm shell was preferred to lighter calibres and automatic data processing (ADP) was introduced into command posts (CPs).

Although the relative power of artillery was waning, its major role throughout the 1970s still lay close to the forward edge of the battle area (FEBA), that is, between 500 metres and the furthest range of assisted vision. The role of depth fire in this period showed little sign of rejuvenation, there being few improvements in target acquisition, range and accuracy, which might have enhanced harassing and counter-battery (CB) fire. The effectiveness of depth fire depended on the resources put into it. In the case of NATO, compared to the WP, this was not very great, with the result that NATO's artillery faced a more serious threat to its survival at a time when its ability to fulfil its traditional role in close support was diminishing. CB fire is examined in Chapter 9. The relative post-war decline of artillery is reflected in the manning figures<sup>(4)</sup>.

The Yom Kippur War revealed how field artillery had been neglected. The suppression of anti-tank defences was clearly of even greater importance than before, but there was little immediate prospect of artillery's regaining a major anti-tank role. Without improvements in target acquisition, range, munitions, command and control - - and in battlefield tactics to take advantage of these developments — its further decline seemed likely.

The technological pendulum swings back and forth. There is now a happy coincidence of technological and tactical change that will secure for artillery a unique position, if not primacy, on the battlefield for the foreseeable future. Heavy indirect-fire weapons, based on the immense potential of emerging technology (ET), will become the most important on the battlefield, giving artillery a decisive role. By contrast, the infantry may hope to achieve some improvements in

<sup>(3)</sup> In June 1941 the Soviets had 37,500 guns and mortars: Larionov et al. (1984), p29. By July 1943 this had risen to 105,000: *ibid*, p199.

<sup>(4)</sup> The most extreme case, that of the British Royal Artillery, showed a fall to 8% of army strength, excluding air defences, by 1980. The Bundeswehr field artillery stood at 15%, and even the Soviet artillery had fallen to 25%: Smith (1983).

protection, mobility and the ability to destroy what they can see, but little of revolutionary change can realistically be expected. Only in the indirect fire of the mortar is there significant scope for change, and there is no reason to suppose that mortars will become the preserve of the **infantry**. The possible demise of the tank has often been predicted prematurely, and while it would be rash to exclude, as some have done, a tank of some design from future military equations, the parameters limiting that design are **identifiable**. On the other hand, the possibilities for artillery equipments and their employment are hard to limit except by lack of imagination and the resources needed to realize them. These arguments and ideas on the future of field artillery are presented in the latter sections of Chapter 18.

# Chapter 2: EQUIPMENT AND MUNITIONS

The definition of field artillery is imprecise. At different periods of history it has encompassed direct and indirect firing guns <sup>(1)</sup> and rocket launchers, delivering a variety of munitions spanning a range of calibres, at targets acquired by numerous means. Each type of equipment has advantages and disadvantages.

## Guns and rockets

Guns have been in common use since the 14th century. They contain the force of the propellant charge at one end of the barrel; and as the power of the charge increases, so must the strength, and generally the weight, of the gun, and the robustness of the carriage to withstand the shock. Heavier guns have therefore generally been able to achieve a greater range than lighter guns, or to deliver a heavier projectile. As a result, long-range guns have usually lacked mobility, and their logistic support has been less flexible.

Recoil systems were developed to absorb the backward thrust of the barrel. These rely upon springs or hydraulic devices, and allow lighter guns to achieve greater range without undue strain. Light alloys and composite materials, as strong as steel or stronger, enhance the mobility of guns; but their lack of mass could reduce a gun's range were it not for improvements in recoil systems.

Another way of increasing range, without increasing the weight of an equipment, is to deliver a warhead by rocket. The rocket has been in military service for more than 200 years, but has been an effective battlefield weapon only since the Second World War. By not containing the backblast of the projectile, the rocket launcher is in theory inefficient; but it can compensate for this loss of energy by employing a greater charge. Rocket launchers tend therefore to be lighter than guns, but to have a heavier munition, or at least a smaller warhead in relation to the rest of the projectile, much of which will be engine, or propellant burned during flight.

Attempts have been made to increase the range of shells by giving them rocket assistance in flight. This reduces the proportion of the projectile taken up by the warhead; but if an overall increase in weight is accepted, equal terminal effect can be achieved, and at greater range.

Because the rocket launcher suffers minimal effect from the recoil, it is able to fire rockets simultaneously or in rapid succession. Rocket launchers therefore

<sup>(1)</sup> The term "gun" can often be confusing. A gun is strictly a flat trajectory weapon. The howitzer was introduced at the turn of the century to achieve a high trajectory, but by the Second World War it was common to find hybrid gun/howitzers combining the characteristics of both. In this study the terms "gun", "cannon" and "piece" will be used generally to denote field artillery ordnance, with the exception of rockets; and "howitzer" will be used in its strict sense.

The mortar is also a uniquely high trajectory weapon, often used by artillery. Traditionally it was a smooth-bore muzzle-loaded weapon, but automatic breech-loaded mortars have been in existence for 40 years, and although mortars are deemed to have a lower muzzle velocity, the distinctions between them and guns are becoming blurred.

tend to provide a high rate of fire, yet find difficulty in supplying and loading their heavier munition to match potential consumption. Rockets tend therefore to be used sparingly to achieve maximum shock effect at specific phases of battle, or against particularly vulnerable targets. Their time of flight and their smoke/light signature on launching may also be greater than those of the gun. This may force rocket launchers to move, and so to be out of action more often than guns, or to leave themselves more vulnerable to enemy attack.

Because rockets use powered flight, their warheads do not have to withstand such high acceleration as do shells on firing. Greater emphasis therefore can be placed on the lethal effects of rocket warheads. These do not need such heavy metal casing as shells, and they can deliver more explosive, in relation to weight of warhead. A lighter warhead increases range still further, or helps to compensate for the additional weight of the rocket motor or fuel.

Rocket launchers also tend to be cheaper than guns, and in terms of cost-effectiveness have often seemed more attractive; but guns are still more accurate than rockets and can achieve a wider variety of trajectories without greatly impairing that accuracy.

In the Second World War, rockets were largely and unwisely neglected in the West, but they have come into their own in the 1980s. It is likely that they will become the dominant artillery system by the end of the century, thanks largely to the new munitions of ET, which can be delivered most cheaply and perhaps most effectively by rocket.

## **Calibre**

Heavier rounds usually have greater explosive power than smaller ones. To deliver a heavier shell, it has usually been necessary to use a higher-calibre round. The average calibre of field guns increased rapidly during the First World War, and although heavy artillery was largely replaced by aircraft in the Second World War, the standard calibre has continued to increase. Before the First World War it was about 75mm, during the Second World War about 105mm, and today it is about 155mm.<sup>(2)</sup>

Explosive power does not necessarily make a shell more effective, particularly if it is fired at long range with relative inaccuracy. Although many anti-tank guns fire high explosive squash head (HESH) and high explosive anti-tank (HEAT) ammunition, most use a kinetic energy round, and as long as the round is of sufficient quality, reduced calibre usually increases penetration.

The 155mm and 152mm have become standard in NATO and the WP field artillery. Heavier calibres such as the 203mm are more powerful, but carry logistic penalties, and the resulting inflexibility is at present preventing their proliferation.

<sup>(2)</sup> Some apparent examples of inconsistency may be noted in this book in the designation of metric calibres, e.g. in discussion of the German 8.8cm anti-aircraft gun often referred to by the British as the '88' or 88mm gun. The explanation lies in the fact that the Germans always referred to calibre by centimetre, until they adopted NATO practice of using millimetres. The principle has been adopted in this book to use the calibration originally applied to a piece by the forces which employed it.

The introduction of Improved Conventional Munitions (ICM) could change this. If ICMs bearing submunitions become the dominant weapon, the 155mm round might prove a relatively inefficient carrier, compared with the 203mm round. On the other hand, rockets are likely to be more efficient, and if guns still find a place in the field artillery, they will probably do so in a role which complements, rather than rivals, them.

### **Mobility of towed and self-propelled (SP) guns**

Guns were always pulled by horses; but only in the 18th century did horse-artillery achieve tactical battlefield mobility. This allowed artillery to keep up with cavalry, and to compensate for lack of range by moving quickly from one sector to another.

The First World War rendered movement in forward areas by horse obsolete, and only a few realized quickly that artillery must match the mobility of the tank, if it were to provide support in mobile armoured operations. In the 1930s and early years of the Second World War it failed to do this. The Second World War demonstrated that in armoured warfare artillery needed not only a mechanical tractor, but also armoured protection, if it were to operate in forward areas. The answer was the armoured SP gun, which remains today the mainstay of NATO and WP field artillery.

Not all SPs have armour, but those which do not are generally deployed in depth positions. The SP has many advantages. If armoured, it can operate in forward areas with protection for its crew similar to that of most armoured infantry vehicles, and a limited quantity of ammunition. Its armour is generally proof against small arms, shell-splinters and, in some cases, NBC effects. The SP should generally be quicker coming into and out of action, allowing rapid, and hence more frequent, moves, over a given period, which increases survivability.

The SP has many disadvantages, though: the gun is dependent on its own engine. Automotive failure can lead to the loss of the piece, unless a recovery vehicle is available. On the other hand, a towed gun can be retrieved by any suitable vehicle, even by a helicopter. Its light weight also gives it strategic mobility, which SPs of comparable calibre do not enjoy. The maintenance of SP guns is more complicated than that required by a towed gun and its tractor; and the former's low endurance on long moves makes desirable the use of transporter or train on non-tactical journeys.

More importantly, the SP costs more to produce; and the balance of advantage should be determined not so much by a gun-for-gun comparison as by considering the value of the number of guns procurable for a given sum. The prevailing view is that in Europe the SP is necessary despite its failings, and the towed gun wherever strategic mobility is required, or where economy is an overriding factor.

### **Target acquisition**

In the 19th century target acquisition was made with the naked eye, assisted by telescope or binoculars, directly from the gun position. The introduction of

indirect fire did not essentially alter this. The guns used instead the eyes of a remote observer communicating by signal, and until the 1970s there was little change in the acquisition of targets in the "close battle"<sup>(3)</sup>.

Since 1914, it has been preferred to conceal guns in depth from the enemy's view, and other means of observing them have therefore been developed. Aircraft were used to extend the range of the visual observer, and photography to record his observation. The sound of gunfire allowed the development of sound-ranging, and the flash the technique of flash-spotting.

Since the Second World War the location of targets by radar has become common. The eye has also been assisted at night by the introduction of image intensification equipment, and more recently of thermal imaging devices, which do not rely upon light.

The greatest change in target acquisition in the history of artillery is about to take place. Not only will guns fire indirectly, as they have been able to do for 100 years; their targets too will be acquired indirectly, both by remotely piloted vehicles (RPVs) and by munitions themselves. This will allow terminal guidance to the target, and after 600 years the human eye will cease to be the dominant means of directing fire.

## Munitions

The earliest munition was the cannon ball. The area of the target struck by it was small, but the terminal effect was substantial, and usually wastefully in excess of what was required. Since it was relatively inaccurate, it was usually employed to engage area targets such as enemy formations.

A better way to engage a large target, and to use the energy of the gun more efficiently, was to employ grape-shot, or its equivalent. The increased spread of shot in effect reduced the inaccuracy, albeit at the expense of range.

The first exploding shells overcame grape-shot's limitations of range. The ballistic quality of the cannon ball was maintained, yet spread of shot was achieved, by fuze detonation closer to the target. It became desirable to increase the quantity of explosive in a round, and this could only be achieved (without increasing its calibre) by developing the shape characteristic of the modern shell. The ballistic shape of the projectile became increasingly important as the power of the propellant increased, and the force behind the shell grew with the introduction of efficient breech-loading guns.

In the First World War, it was found that shrapnel might well be effective against soft targets, but that the dispersion of a shell's energy in this way rendered it largely ineffective against field defences, and that the destructive power of a point detonating fuze was needed. As the effect of a shell was concentrated, the area it could damage was reduced, and in order to compensate for this the quantity of shells fired was increased.

Apart from the introduction of the radar fuze, there were few innovations in

<sup>(3)</sup> For discussion of the "close battle" see Chapter 4.



field gun munitions in the Second World War or (with the exception of nuclear shells) in the 30 years after it. In the last decade, however, there have been major advances. Ranges have been increased by improvements to delivery systems and propellants. The ballistic shape of shells has improved, and rocket propulsion and "base bleed" devices have added to range. The greatest advances have been in terminal effect. This has been enhanced in two ways: accuracy through terminal guidance, and its equivalent, area coverage — contributions comparable to those of grapeshot and shrapnel in earlier times. Terminal guidance may be achieved by using an external source, such as laser designation for a shell, equipped with a laser detector, or by some electronic means of its own<sup>(4)</sup>. The accuracy of a shell may cause overkill like that of the cannon ball. Its effect may be dispersed over a wider area of target by dispensing submunitions, and each of these may be terminally guided. The submunition of the future has the same role against armour as shrapnel had against infantry 70 years ago.

Increased accuracy of this nature reduces the weight of the warhead required to destroy a target. If a munition, such as an artillery-delivered scatterable mine or "top-attack" shell, can hit a relatively ill-protected part of an armoured vehicle, it can also achieve a kill with relatively less explosive force. These factors, combined with advances in the design of explosive anti-armour submunitions, make field artillery increasingly lethal, in proportion to its weight. This in turn increases artillery's mobility in relation to its destructive power, and makes it a more flexible battlefield weapon, not least because of the reduction of the logistic burden.

For a survey of types and capabilities of modern, so-called "intelligent", fuzes see Wilke (1986).

## Chapter 9: COUNTER BATTERY FIRE

The attacking of artillery by artillery is called Counter Battery (CB) fire or, in some armies, Counter Fire (CF). It is a battle in which artillery may appear to play an independent offensive role, divorced from the operations of other arms, but, on the contrary, the importance of CB lies in the dependence of other arms on the survival of artillery, and its ability to suppress its hostile counterpart. CB is therefore an indispensable part of combined-arms operations.

The principle of CB operations has remained unchanged over the centuries: to destroy enemy artillery as quickly as possible, to prevent it from influencing the battle. How this may be achieved in practice in the face of technical, tactical and logistic restraints, and against enemy counter-measures, has often been less clear.

### Attitudes to CB

Although few would deny the need for CB fire, the energy and resources devoted to it have varied over the years. It has usually been out of fashion when technical weakness rendered it ineffectual. This was the case in the West in the 1960s and 1970s, but the 1980s have seen a revival in the estimation of its value, as new technologies come into service.

At the outbreak of the First World War, the British Army was ill-equipped to mount major CB operations. It started that war with 500 pieces, of which all (except twenty-four 60pdrs) were light field guns or howitzers. By 1918 it had 6,500 pieces, one third of them medium or heavy — testimony to the new emphasis on CB fire. However, this was made possible only by improvements in survey, the computation of predicted data, the location of targets, the correction of fire from the air, and the creation of specialized CB C3I, none of which had existed before 1914. Most of these advances were made after 1917, in recognition that the failure of many infantry assaults in 1915 and 1916 had been caused by ineffectual CB work <sup>(1)</sup>.

In static warfare, CB operations became highly efficient; but the technology and techniques developed in the First World War were impracticable in the scenarios of mobile warfare propounded between the wars. Unfortunately, little was done to correct the technical inadequacies, and instead the medium and heavy guns on which CB operations relied were gradually withdrawn from service. The British Army continued to neglect CB operations until July 1942, when they were revived, thanks largely to the CCRA of XXX Corps <sup>(2)</sup>.

Enthusiasm for CB operations usually grows as casualties from enemy artillery fire mount <sup>(3)</sup>. Peacetime training in the British Army after 1945 had done little

<sup>(1)</sup> Ironically, even though CB fire was at its most important in the First World War, most commanders had relatively little knowledge of it, regarding it as something of a 'Black Art': Broad (1922b).

<sup>(2)</sup> Bidwell (1967a), p.89.

<sup>(3)</sup> The resurgence of CB skills in the Second World War reflected the high casualties inflicted by artillery. During the Canadian attack on the Gothic Line between August and October 1944, for example, 58.7% of casualties were caused by artillery and only 11.7% by small arms: Pemberton (1950), p.242.

to prepare British troops in the Korean War for the lethality of indirect fire. CB operations soon assumed a high priority in that war, and it was estimated that as much as 70% of artillery assets were devoted to CB fire.

Since the early 1950s most advances in target acquisition have been designed to assist the Forward Observation Officer (FOO) rather than CB fire planners. In the British Army, CB fire has been an unfashionable subject<sup>(4)</sup>. Just as in earlier times horse artillery was perceived to be professionally and socially superior to field and heavy artillery, so more recently close support artillery has been regarded as in some way more glamorous than that which undertakes CB tasks<sup>(5)</sup>.

During the 1960s and 1970s NATO's CB resources were very slender. NATO armies lacked the mass of guns and ammunition to tackle WP artillery, given what seemed the more immediate need for close support of manoeuvre arms. This was ironic, for the importance of CB fire was amply demonstrated in the Vietnam War<sup>(6)</sup>. By the late 1970s the situation had become serious. Most NATO armies were equipped with the M107 175mm piece for CB fire, which had a range of 30km and a good shell, but which could not create the weight of fire which 100 years of experience had shown to be necessary<sup>(7)</sup>. The gun was relatively inaccurate, and not well supported by locating devices. If it is remembered that 500 six-inch shells were considered necessary to knock out a battery in the First World War, it will be seen how limited the scope seemed for major attrition of WP forces<sup>(8)</sup>. The weapon best suited to CB operations is the multiple-barrel rocket launcher (MBRL), but NATO had none of these apart from the Bundeswehr's LARS<sup>(9)</sup>. What locating systems there were, were inadequate. The Midge drone with a response time of one hour could not provide target acquisition, the UK's Cymbeline radar could locate mortars but not cannon or rocket launchers, and sound-ranging had advanced little in 70 years.

<sup>(4)</sup> Davis (1977).

<sup>(5)</sup> The fact that the British Army's training pamphlet on CB operations, issued in 1944, had not been amended 40 years later reflects this apparent lack of interest.

<sup>(6)</sup> The Battle of Dien Bien Phu in 1954 was essentially an artillery duel. The French artillery commander, Colonel Piroth, claimed that he could destroy any Viet Minh gun that fired more than three rounds. Most Viet Minh guns held their fire until the assault, attacking French OPs first, in order to blind French guns. 75% of French casualties were from attacking fire: Hamilton & Kaplan (1983). The success of the US Army's Operation PEGASUS in 1968, which effectively ended the siege of Khe Sanh, was largely due to the artillery CB programme. North Vietnamese 130mm and 152mm pieces had been able to shell Khe Sanh, but once the artillery of 1st Cavalry Division came into range, the former ceased to be a serious threat to manoeuvre or to the base: Ott (1976a), p.48. A detailed description of US CB techniques at low level in the Vietnam War is given in Love (1968).

<sup>(7)</sup> Robinson (1977), p.94.

<sup>(8)</sup> Guns under heavy protection are even harder to destroy. A battery of German 8.8cm guns fired 2,000 rounds at Allied forces attacking Boulogne in September 1944, despite having 6,000 shells land within a 300-metre radius of them: Pemberton (1950), p.245.

<sup>(9)</sup> The value of rockets in CB operations was appreciated by the US Army in Vietnam. The best reply to the North Vietnamese 4.5-inch rocket launcher was the US M21 and M32 rocket. One M21 could fire the equivalent of one battalion's worth of shells in one minute. With pre-loaded tubes, its response time was short. Its relative lack of accuracy was not a disadvantage but an advantage, giving instantaneous area saturation: Love (1968). This success may have influenced the US decision to develop the MLRS (multiple-launch rocket system) specifically for CF.

NATO's CB forces in the 1970s were thus ill-equipped and relatively ineffectual, unlike those of the WP, in whose concept of operations they played a major part. The Soviets believe in achieving fire superiority over their enemy in the traditional manner, the 'artillery duel', and plan to allot 50% of their guns for this purpose <sup>(10)</sup>.

By the late 1970s it was clear that NATO could not tolerate such a threat to its own artillery <sup>(11)</sup>. A Fire Support Mission Area Analysis, conducted at Fort Sill in the USA, studied the effects of CB as part of deep interdiction <sup>(12)</sup>. It found that CF directly affected the battle on the FEBA. A comparison of infantry fighting vehicle (IFV) exchange ratios over a five-day battle showed improvements for the defence by factors of three or five, thanks to a reduction in the enemy's ability to suppress direct-fire weapons. An appreciation of this in the 1970s led to the development of new ordnance and munitions such as MLRS <sup>(13)</sup> and target acquisition systems in the 1980s. While great progress has been made in the provision of real-time accurate information about targets over the horizon, target acquisition systems remain vulnerable. Locating radars may themselves be readily targetted, and drones or RPVs with in-flight transmission capability may become vulnerable to enemy air defences.

It has not always been agreed when enemy artillery should be attacked, or with what resources, or whether CB fire is sufficiently effective to make it worthwhile at the expense of other tasks, in particular close support. Offensive CB action is the best defence against enemy CB fire, but other measures may greatly assist such defence. It may also be possible to direct CB fire in such a way as to deceive and defeat the enemy <sup>(14)</sup>.

### The timing of CB fire

The desirability of destroying enemy artillery is clear, but *when* it should be attempted has long been a bone of contention. By 1914 it had been military convention for a hundred years that a battle should be preceded by an 'artillery duel', in which the attacker sought to destroy the enemy's guns. Napoleon was the master of this tactic, and owed much of his success to the early massing of artillery in the CB role <sup>(15)</sup>.

Effective CB fire was recognized as one of the best methods of supporting the infantry. Colonel W. Balck maintained that the attacker's artillery should deliberately provoke enemy artillery and draw their fire on to itself, to spare its own

<sup>(10)</sup> O'Hagan (1978) and Bellamy (1983a).

<sup>(11)</sup> Robinson (1977a).

<sup>(12)</sup> "Implementing the AirLand Battle" *Field Artillery Journal* Vol.49 No.5 (September-October 1981) pp.202-207.

<sup>(13)</sup> Sundaram (1980). The merits of rocket munitions in CB are discussed in Robinson (1978a).

<sup>(14)</sup> See Chapter 12 on survivability.

<sup>(15)</sup> The Russian General Kutaysov maintained that in offensive operations artillery's main task was CB, with a major role for howitzers firing indirectly: Bellamy (1986), p.20. Throughout the 19th century it was also usual to reserve approximately one third of artillery assets for subsequent CB tasks once the close battle had been joined.

infantry<sup>(16)</sup>: "So long as the attacking infantry is defenceless at the mercy of hostile artillery fire, the **assailant's** artillery must endeavour at least to keep the **defender's** artillery from firing undisturbed" <sup>(17)</sup>. "From this it follows that the defending artillery will likewise have to do its utmost to prevent the batteries of the assailant from developing their full firepower against the defender's **infantry**" <sup>(18)</sup>.

For a defender the issue was not quite so clear. On the one hand, the Germans saw the need to open fire early, for "the advantage possessed by the defender dwindles as the range **decreases**" <sup>(19)</sup>. On the other hand, "The defender could not commit a greater blunder than to reply to artillery fire which can have no other object than that of **reconnaissance**" <sup>(20)</sup>. Before the First World War, the British Army believed that, if its artillery were outnumbered, **it was** best to remain masked and to hit the enemy while he was **advancing** <sup>(21)</sup>. The essential dilemma is whether to optimize the advantages accruing to the defender by striking out in depth early, or to remain concealed (or 'masked') until the best moment. If the defender does not hold a clear indirect fire **superiority**, that moment is most likely to be when the attacker's artillery is manoeuvring or out of action <sup>(22)</sup>.

Although the conventional idea of the need for a preliminary 'artillery duel' remained intact at the outbreak of the First World War, doubts about its viability had been growing for some years. The 'artillery duel' was not justified by British experience in the Boer War, where British artillery frequently deluged supposed Boer gun positions with fire, usually without success. Either the Boer positions had not been correctly located, or ranges were excessive. The lessons of the Boer War were reflected in British CB policy in 1914, when it was held that "till the enemy discloses his dispositions, artillery must usually limit its action to preparing to support the other arms as soon as occasion demands it" <sup>(23)</sup>. Even when the British did locate enemy artillery successfully in the First World War, it was not always easy to destroy it, and attacking too early sometimes proved counter-productive. The British realized that a premature CB programme often served only to flush out enemy artillery, which could then not be located on the day of the attack. It often proved best to hold fire until the last possible moment, and then to deliver a massive and decisive blow <sup>(24)</sup>.

<sup>(16)</sup> Balck (1914), p.418.

<sup>(17)</sup> In 1907 General Richter suggested mounting guns on automobiles to accompany infantry and to protect them from defending artillery: quoted in Balck (1914), p.425, from *Artilleristische Monatshefte* Vol.IX (1907) p.249.

<sup>(18)</sup> The Germans found this tactic highly successful in the Franco-Prussian War, in which they regularly undertook massive CB programmes, before the combined-arms **battle** was joined. This frequently destroyed French artillery, or so separated it from its infantry that it could not offer adequate close support later in the battle.

<sup>(19)</sup> Balck (1914), p.420.

<sup>(20)</sup> Ibid, p.432. Observing Russian **artillery's** silence on the **Yalu** River in April 1904. a Japanese staff officer remarked: "When the enemy fires very heavily it is unpleasant. When he does not fire at all, it is terrible": Warner (1975), pp.264-265.

<sup>(21)</sup> Balck (1914), pp.465-466.

<sup>(22)</sup> The British in the 1980s have made an analysis similar to this German one of a hundred years ago.

<sup>(23)</sup> Oldfield (1922), p.462.

<sup>(24)</sup> Brooke (1926a), p.249.

By 1914 the German Army had also realized that it was unrealistic to expect guns with shields to be destroyed by flat trajectory guns alone. Their realistic aim was to "nail it down to its positions, to prevent it from changing position, and to interfere with the ammunition supply service" <sup>(25)</sup>. Hence the Germans invested heavily in howitzers, so that their enemy might be engaged from concealed positions with high trajectory fire <sup>(26)</sup>.

If success in an artillery duel in the First World War was not regarded as an essential prerequisite for an infantry attack, this was not because it was not considered desirable, but because it had in most cases become manifestly impracticable. Yet on the few occasions when a decisive 'artillery duel' did take place, it was often a determining factor for the outcome of the battle <sup>(27)</sup>.

CB fire played a large part in the planning of major battles, but it was also a continuous operation. It was the policy of the British High Command to be constantly on the offensive, for reasons of politics, strategy and morale. CB fire forced enemy artillery back, reducing its reach into and across friendly-held territory, but as a result little German artillery was captured. Although CB operations in the First World War seldom produced a decisive result, they were none the less important. Failure to engage in an early, albeit indecisive, 'artillery duel' would have given the enemy a free hand and an easy victory.

Most battles of the Second World War commenced with an 'artillery duel' <sup>(28)</sup>, but by the end of the war the British tended to concentrate their efforts before an offensive on gathering intelligence and planning their CB programme, which was put into practice only when the all-arms battle had begun <sup>(29)</sup>.

The Soviet Army paid the most attention to this type of operation, and often achieved great success, sometimes committing their own artillery early. The main effort of the Soviet 13th Army at Kursk in July 1943, for example, was based on CB fire. In the days before the battle the Soviets detected 104 battery positions. Their subsequent fire destroyed 90 of these, successfully depriving the Germans of the larger part of their artillery. Yet their artillery sometimes remained masked: in the Soviet 6th Army at the battle of Kursk, guns remained concealed until the

<sup>(25)</sup> Balck (1914) p.419.

<sup>(26)</sup> The value of howitzers in CB operations was demonstrated by the Turks at the battle of Dhomokos, on 17 May 1897, with their destruction of four Greek batteries: Balck (1914), p.436. On 26 April 1904 Japanese howitzers destroyed Russian artillery at vital crossing points on the Yalu River in Korea. The threat of their further action caused a Russian withdrawal without a major infantry action: Warner (1975), pp.264-265.

<sup>(27)</sup> The Germans continued to attach importance to an early successful CB programme. A report dated 14 December 1917 by army group commander Crown Prince Rupprecht declared that the aim for the first day of an offensive should be the elimination of enemy artillery: *Deutsche Militärgeschichte Band 6*, Militärgeschichtliches Forschungsamt (Bernard und Graefe Verlag, Munich 1983) p.520.

<sup>(28)</sup> For example, full use was made of concentrated artillery in CB fire for Operation LIGHTFOOT, the opening of the final battle at El Alamein.

<sup>(29)</sup> For example, for Operation TOTALIZE there was no preliminary CB programme before H hour. Instead it was fired by 16 regiments from H+100 to H+120, after the opening barrage; and then H+420 to H+440. For Operation VERITABLE in February 1945, CB fire before D Day was very restricted, but it became intense once the offensive had begun.

Germans launched their attack <sup>(30)</sup>.

Since 1945 the Soviets have persisted in the belief that enemy artillery must be destroyed before the close battle is joined. NATO forces have fewer guns at their disposal, and take care in judging when to retaliate in the event of a Soviet offensive. Some periods of the battle will be better suited than others to this, depending on radio emission control (EMCON) policy, deception plans, ammunition supply, and the movement of enemy artillery.

For many years British artillery intended to engage WP forces as early, and close to the inner German border (IGB), as possible <sup>(31)</sup>, but paid relatively little attention to these operations. By the mid 1980s they had once again become an essential part of the artillery concept of operations, but one not necessarily timed to take place at the start of hostilities.

The arguments about the timing of CB fire have not changed in a hundred years. The sooner enemy artillery is destroyed, the greater the advantage; but the difficulty of locating it and defeating it, against disadvantageous odds, has often reduced the attraction of preliminary engagement.

### The effectiveness of CB fire

Effective CB fire requires the accurate location of enemy positions, large numbers of guns, great quantities of ammunition and time, which could be spent on other tasks <sup>(32)</sup>. The manner in which fire is applied is also likely to be important. Colonel W. Balck maintained that the artillery commander should open fire suddenly, with the majority of his guns simultaneously, and there has been general agreement on this ever since. Concentrated mass fire is most successful, because it takes effect before the enemy can shelter or move away <sup>(33)</sup>; but to marshal resources, and to synchronize and converge fire, requires skill and sophisticated C3.

Except on the Yalu River in April 1904, CB fire in the Russo-Japanese War was seldom successful. Both sides saw the importance of C3 and devoted great efforts to it, but generally failed to achieve a decisive result <sup>(34)</sup>. The CB effort in

<sup>(30)</sup> Niessel (1956), p.74. For statistics of Soviet CB operations in the Second World War see Bellamy (1986), p.56.

<sup>(31)</sup> Blunt (1974).

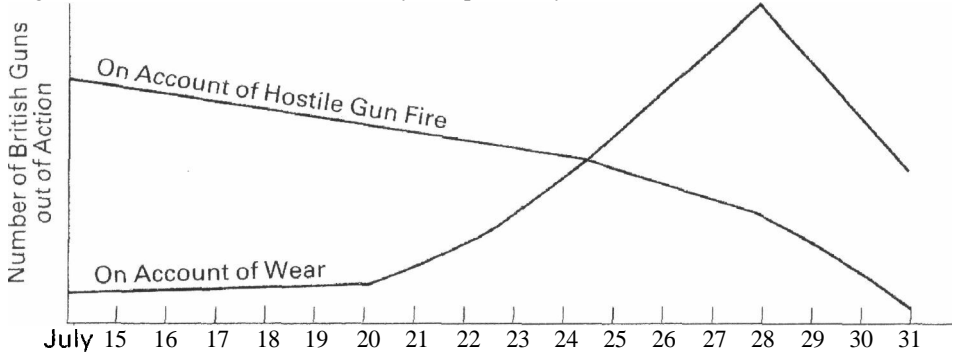
<sup>(32)</sup> It was calculated that in the First World War, under the most favourable circumstances, it took five hundred 6-inch howitzer rounds to knock out a battery with observed hits — unobserved fire was far more extravagant: Oldfield (1922), p.47. It was estimated that to destroy a single gun in a protected pit would take 80 rounds of 8-inch, or 60 rounds of 9.2-inch fire, with shrapnel from 60pdrs mixed in for anti-personnel effect: Broad (1922c), p.231.

<sup>(33)</sup> British policy by 1918 was that all CB should start with the attack on personnel to cause maximum casualties, and to encourage detachments to desert their guns. As a result of this, on 8 August 1918, many German batteries were captured with their muzzle covers on.

<sup>(34)</sup> The Japanese used decoys to draw the fire of Russian guns, and then attempted to destroy them with heavy concentrations of CB fire. The strategem was seldom effective: on 26 August 1904, a Japanese Guards Division was held up for 24 hours by 24 Russian quick-firing guns, which the Japanese were unable to silence. The Japanese infantry never reached the Russian trenches, and lost over 1,000 men in the assault: Broad (1922c), p.233. On 30 August 1904, the Japanese again bombarded Russian artillery at Liaoyang for 16 hours, with little effect. The Russians were usually equally unsuccessful

the First World War was prodigious, but any fire from enemy artillery was usually regarded as a sign of CB failure<sup>(35)</sup>. However, the effectiveness of CB fire in the First World War cannot be denied (see Figure 1 for an illustration of the effectiveness of British CB in July 1917 at Ypres), and General Ludendorff admitted that in August 1918 Allied fire destroyed 13% of all German guns on the Western Front<sup>(36)</sup>.

Fig. 1 The defeat of German artillery at Ypres, July 1917



Note: British infantry assaulted on 31 July 1917. Source: Broad (1922a).

After the First World War most armies reduced their holdings of medium and heavy artillery, in keeping with the contemporary doctrine of mobile warfare. The desirability of massing a heavy weight of fire to conduct effective CB operations was thrown in doubt. From being an indispensable prelude to infantry operations, it came to be seen as no more than a morale-raising display, in an operation in which artillery support in general was not so important. Without the resources to destroy main enemy artillery positions, CB fire tended to concentrate on destroying observation posts (OPs)<sup>(37)</sup>.

In the First World War German artillery was eventually outnumbered 3:1, and it faced an equally serious threat in the Second World War, especially on the Eastern Front. Although at first British artillery lacked the medium and heavy guns which had undertaken most CB tasks in the First World War, it soon perfected techniques of locating targets and concentrating fire that were to make it equally

When the Russians fired, Japanese artillery often fell silent, only to start again when the Russians ceased. Batteries on either side were seldom knocked out, but great quantities of ammunition were wasted: Balck (1914), p.386. The main problem was the lack of observation of fire on the target.

<sup>(35)</sup> A single British 18pdr battery held up the German advance towards Beaumont Hamel and Beaucourt in March 1918; and on the 21st of that month one witness saw a British battery continuing to fire although enveloped by black smoke and under HE fire itself: see "Counter battery in mobile warfare" *Royal Artillery Journal* Vol.LXV No.2 (July 1938), p.200. Had the CB fire on these occasions been better concentrated and observed, this could not have happened.

<sup>(36)</sup> Broad (1922b), p.188.

<sup>(37)</sup> The value of destroying artillery OPs and C3I was demonstrated on 11 June 1943 during the Allied attack on Pantelleria. Despite a RN bombardment and the dropping of 4,656 tons of bombs, only 16 out of 109 Axis guns were damaged, but those guns were inoperative because their command posts, communications and observers had been destroyed: Pemberton (1950), p.183.



effective. As early as November 1941, the British were able to achieve ratios of 14:1 (i.e. 14 guns to one on a selected sector) for particular operations<sup>(38)</sup>, and in April 1943 achieved 10:1 in Tunisia.

British artillery policy underwent a complete revision in July 1944, when a new emphasis was placed on mass and concentrated fire, and CB policy changed to reflect this<sup>(39)</sup>. The minimum fire ratio established by the British was usually about 5:1<sup>(40)</sup>, but this was often exceeded<sup>(41)</sup>.

In Italy, German guns often deployed singly in deep shelters, and made frequent moves as a defence against CB fire. They were difficult to locate and hard to destroy without the consumption of much ammunition. The traditional neutralizing mission proved ineffective, and in June 1944 it was replaced by the destructive mission, in which one gun fired until an air OP observed a direct hit<sup>(42)</sup>.

By 1944 the British had largely mastered German artillery, and the mortar loomed as a greater threat. The Germans usually placed their 81mm mortars between 500 and 800 metres short of British Forward Defensive Localities (FDL), and their 12.1cm mortars generally 1,000 metres from the FDL. The safety distances from the FDL for the British 25pdr round were 300 metres for groundburst and 600 metres for airburst, and for the 7.2-inch howitzer round 800 and 1,500 metres respectively; it was therefore difficult for British artillery to engage German mortars without endangering their own troops.

Although field artillery played a relatively smaller role in the Far East Theatre,

<sup>(38)</sup> Ibid, p. 109.

<sup>(39)</sup> Bidwell (1967a).

<sup>(40)</sup> Wilson (1968), p. 102.

<sup>(41)</sup> CB fire was particularly important in the battle of El Alamein. The Germans had 200 field, 40 medium and 14 heavy guns on the main front, and it was judged that these would be hard to destroy during the assault. A preliminary CB programme was therefore devised, which established British artillery superiority at between 10 and 20:1 — see Pemberton (1950), p. 142. Its success was due largely to the accurate location of enemy positions by air photography, the massing of resources and the relatively short period it took to execute, with all available assets firing from H to H+15. For Operation GOODWOOD, on 18 July 1944, the British mustered 660 guns supported by naval gunfire support (NGS) and medium bombers, dedicated to CB tasks for 100 minutes before H hour. For Operation VERITABLE the British achieved a ratio of 40:1. In March 1945, the crossing of the Rhine was preceded on D-1 by a two-hour CB programme, controlled by the Commander 9 AGRA, in which enemy batteries were again hit one at a time, by 8 regiments, in what became known as 'The Milk Round'. At Monte Cassino in May 1944 the British delivered 7 tons of ammunition at a time on to hostile batteries. In Normandy, in the summer of 1944, British superiority reached a peak of 104:1, delivering 20 tons of ammunition on to a single target in a single mission: *ibid*, p.223. Even so, such weights of fire were sometimes still insufficient. After the Battle of the Reichswald, in February 1945, one infantryman observed that "too much time and ammunition is spent in 'stonking' the enemy before an attack and not enough in CB work when we have reached our objective. Many times we have sat on the objective and had everything thrown at us, and our gunners have been unable to do anything about it": quoted *ibid*, p.278.

<sup>(42)</sup> The disadvantages were that the long time often required to achieve a hit usually limited each sortie to one mission; and that individual guns had to fire without the cover of other guns, from other batteries, and were therefore more vulnerable to sound location. Later as many aircraft as possible were used, and each was given two or three concurrent shoots. This system became known as a 'Fiesta', and although originally devised for the assault on the Gothic Line, it was later used widely elsewhere.

CB fire preoccupied much of artillery's resources. The most complex and heaviest CB operations were mounted by the US forces on Okinawa in March 1945. The US deployed sound-ranging and flash-spotting equipment and aircraft to seek out Japanese guns hidden in caves. On one occasion an entire corps artillery was devoted to silencing just two guns<sup>(43)</sup>.

Aircraft were often used in the Second World War as a substitute for artillery, when its use would have been inappropriate or ineffective. It is possible that fixed-wing aircraft or helicopters might also be used in a CB role in future hostilities in Europe. In the Six Day War of 1967 the Israelis tried to destroy Arab artillery as early as possible, and because of their air superiority were able to do this with aircraft<sup>(44)</sup>. It is also clear from Argentine accounts of the Falklands War of 1982 that British CB was effective in suppressing Argentine guns during important phases of that conflict.

### The development of CB equipment and C3I

Poor equipment has led to lack of interest in CB and *vice versa*. CB technology reached high points in the latter halves of the two world wars, when experience showed it to be essential. A similar resurgence is under way in the 1980s, thanks to the doctrine of deep attack and the proliferation of high-technology munitions, which require means of target acquisition and C3 to match.

Without adequate reconnaissance and target acquisition, the ratio of guns means little<sup>(45)</sup>. The Soviets have traditionally set great store by artillery reconnaissance. In the Second World War they spent months locating German artillery before an offensive: "Reconnaissance in this case meant everything"<sup>(46)</sup>. The main methods of locating artillery are: visually from the ground or the air; heat sensor or camera; radar, radio direction finding; sound-ranging; and flash-spotting. The eye of the ground observer was the primary means of target acquisition in the era of direct fire artillery, but by the First World War this had become almost impossible, since the Germans, and where possible the British, adopted reverse slope positions<sup>(47)</sup>.

The aeroplane enabled the human eye to peer over the hills at hiding artillery, and the development of air photography made up for the limited memories of aerial

<sup>43</sup>Waterman (1945a).

wo Near Kfar Szold, for example, aircraft undertook CB missions, while artillery concentrated on close support: Campbell (1968), p. 134.

<sup>45</sup> During the Battle of Sedan in 1870, a battery of the German 12 Field Artillery moved through Lacretelle and held its own against six French batteries. In the Boer War British artillery seldom managed to locate its opponent, despite numerical superiority.

<sup>46</sup> Colonel B. Belayev, quoted in Belayev (1944), p. 119. The Soviets made a protracted study of the direction of fire, its density, and the number of shells fired. From this the German dispositions could be plotted, and Soviet deployments correctly balanced.

<sup>47</sup> In modern times the eye has also proved valuable. In the Yom Kippur War target acquisition on both sides was primitive. It was usually undertaken by small parties consisting of an officer and signaller with an assistant, who penetrated enemy territory at night, and observed targets and corrected fire: Morony (1975), p. 13. The British are placing increasing emphasis on visual observation in the 1980s.

observers<sup>(48)</sup>. Air photography proved most valuable in the First World War. By the end of the war there was a Corps Squadron RAF, which maintained a patrol in the air in daylight hours, reporting and photographing occupied gun positions. Instant reports were sent by radio and their photographs were sent to Artillery Intelligence at Army Headquarters, and to the CBSO<sup>(49)</sup>. Air photography could locate an enemy, but intelligence derived from it was usually out of date by the time guns could fire. Aircraft could however provide platforms for observers to flash-spot and correct fire<sup>(50)</sup>. Fixed-wing air OPs were used successfully in the Second World War, and continued in service into the 1950s. In the 1960s and 1970s the helicopter was the preferred vehicle for air OPs, but by the 1980s it had become too vulnerable for the Central Front in Europe. Manned aircraft are still used for aerial photography, but by 1990 RPVs with real time imagery will have largely replaced them<sup>(51)</sup>.

Radar to track the trajectory of shells and mortar bombs, and to locate their origin, was developed in the 1940s<sup>(52)</sup>, but it did not become an effective means of acquiring artillery targets until the 1970s and 1980s, with the introduction of the US Army's AN/TPQ-37 counter-artillery system, complemented by the TPQ-36 counter-mortar radar<sup>(53)</sup>.

<sup>(48)</sup> The value of aircraft in locating artillery had already been proven in the Balkan Wars of 1912: Weber (1919).

<sup>(49)</sup> The RAF also possessed a Long Range Gun Flight, which undertook special deep reconnaissance missions. Each Army also possessed a Balloon Wing, and every corps a Balloon Company of two or three balloons. These were used to observe and adjust CB fire, and often had direct communications to batteries: Broad (1922b). Balloons had been used for CB observation since the US Civil War. An example of this on 24 September 1862 is described in Schmidt (1948).

<sup>(50)</sup> Air reconnaissance and air OPs were used by the British in most major battles of the Second World War. They played a particularly important part in the CB programme fired against German artillery in Le Havre and Boulogne in September 1944. The Germans had 90 guns under heavy protection, which held out for six days, despite being attacked with 80,000 rounds and 3,000 tons of bombs. This fire was reinforced by that of the 14- and 15-inch coastal guns at Dover. On 17 September one of these guns scored a direct hit on a battery near Calais at a range of 42,000 metres: Pemberton (1950), p.245. Air OPs were especially useful when gun survey was poor. This was often the case in the Far East, and air OPs were used in CB operations with success at, for example, Kangaw in Burma in February 1945. The development of air OPs in the British Army in the Second World War was described in Parham & Belfield (1956). The development of air OPs in the US forces is described in Donnelly (1943a). The operations of an Air OP Flight in the Korean War and the adjustment of 155mm fire in high angle against mortars are described in Hailes (1954), pp.187-188. The establishment of an air OP in 1st Commonwealth Division in Korea in the winter of 1951 is described in Pike (1953).

<sup>(51)</sup> As long ago as November 1922, Colonel L.C.L. Oldfield predicted that most CB programmes would one day consist of concentrations of fire in answer to calls from aircraft. The RPV will fulfil this prediction: Oldfield (1922).

<sup>(52)</sup> Before 1944 it was hard to locate and engage mortars. Experiments were made firing in high angle and using aircraft to correct fire, but the real need was for better initial location. This was improved in the British Army in 1944 with the introduction of the 'fourpen recorder' and radar. In November 1944, 21 Army Group found that the GL III radar was accurate to 50 metres, and the 'fourpen recorder' to 100 metres, against 150-200 metres for an OP. In July 1945 trials were even conducted with mortar-locating radar mounted on landing craft to support amphibious landings. The development of radar for use in CB operations in the Second World War is described in Combs (1946).

<sup>(53)</sup> These were held in the target acquisition batteries created in the late 1970s to support US divisions. These batteries replaced the Target Acquisition battalions, which had supported US corps. The change reflected the shift in responsibility for CF, from corps to division.

The possibility of radio direction finding was realized almost as soon as the use of radios became widespread, but it is only since the 1970s that it has become an accurate and flexible system. It is particularly favoured by the Soviets, and to a lesser extent by the West.

Sound-ranging was developed in the First World War<sup>(54)</sup>, and the principles of listening to the sound of gunfire from a series of known points, and fixing the location of the guns from converging bearings and comparative timings, have not changed. It was a cumbersome technique, well suited to static operations<sup>(55)</sup>. Conditions after 1918 were seldom favourable, and little was done to improve sound-ranging equipment.

For fifty years sound-ranging was a relatively inflexible system. It was vulnerable to high winds and to the confusion created by the simultaneous fire of many guns, and the base line itself was liable to disruption or even capture by the enemy<sup>(56)</sup>. Modern technology has now revolutionized sound-ranging techniques: survey can be instantaneous and ADP can overcome many of its old difficulties. As a result, sound-ranging now offers excellent opportunities for artillery target acquisition, should the necessary investment be made.

Flash-spotting was a successful technique similarly developed in the First World War. It relied on observing the flash of enemy guns from more than one known point, was vulnerable to meteorological conditions, and was most effective at short range<sup>(57)</sup>. It was not widely used after that war<sup>(58)</sup>, and it is only in the 1980s, with advances being made in thermal detection devices, that its potential may again be realized.

Advances in equipment achieved little unless C3 was of equal sophistication. In 1889 Prince Kraft zu Hohenlohe-Ingelfingen advocated the earliest possible concentration of guns for CB operations, under the control of "one brain"<sup>(59)</sup>, but at the turn of the century no such brain existed<sup>(60)</sup>. In 1914 the British created

<sup>(54)</sup> British sound-ranging equipment in the First World War had a range of six miles, and could cover a frontage of 8,000 metres. A sound-ranging base was placed opposite the main group of enemy batteries. It consisted of a series of microphones and timers, triggered by an advance post located 1,000 to 1,500 metres to its front. Each microphone had to be accurately surveyed, a lengthy procedure with might take 48 hours. For a further description of sound-ranging in the First World War see Brooke (1925a), and Annex L to Farndale (1986).

<sup>(55)</sup> For example, between 3 and 6 November 1918, one detachment located 17 batteries, to a mean error of just 110 metres. This accuracy was validated after the battle: Broad (1922c), p.237.

<sup>(56)</sup> The Soviets made extensive use of sound-ranging in the Second World War, and were prepared to risk its deployment well forward in offensive operations: Roslovstsev (1945), p.99.

<sup>(57)</sup> German flash-spotting was especially effective against British guns in the Ypres Salient in 1917, where there was little cover. On the Somme in the previous year, it had hardly been necessary, since British guns were easily located, being huddled together in valleys in four tiers: Broad (1922).

<sup>(58)</sup> The British Army abandoned flash-spotting in 1958: Wilson (1968).

<sup>(59)</sup> Weber (1919).

<sup>(60)</sup> The British Army in 1914 had no artillery commanders above divisional level, and even at that level they exercised direct command over artillery brigades only in exceptional circumstances. For a description of the development of British C2 in the First World War see Annex C to Farndale (1986). The Germans also had no artillery command above division. Their need for a higher artillery command was satisfied at the Battle of Riga in 1917, when for the first time a proportion of artillery was specifically

artillery survey companies, CB offices were introduced at divisional level and artillery intelligence efforts were increased; but even so in 1915 the British Army witnessed numerous failures in CB operations, as divisions and field survey units struggled to produce proper intelligence <sup>(61)</sup>.

The old-style 'artillery duel' was about to be replaced by one of science; and corps seemed the best level at which to conduct it. In July 1917 the British established the Counter Battery Staff Officer (CBSO). The CBSO was a lieutenant colonel based at corps headquarters, and usually located with the heavy artillery commander, although he came under the direct authority of the corps artillery commander. The CBSO issued direct orders to the guns, or issued a list of CB target priorities to lower formations for action, giving targets, timings and ammunition to be fired. The CB staff remained distinct from artillery intelligence, although both had the same objective — to defeat enemy artillery. To start with there was little co-operation, but by the end of the war the two had virtually merged <sup>(62)</sup>. Corps usually proved the best level for the C3 of CB operations in the First World War, but in the attack it was often considered best to delegate responsibility to divisions, with a specific allocation of guns for them to carry out the task.

The CB organizations built in the First World War soon disappeared after 1918, and it was not until 1942 that the British Army went some way towards re-creating them <sup>(63)</sup>. They grew in size and often included representatives from the Royal Navy and the RAF. In July 1945 a British War Office Committee was set up to review methods of gun and mortar location. It recommended the formation of a corps observation regiment, combining survey, observation, sound-ranging, and radar units, and that a CBSO be established at corps, with a divisional observation troop and CB officer at division.

allocated to CB operations. The British noticed increased German CB effort that year on other fronts, at, for example, the Battle of Arras: Weber (1919). By May 1918 the Germans had established a CB organization under corps control, known as the *Artillerie-Kampf-Artillerie* (AKA): Brooke (1925b).

<sup>(61)</sup> Brooke (1926).

<sup>(62)</sup> A compiling office was established at Army HQ. Its task was to examine air photographs and data from flash-spotting and sound-ranging, and to plot the positions of guns. It became the authority on all enemy gun positions to its front, but it was responsible only for passing its data to artillery intelligence at corps. It produced a 'Hostile Battery Position List' and a 'CB Map'. The list did not say where enemy batteries were, but gave positions in which they might be deployed. Artillery intelligence was responsible for assessing its tactical significance in terms of enemy movements and intentions: Broad (1922b). During the German offensive on 1918 the first indications of enemy attacks came from his artillery preparation. Artillery intelligence also received the intercepted radio messages of enemy air OPs, and passed the appropriate information to the RAF, who were thus enabled to shoot them down — an indirect form of CB fire: Broad (1922c). The development of artillery intelligence in the First World War is described in Annex H to *Fardale* (1986).

<sup>(63)</sup> A grouping of medium guns for CB operations under an Army Group Royal Artillery (AGRA) was formed in the UK in September 1942. The Germans also created groups of heavy and medium artillery for CB tasks: Bidwell (1967a), p.93. The Soviets held groups of longer-range guns at corps and division for the same purpose: Bellamy (1983a).

The most significant British development in C3 to counter enemy indirect fire, in the Second World War, was the creation of a Counter Mortar (CM) organization. In 1940 the response to the threat from mortars had been to increase the numbers of 3-inch mortars in the infantry battalion from three to six. This increase was quite inadequate, as too were arrangements for C2. There was a clear need for a Counter Mortar Officer (CMO). The failure to create a CMO early in the war was a major failure on the part of the British Army.

An attempt was made in Italy to combine CM with CB operations, but it failed because enemy guns and mortars generally deployed in different areas. A CMO was eventually established at division, with an assistant at brigade. The CMOs proved especially valuable in NW Europe in 1944, when the threat from German mortars reached its peak. They were allocated substantial assets specifically for CM operations; for example, in Operation VERITABLE the CMO was supplied with 20 OPs, two radars, and ten batteries of 7.2-inch howitzers. At first CM fire was co-ordinated at corps level, but after H hour each division controlled its own <sup>(64)</sup>.

CB and CM staffs were soon weakened after the Second World War, only to be revived during the Korean war. In the winter of 1951 the 1st Commonwealth Division found itself unable to respond adequately to enemy artillery. For a year it had no CB staff, and no locating battery; it was forced to improvise in the meantime. Normally it might have been expected to seek assistance from corps, where CB operations were traditionally centred, but in this case the US Corps to which it was attached had no such facility <sup>(65)</sup>. The importance of an efficient CB organization was demonstrated again in the Vietnam war, although in that scenario decentralized C3 proved most practicable <sup>(66)</sup>.

Despite the lesson that, in general war, CB fire is most effective when targeted, concentrated and controlled at high level, it was not until January 1967 that the British Army once again grouped its heavy artillery in a brigade at corps for this purpose, supported by a locating regiment <sup>(67)</sup>. Previously regiments had deployed with divisions, which had been responsible for CB fire. Artillery intelligence staffs

<sup>(64)</sup> 21st Army Group organized CM fire in two stages: first, immediate retaliation against pre-selected targets, then deliberate shooting against positively identified targets. Most divisions had a CM group of one 7.2-inch howitzer battery, and one and a half batteries of medium guns. The Nebelwerfer rocket launcher was usually a target for the CMO, but close liaison was maintained with the CBO in such cases. Unlike the British, the Germans had no CMO or aural sound-ranging facility. They based their CM efforts on technical sound-ranging, introducing the 'four pen recorder' in 1942, two years before the British.

<sup>(65)</sup> Pike (1953).

<sup>(66)</sup> US FSBs were prime targets for communist artillery. A North Vietnamese rocket had a time of flight (TOF) of perhaps 45 seconds. US forces calculated that their CF must be returned within 75 seconds of that opening round. To achieve such a response, many units maintained continuous surveillance of likely enemy positions, updated target lists and obtained prior clearance to fire into certain areas: Love (1968), p.38.

<sup>(67)</sup> Wilson (1968), pp.103-104.

were now established at corps and division with sections at brigade level <sup>(68)</sup>.

In the mid-1970s the US Army adopted the term CF, which included CB fire, as well as the attack of enemy locating and C3 organizations. At that time US corps were responsible for CB fire; but wide corps frontages and a growing target array made CB fire at that level too slow and imprecise. CF therefore became the responsibility of the US division, giving the manoeuvre commander the ability to decide the balance of artillery support between CF and close support.

A fresh appreciation of the threat posed by WP artillery led to a revival of interest in CB in the 1980s, and in many NATO armies it once more takes priority over close support at certain stages of operations. The complexities of C3 are being eased by ADP, and it is likely that in future guns, or rockets, will fire automatically in response to calls from locating devices.

<sup>(68)</sup> Although the British C3 organization was rationalized at that time, the guns required to carry out CB fire were too few, and unsuitable. CB tasks in general received insufficient attention in the planning of operations.

of these advantages may also be gained by deploying in small villages <sup>(32)</sup> but the best areas are likely to be the modern outskirts of towns and cities, where more buildings have strong steel and concrete frames. Such areas also have wider spaces between buildings, which create wider fields of fire. Industrial buildings can conceal SP guns, which can sally out to 'shoot and scoot' back after missions. This technique may be effective at times, but it makes command and control difficult, and compounds the problems of deploying in urban areas.

Guns are vulnerable once their locations are known, and should move again, if possible, after firing. However, it is often hard to find a traditional battery or platoon position in urban terrain. The provision of common orientation is more likely to be obstructed than in open country, but the development of equipment, enabling guns to orient themselves and produce individual firing data, will overcome many of these problems in the future.

Communications on a battery position are also made more complicated by the clutter of urban terrain, and VHF radio communications are likely to be severely degraded. On the other hand, other existing civilian communications, such as telephones, can be used even if their security is doubtful. Command posts deployed in open country are readily pinpointed by radio direction finders, and are thus highly vulnerable, but in a city it is relatively hard to destroy a well-positioned command post, even if its location is known. A command post protected in a cellar, sewer or railway tunnel would probably have to be dealt with by direct assault.

## Conclusion

It will usually be to a defender's advantage to draw the enemy into FIBUA, and the role of artillery is at least as important in this as in other operations, although in peacetime it is little practised in NATO. Interest in FIBUA tactics for infantry is reviving, but artillery's worth is generally ignored, even though historical experience and current Soviet doctrine acknowledge it as the most effective source of firepower in such operations.

Strategic areas of West Germany are becoming increasingly urbanized and attractive to the defence; and even if an attacker were to manage to avoid combat in urban areas, he would still provide defending artillery with excellent opportunities for concealment, and protection from which to assail the enemy.

## B: AIRBORNE OPERATIONS

Airborne forces are those able to deploy tactically on the battlefield by air: either by parachute, glider, helicopter, or transport aircraft, although in the past they have sometimes been more narrowly defined, as those delivered by air, without the need of an airfield. In addition, airborne forces usually enjoy high strategic mobility, albeit with a limited logistic sustainability.

They are generally given *coup de main* tasks, requiring speed, surprise, the

<sup>(32)</sup> Jones (1984). See also Chapter 12: Survivability.



seizing of critically important but limited objectives, and early relief <sup>(33)</sup>. Their high mobility is bought at the expense of weight, and hence of firepower. This deficiency is particularly severe in the case of parachute forces. Even if airborne forces secure their objective, they are vulnerable to counter-attacks and logistic exhaustion.

Airborne forces have a special need for artillery support, because they are so light; but even airborne artillery is relatively heavy and greatly increases the requirement for aircraft <sup>(34)</sup>. The calibre of guns and the ratio of guns to supported troops have therefore tended to be lower than in ordinary units and formations.

The first US airborne artillery trial took place on 20 March 1931, with the landing of a battery of 75mm pack howitzers by plane <sup>(35)</sup>. The Germans formed an airborne division in July 1938, in anticipation of operations in the Sudetenland, with an artillery troop of four Skoda light guns. By the end of 1940 this had grown into a battalion of three troops, with an anti-tank battalion of four companies; but after the assault on Crete the Germans did not mount another major airborne assault. The British formed an airborne force in November 1940, designed to capture airfields, and equipped it with two sections, each of four 3.7-inch howitzers. By the end of 1941 the British had formed the 1st Airborne Division, which was supported by just eight 3.7-inch howitzers. These were reinforced by two batteries of anti-tank guns in September 1942, but artillery support was meagre by non-airborne standards <sup>(36)</sup>. The quality of its fire support was also limited by a lack of centralized C3 <sup>(37)</sup>.

Opportunities for artillery to operate in an airborne role in the Second World War were limited <sup>(38)</sup> and most airborne units spent the majority of their time in a conventional role. Throughout the Vietnam war, US artillery only parachuted into action once, although frequent use was made of helicopters for tactical movement <sup>(39)</sup>.

<sup>(33)</sup> Even though in the D-Day landings in Normandy, and in Operation MARKET GARDEN, in 1944 these were on a grand scale.

<sup>(34)</sup> The supply of artillery ammunition to the British 6 Airborne Division in Normandy in June 1944 could not be sustained at the same level as expenditure: 8 guns fired 1,500 rounds on D+1, 1,300 rounds on D+2, and 2,500 rounds on D+3. For this reason it, like the 82nd and 101st Airborne Divisions, had to rely on the fire of other formations, such as the British 3 Division and NGS (naval gunfire support).

<sup>(35)</sup> Morgan (1943), p.55. This gun was used in support of all US airborne divisions by 1943 and in British airborne forces by 1943-44.

<sup>(36)</sup> The British 6 Airborne Division began to form in May 1943, and was also lightly equipped with just twenty-four 75mm pack howitzers and an anti-tank regiment, although in 1944 the number of field guns was greatly increased.

<sup>(37)</sup> An artillery headquarters for the Division was not formed until October 1942; and even then it was commanded by a lieutenant colonel, who was responsible only for training. Centralized command in operations was not envisaged until October 1944, when the command of divisional artillery was given to a brigadier.

<sup>(38)</sup> In July 1943, 12 guns of the British 1st Air Landing Anti-Tank Battery landed at Primosole Bridge in Sicily to support 1st Parachute Brigade and artillery was used again in support of landings at Taranto in September 1943; but opposition was limited. In February 1945 US forces delivered an airborne assault on Corregidor to destroy Japanese forces threatening shipping in Manila Bay; and airborne artillery proved invaluable in the defeat of a Japanese counter-attack on 24 February: Heller (1982), p.25.

<sup>(39)</sup> Battery A of the 3rd Battalion, 319 Field Artillery, jumped into the Katum area on 22 February 1967,

The Soviet Union at present maintains large airborne forces and supports each airborne division with thirty-six 122mm towed guns. In the West the need for parachute, or even airborne, forces has often been questioned, and with it the need for airborne artillery. The US 82 Airborne Division is the only real airborne division in NATO, although other US formations have significant strategic mobility, thanks to the large US fleet of transport aircraft <sup>(40)</sup>, and a tactical airborne role in helicopters <sup>(41)</sup>. NATO has maintained airborne forces in Europe to reinforce its weak flanks <sup>(42)</sup>; and most countries retain some kind of airborne forces with artillery for use in emergencies, such as the rescue of nationals held hostage overseas <sup>(43)</sup>.

Airborne artillery is highly mobile but highly vulnerable. Attrition can occur in the air, on landing, and on the ground in what may be hostile territory. Airborne artillery OPs and command posts may not be able to carry heavy sophisticated equipment; ammunition will probably be in short supply; and the number of guns deployed will probably limit the scope for heavy concentrations of fire. Airborne infantry and armour pay for their mobility by sacrificing firepower; and for this reason, whatever the handicaps, artillery plays, and will continue to play, an important role compensating for that deficiency in airborne operations.

## C: AMPHIBIOUS OPERATIONS

Fire support in amphibious operations falls into three categories, not counting air power. Firstly, it may be provided by special SP amphibious artillery pieces, which can fire while driving themselves ashore; secondly, it may come from ordinary field artillery firing from landing craft, or when once ashore; thirdly, it may take the form of naval gunfire support (NGS), for whose co-ordination field artillery has usually been responsible.

The SP amphibious gun was developed by US forces in the Second World War for use in the Pacific theatre <sup>(44)</sup>. It was originally designated as an amphibious tank, or 'amtank' <sup>(45)</sup>, but its thin armour left it too vulnerable for use as a tank ashore. It usually opened fire from its landing craft on the upswing of the bow, at a range of up to 4,000 metres. It also fired while swimming or driving ashore, ahead of assaulting infantry, engaging defensive positions on the beach with direct

in support of search and destroy operations: Ott (1975d), p.32.

<sup>(40)</sup> Each of the USAF's new C-17 aircraft will be able to carry six 105mm guns or three 155mm guns: Hamill & Davis (1986).

<sup>(41)</sup> The US M198 can be lifted by helicopter, but its weight reduces the distance it can be carried. The USMC would like a new lighter medium gun to increase artillery mobility. See discussion in Chapter 17, note 136.

<sup>(42)</sup> A description of NATO's South East Task Force in Vicenza, Italy, in 1981 is given in Barham (1981).

<sup>(43)</sup> US methods of dropping artillery in the 1970s are described in McCollum (1976).

<sup>(44)</sup> Other armies developed similar vehicles (the Duplex Drive variant of the British Valentine tank, for example), but these were primarily direct fire systems.

<sup>(45)</sup> It was designed around a Landing Vehicle Tracked, with an M8 assault gun turret, armed with a 37mm (and later a 75mm) howitzer, and could carry 200 rounds of ammunition. This vehicle was later used by the French in Indo-China in the 1950s: Croizart (1984), p.57.

fire. As soon as possible it would resort to an indirect fire role, operating as part of the US's divisional artillery.

The 'amtank' provided the mobility which other field artillery lacked in that theatre, enabling it to give fire support where ordinary artillery could not reach. It could avoid difficult terrain by swimming around islands, and even between islands <sup>(46)</sup>.

Such artillery was very specialized and consequently restricted in numbers, and most close artillery support for amphibious operations in the Second World War continued to be provided by standard field artillery. In an amphibious environment field artillery lacked mobility, and it proved difficult to provide fire support during beach landings, which was when supported arms were at their most vulnerable. NGS was therefore relied upon to support most landings, while field artillery adopted its traditional role once ashore, although at times it did fire from landing craft.

It is not easy to put towed artillery ashore. In the Pacific theatre in the Second World War, US amphibious doctrine required infantry and artillery to be landed from small craft, but it was often difficult to move medium and heavy pieces in this manner <sup>(47)</sup>. Beaches were often battered by heavy surf, protected by hidden sand bars or by coral reefs (like those on Saipan). It was hard to drive vehicles ashore, and to unload great quantities of ammunition, fuel, water and rations without proper docking facilities. The DUKW amphibious vehicle proved most suitable for these tasks. The sea thus imposed serious restrictions on the mobility of field artillery; but the terrain of Pacific islands was often even worse; and when it became impassable (as it did during the Battle of Leyte), medium and heavy artillery could at least re-embark, albeit with difficulty, and move up the coast <sup>(48)</sup>.

There have been few amphibious operations since the Korean War. Most field artillery today relies upon helicopters to lift it ashore, while NGS and aircraft provide fire support; but if necessary field guns can still go ashore in landing craft <sup>(49)</sup>. In some cases field guns have provided fire support while still afloat. The British mounted 25pdr field guns in a variety of small landing craft and barges to operate off the coast of Burma in the Second World War; and fire from field guns mounted in landing craft played an important part in the support of D-Day landings

<sup>(46)</sup> This mobility was illustrated by 'amtanks' during operations on Leyte. The US 776 Amphibious Tank Battalion moved around the southern tip of Leyte on 5 December 1944 under its own power, covering 33 miles a day, of which on average seven hours a day were spent in the water. Each vehicle swam between 125 and 300 miles in three days. The battalion outflanked Japanese positions, and often attacked reverse slope positions from the rear. On 7 December their indirect fire hit and set alight a Japanese ship which was attempting to land reinforcements. They also supported the attack by the Task Force on the 77th Division on Palompon, after making an approach swim of 38 miles: Collier (1945), p.730.

<sup>(47)</sup> A description of trials with 'Long Toms' and LSTs, conducted in Hawaii in April 1944, is given in Waterman (1945).

<sup>(48)</sup> In one exceptional case, during the battle of Tarawa Atoll in 1943, a battalion of the US 10th Artillery Regiment drove at low tide from Diana Island to Ella Island: Rowse (1948), pp.68-69.

<sup>(49)</sup> During the Falklands War, some British 105mm pieces were off-loaded from landing craft and pulled to gun positions by hand.

in Normandy. US forces used similar combinations to create Riverine Artillery during the Vietnam war <sup>(50)</sup>. More recently, British forces have been prepared to fire guns tied to the decks of ordinary ships <sup>(51)</sup>. Once ashore, fieldartillery can bring direct fire to bear on enemy strong points <sup>(52)</sup>, but it is subsequently best employed in its indirect fire role to support units moving inland <sup>(53)</sup>.

Despite attempts to enable artillery to give fire support during a landing, it could not and cannot provide the weight of support required. Techniques of NGS, in place of artillery, for such operations reached their height in the Second World War, and have been preserved in a much reduced and often neglected form since.

NGS played an important part in landings in Europe in the Second World War, but soon lost its importance as armies advanced away from the coast. In the Pacific, on the other hand, the land masses were small, the distances between them great, and initial resistance on beaches was stiffer. Whereas on large land masses enemy strong-points could often be by-passed, in the Pacific objectives, such as Tarawa, Saipan, Pellelieu and Iwo Jima, could not, because there were no island alternatives. Assaults on such islands amounted to fortress sieges, and NGS in effect took on the role of heavy siege artillery, to breach the defences. Equally, in the Falklands war of 1982, warships proved the only means of attacking and supporting a landing in the absence of a land base. It would however be wrong to conclude that NGS is therefore divorced from artillery operations. It forms an integral part of joint service planning; and was, and continues to be, delivered at the request of artillery commanders.

NGS has had a significant effect upon the outcome of land battles. Many Japanese prisoners, captured in the Pacific, testified to its shock and destructive effects; and Field Marshal K.G. von Runstedt, in explaining why the Allied landings in Normandy succeeded, claimed that "Your naval artillery was terrific" <sup>(54)</sup>.

US NGS in the Second World War began as little more than primitive area saturation, but soon adopted more sophisticated techniques. Targets were carefully selected and allotted priorities. Records were made of damage to targets, with data from air observation and photographic reconnaissance, as a result of which the military could be better advised where and when to land <sup>(55)</sup>. NGS was supplemented by the fire of rockets from landing craft, which eventually became a separate class of vessel. This combined fire was largely responsible for forcing

<sup>(50)</sup> This was used in the swamps, rivers and canals of the Mekong Delta from December 1966 in support of the 9th Infantry Division. Details of its equipment and operations are in Ott (1975b) and Hay (1974), p.73. The Soviets also made use of 'riverine artillery' in the battles for Budapest and Berlin: Vigor (1977). The role of Soviet riverine artillery in the Second World War is described in Sinegurov (1986).

<sup>(51)</sup> The use of field guns on HMS FEARLESS, on exercise off Norway in 1978, is described in Dyer (1978). British field guns were prepared to fire from the decks of car ferries during the Falklands War.

<sup>(52)</sup> The value of US artillery direct fire against Japanese positions on Tarawa in 1943 is described in Rixey & Best (1945).

<sup>(53)</sup> A description of the support provided by a US artillery battalion throughout the Pacific campaign is given in Rowse (1948).

<sup>(54)</sup> Quoted in Heintz (1945).

<sup>(55)</sup> Ibid. Soviet NGS equipment and techniques also became more sophisticated: Sinegurov (1986).

the Japanese to give up opposing US landings on the beaches, when they were at their most vulnerable, and to base their defences deeper inland <sup>(56)</sup>.

Most guns used today for NGS are of 4.5- or 5-inch calibre, and have a high rate of fire, with which each can generate firepower equal to that of a 105mm field battery <sup>(57)</sup>. There was a tendency in the 1970s and 1980s to phase out naval gunnery; but experience in Vietnam, the Lebanon and Grenada changed US attitudes, as experience in the Falklands changed those of the British <sup>(58)</sup>. With approximately 450 gun-armed ships, NATO has the means to generate substantial NGS, although it is most unlikely that many of these would be available in general war, except in amphibious operations on the northern flank.

Naval gunfire can be extremely accurate. In the European theatre in the Second World War, the US Navy regularly brought down fire to within 500-1,000 metres of friendly forces. In the Pacific, where skills were more highly developed, this was sometimes reduced to as little as 100 metres <sup>(59)</sup>. In the Falklands War, British warships also brought down fire safely at night to within 100 metres of British troops.

NGS does however have some disadvantages from the viewpoint of ground forces. While it is often very accurate, there have been many cases where it has not been. Field artillery can also be at fault; but heavy calibre guns have made NGS particularly dangerous when errors do occur <sup>(60)</sup>. Naval guns are designed for flat trajectory, high velocity attack, and so have difficulty in hitting concealed targets, unless a low charge is used. While they can often sail to within range of targets beyond the reach of field artillery, they are dependent on the navigability of adjacent water. They are also subject to naval constraints, such as weather

<sup>(56)</sup> Hedekin (1946).

<sup>(57)</sup> The British Mark 6 Turret has two 4.5-inch guns, with a range of 18km and can fire 32 rounds per minute. The more modern 4.5-inch, Mark 8 gun is mounted singly in a turret, has a range of 24km and a rate of fire of 24 rounds per minute: Morgan (1983), pp.90-91. The US Mark 42, 5-inch gun has a range of 23km, and fires 32 rounds per minute. A USN SPRUANCE class destroyer with two of these guns has more firepower than a 155mm battery. The USA is bringing back into service a number of IOWA class battleships, which can generate massive firepower. Each is armed with twelve 5-inch guns, and nine 16-inch guns, which can fire 2,700lb armour-piercing shells 37km: Kline (1985).

<sup>(58)</sup> The value of NGS was demonstrated in the first British offensive action of the Falklands War, Operation PARAQUAT, on 25-26 April 1982, when the Argentine garrison on South Georgia surrendered without ground force action. Operation TORNADO on 1 May 1982, the bombardment of Argentine forces occupying the Falkland Islands, struck an important political and psychological blow before the main British force landed. Fifty per cent of naval ammunition fired during the war was Variable Time (VT) fuzed for airburst, which was particularly effective in harassing fire. The war ended with another success for NGS, the surrender of the Argentine garrison on the island of Thule in the South Sandwich Islands, on 17 June, under bombardment from HMS Yarmouth. In all, British ships fired 7,921 rounds in 63 bombardments: Morgan (1983), p.114.

<sup>(59)</sup> Calls for fire at such close quarters were usually made at night to break up Japanese assaults, and the illuminating round proved as effective as HE, by lighting up targets for the defenders: Heintz (1945), p.618.

<sup>(60)</sup> "Naval gunfire could and did prove especially damaging to friendly forces when poorly placed": Shrader (1982), p.11. For example, on 22 February 1944 US landing craft were hit by the US destroyer HAILEY, and on the same day the 1st Battalion of the US 22nd Marines called for fire support, which hit their own positions.

conditions, sailing times, air and submarine threats; and consequently their fire cannot be guaranteed. Casualties to ships may also reduce the numbers of guns available, and ground forces should not forget the possible price to be paid for the providing of NGS <sup>(61)</sup>. Thus it is a mistake to regard naval guns as substitutes for field guns; rather they can supplement them, and take on special tasks where possible.

The essential difference between NGS and field artillery has not always been grasped by commanders, and so NGS has been misused, or not used at all <sup>(62)</sup>. The C3 of NGS has usually been a field artillery task, and has always required careful planning if it is to succeed <sup>(63)</sup>.

Ships have taken part in shore bombardment and support of amphibious landings for centuries; but it was not until the Second World War that special units were created for this purpose. The British formed Combined Operations Bombardment Units in April 1941 <sup>(64)</sup> with manpower derived primarily from the field artillery. For example, the 101 NGS missions for British forces on D-Day in Normandy were directed by 124 Royal Artillery captains.

US arrangements varied, depending upon the theatre. In Europe, special Naval Shore Fire Control Parties (NSFCP) were formed for specific operations <sup>(65)</sup>. In the Pacific, organizations were standardized, in the centralized training for the Fleet Marine Force and most army divisions, and affiliations to battalions were made permanent <sup>(66)</sup>. It was the army's or marine's task to identify targets for attack, and this was usually assisted by the daily provision of 1:5,000 photographic coverage of enemy positions <sup>(67)</sup>.

After the Second World War, as in so many other areas of fire support, organizations were broken up or neglected <sup>(68)</sup>. The British at present have Naval

<sup>(61)</sup> The loss of a 44-gun British frigate off Yorktown on 10 October 1781 was critical to the British land forces: Hure (1986). In 1982, British ships provided close support close inshore in daylight during the Falklands War, and lost one ship sunk, five seriously and four slightly damaged by enemy aircraft, missiles, and artillery. As a result, all bombardments were by night after 23 May 1982.

<sup>(62)</sup> Such criticisms of the planning of British NGS in the Falklands War are made by Major M.J. Morgan in Morgan (1983), and of US NGS in Grenada, (Operation URGENT FURY) in October 1983, by Major S.R. McMichael in McMichael (1985). See also note 70 following.

<sup>(63)</sup> After the battle of New Bern on 14 May 1862, during the US Civil War, General A.E. Burnside reported that "... the plan of attack contemplated the cooperation of the Navy, which was most successfully carried out... In this instance as well as in every other, where it has been needed, the most perfect understanding and cooperation have existed": quoted Wood (1964), p.34.

<sup>(64)</sup> Their organization and operations are described in Jureidini & McLaurin (1979).

<sup>(65)</sup> The formation of such parties, in February 1944, with twenty artillery officers for the invasion of Southern France, and their operation on 15 August 1944, is described in "Naval shore fire control parties in the Southern France landings" *Field Artillery Journal* Vol.35 (March 1945) pp131-134.

<sup>(66)</sup> A battalion's NSFCP was controlled by a regiment's Naval Gunfire Liaison Team. At divisional headquarters a Naval Gunfire Officer, a major, sat beside artillery and air force representatives, and at corps and Fleet Marine Force (Field Army) level, Naval Gunfire Sections and special staff were responsible for the provision of ships, aircraft, communications and logistics for NGS. Such liaison at all levels proved highly effective in the Pacific campaign.

<sup>(67)</sup> A NGS mission using artillery liaison officers and air OPs is described in Crossen (1945).

<sup>(68)</sup> From 1948 to 1977 the British relied upon 95 Amphibious Observation Regiment to provide the links with the Royal Navy for NGS, but since then there has been only 148 Commando Forward Observation

Gunfire Forward Observers, and the US A has Air/Naval Gunfire Liaison Companies (ANGLICOs) <sup>(69)</sup> dedicated to NGS; but these are the only units of their kind in NATO, and Operation URGENT FURY demonstrated that, in comparison with those of the Second World War, present arrangements for NGS are inadequate <sup>(70)</sup>.

Fire support in amphibious operations reached a peak of sophistication in the Pacific theatre in the Second World War. Few scenarios of general war envisage major amphibious operations on a similar scale, and the means of providing it have been allowed to deteriorate as a result. Amphibious field artillery <sup>(71)</sup> is unlikely to play a major role again, although amphibious transport for field artillery will continue to be required. In the early 1980s the value of NGS has been demonstrated in operations outside the NATO area, and its steady decline has been arrested <sup>(72)</sup>. The means of providing NGS may be preserved, but if this is to be used effectively, joint service planning will have to receive greater attention than it has done in recent years, and the manner in which air and ground operations have been so closely combined should be imitated.

## D: OPERATIONS AT NIGHT

Artillery must be prepared to provide continuous support to operations by day and night. As technology helps to improve night vision, with image intensification (II) and thermal imagery (TI) devices, operations by night are likely to become more common. While artillery itself benefits from improvements in night observation <sup>(73)</sup>, many of the problems associated with operations in darkness remain.

Armies have traditionally tried to eat, sleep, dig, camouflage and move by night, to lessen the chances of detection. In the Second World War such moves often involved long journeys, requiring careful administrative planning, which

Battery to carry out this task: Morgan (1983). Fire control arrangements for NGS in the British and US forces are described in Gillet (1987).

<sup>(69)</sup> The ANGLICOs are described in Hucks (1985).

<sup>(70)</sup> Major S.R. McMichael has claimed that the joint planners for Operation URGENT FURY failed to determine the NGS requirements for the US 82 Airborne Division; that ANGLICOs for that division did not arrive until D+2; and that they were then unable to communicate properly with ships. Naval and artillery fire, planned to support the attack on Egmont Compound on 27 October, was said to have proved unsatisfactory. Naval fire was also planned to support the Calvigny raid, but ships are said to have been refused permission to fire, for fear that communications between ANGLICOs and ships were inadequate; unfortunately the 82 Airborne Division and Rangers were apparently not given prior warning of this. It is claimed that as a result two destroyers were available but did not fire: "Restrictions on the use of naval gunfire... in effect eliminated it from use as a fire support asset for the Army ground forces": McMichael (1985), p. 12.

<sup>(71)</sup> The Soviet 2S1 SP gun is amphibious, and while it could be used for coastal landings, particularly in the Baltic, the facility is primarily for use in crossing rivers. Various NATO SP guns have an amphibious capability, but rely upon cumbersome bag-inflating procedures, and are not suitable for assaults from the sea.

<sup>(72)</sup> Future developments in NGS and target acquisition by RPV are discussed in Friedman (1986) and Preston (1987).

<sup>(73)</sup> A wide range of night-viewing devices is issued to OPs in most well-equipped armies. Flash-spotting is easier at night, and sound-ranging also improves. Automatic laying systems on the guns themselves will eliminate the need for lights on gun positions at night.

found that all actions took four or five times longer to complete than in ordinary conditions <sup>(85)</sup>. As it has in other difficult environments, the helicopter has helped artillery deployment, reconnaissance, observation and re-supply, but in northern Norway in winter, helicopters are usually grounded for fifty per cent of the time. Observation of fire on a barren landscape can be difficult, and impossible in 'white-out' conditions, but it is easier if airburst is used. Illumination works well against a white background and is important in long arctic nights; but base ejection smoke rounds often fail when their pots sink in the snow <sup>(86)</sup>. The greatest problem in arctic conditions is remaining healthy, and continual attention is required to stay alive and to keep equipment functioning, let alone to overcome the consequences for gunnery.

## F: OPERATIONS IN JUNGLE

Artillery was used little in jungle areas before the Second World War and few anticipated the requirement to mount large-scale operations across such hostile terrain. The Japanese preparedness to do so accounted in part for their early successes, and the US and British armies quickly acquired jungle skills to match. The main problem for artillery in that theatre was lack of mobility, which also inhibited firepower by interfering with the logistic re-supply. Artillery had to keep up with its supported arm, often moving directly across country along inadequate tracks or along freshly cut routes. Waterways sometimes proved useful transport arteries, and the value of aircraft was quickly learned.

Since the Second World War most operations in jungle terrain have been concerned with COIN. Such operations have tended to focus on centres of population, where guerrillas have concentrated their efforts, and artillery has been able to exploit the better communications found there. These in their turn have often become vulnerable to attack.

Since 1962 there has been a revolution in artillery mobility because of the proliferation of helicopters, pioneered by US forces in Vietnam <sup>(87)</sup>. Given air superiority, helicopters can largely overcome the jungle's barrier to movement <sup>(88)</sup>. Whatever the assistance of aircraft, the jungle imposes restrictions on other aspects of artillery operations. There are few suitable gun positions in the jungle, and although aerial reconnaissance may help to find these <sup>(89)</sup>, bulldozers and explosives have often proved essential for clearing ground and allowing guns to deploy.

<sup>(85)</sup> For example, it took 63 minutes to emplace a single 105mm howitzer at minus 60 degrees Fahrenheit, chopping holes for the gun spades with axes: Kane (1947).

<sup>(86)</sup> Betit (1975).

<sup>(87)</sup> The role of helicopters in Vietnam is discussed in Ott (1975b).

<sup>(88)</sup> Without the helicopter, British artillery would not have been able to deploy with such ease along the 970-mile frontier between Indonesia and Borneo in the 1960s, or at least to move so frequently as to ensure its survival: Walker (1969). A description of the movement of Green Archer mortar-locating radar in Borneo is given in Beaton (1969). The problems of jungle operations from a British viewpoint are discussed in Howard-Vyse (1985).

<sup>(89)</sup> On Guadalcanal in 1942 the clearings shown on air photographs proved to be swamps: Casey (1943).



In close country, FOOs have particular difficulty in identifying targets accurately and adjusting fire. In the Far East in the Second World War, maps were often inadequate, communications poor <sup>(90)</sup>, and visibility very restricted <sup>(91)</sup>. Advances through thick jungle were often made by whole formations in single file by company columns; and FOOs had to be prepared to call for divisional fire on identified targets <sup>(92)</sup>. It is extremely difficult to adjust fire in such conditions, and sometimes when visibility was poor this had to be done by listening to the fall of shot <sup>(93)</sup>. It is also unlikely that an FOO's party will carry heavy sophisticated observation devices, unless it is dropped and retrieved by helicopter. Where possible, an OP is best placed in a helicopter, on a hilltop, or even in a tree.

Skies over jungle are often overcast and this makes observation even more difficult. Poor visibility and poor communications make it hard to keep track of friendly forces, which means that artillery fire has often been directed at friendly troops <sup>(94)</sup>. Artillery fire at known points can also be used to adjust fire. In the past, 25pdr and 105mm shells have tended to burst in the jungle canopy, while heavier rounds may better penetrate to ground level <sup>(95)</sup>. High angle fire may have similar advantages, and for this reason, as well as crest clearance, rate of fire and portability, mortars have proved useful weapons in the jungle.

Jungle terrain limits the suitability of gun positions and increases the problems of local defence. Because clearings are likely to be small, the gunners have to be alert to the problems of crest clearance caused by tall trees. It may often be necessary to fire in the high angle and to accept the disadvantages of increased time of flight and possible inaccuracy <sup>(96)</sup>. In the Second World War, guns usually deployed on one side of a clearing, with their 'backs to the timber', to reduce the crest clearance hazard, but this sometimes increased the problems of local defence. The Japanese were able to push patrols on to gun positions at night from a covered approach <sup>(97)</sup>. The best defence was to keep guns close together, to increase patrolling and the number of sentries, to lay barbed wire, and to ensure good communications <sup>(98)</sup>.

The condition of men and equipment quickly deteriorates in the jungle. Besides the hazard to health from temperature, humidity, disease and physical dangers <sup>(99)</sup>, the moist climate tends to rot electronic equipment, and can affect

<sup>(90)</sup> On one occasion in Burma in April 1944, a British OP found the antiquated Signalling Lamp Daylight Signalling Short Range invaluable in calling for fire support: Collin (1981).

<sup>(91)</sup> Operations in the Borneo jungle were likened to night operations. Night exercises have been recommended as good training for the jungle: Walker (1969).

<sup>(92)</sup> Casey (1943).

<sup>(93)</sup> Collin (1981).

<sup>(94)</sup> Shrader (1982), pp. 11-14.

<sup>(95)</sup> Lyon (1972).

<sup>(96)</sup> On many Pacific islands in the Second World War, terrain was not only covered in jungle but was also mountainous. Guns sometimes had to deploy in deep hollows without ready reference points. Often only one aiming post could be used, and that at too short a distance. Inaccuracies were expected, and occurred: Casey (1943).

<sup>(97)</sup> Ibid, p. 744.

<sup>(98)</sup> The local defence of a 25pdr battery is described in Cowey (1946).

<sup>(99)</sup> See Bidwell (1965).

sights and lenses.

The problems of C3 are intensified in the jungle. It may be best to decentralize artillery C3, but generally this has been done only in COIN operations, where limited resources make it desirable. In general war, physical concentration of guns may prove as important as the concentration of their fire. US artillery in Bougainville in November 1943 discovered that "No matter how close the terrain, all artillery within mutually supporting effective range can be successfully coordinated" <sup>(100)</sup>.

## G: OPERATIONS IN MOUNTAINOUS AREAS

"The effect of terrain in such operations cannot be underestimated, nor can that of weather... the terrain was difficult even for mountain units" <sup>(101)</sup>. The Chinese Deputy Chief of the General Staff WU Xiuguan was referring to the severe effects of mountainous terrain upon Chinese operations in northern Vietnam in February 1979. Mountains impede movement and both enhance and restrict observation. The problems they create are often compounded by the desert, jungle or arctic conditions with which they may co-exist.

Approaches through mountains are usually limited, and hence more easily predicted and defended than in open terrain. Speeds of advance will probably be reduced, and re-supply made more difficult <sup>(102)</sup>. Armies which rely upon wheeled transport are the most likely to be handicapped. Oxen and mules have been, and still are, used to negotiate difficult routes <sup>(103)</sup>, but the greatest boon to movement in mountainous areas is the helicopter <sup>(104)</sup>. This can lift observers and guns over obstacles and up otherwise inaccessible peaks, escort convoys, and deploy picquets along routes <sup>(105)</sup>.

Height gives the well-sited OP great advantages, but mountains can also obscure vision, creating large areas of dead ground which an enemy can exploit. OPs may also be blinded by clouds and fog. Maps of remote mountain regions have often proved inadequate <sup>(106)</sup> and aerial photographs often mislead because they do not properly reflect height differential. An OP will therefore have to make its own aids to shooting by drawing or photographing a panorama. With the help of a laser range finder, precise distances can be established, and points on the ground

<sup>(100)</sup> Guenther (1945), p.334.

<sup>(101)</sup> Jacobs (1983).

<sup>(102)</sup> For example, the Alpine region of North Eastern Italy, which is an object of concern to NATO, presents major barriers to movement. Forests, and the snow which lies for six months of the year, increase the difficulties: Cappuzzo (1983). The problems encountered in desert mountainous regions of Arabia are described in Stagg (1965), Thwaites (1971) and Lee (1977).

<sup>(103)</sup> A Soviet view of the movement of artillery in mountains in the 1930s is given in "Employment of artillery in the mountains" *Military Review* Vol.23 No.6 (September 1943) pp.83-84.

<sup>(104)</sup> The value of aircraft in artillery operations is described in Lee (1977), pp.356, 359 and 361. The Soviet use of helicopters in Afghanistan in the 1980s is described in Isby (1987).

<sup>(105)</sup> On the other hand, in hot weather they have had difficulty in operating at high altitude. In the Radfan in June 1963, helicopters were grounded between 0900 and 1600 hours.

<sup>(106)</sup> In the Radfan in 1963 some areas were known as 'Brown Wash'.

## Chapter 13: BEFORE 1914

In the 300 years before 1914, all artillery except siege guns was engaged in close support of infantry or cavalry. During that time artillery endeavoured to match the mobility of the supported arms and to make its firepower more effective.

There were continual improvements in artillery mobility: the French invented the limber during the Thirty Years' War, and Gustavus Adolphus provided his infantry with mobile battalion guns. Heavier, less mobile, siege guns seldom appeared in field operations; but mobility was sacrificed on occasions as a matter of policy <sup>(1)</sup>.

In field armies emphasis was given more to mobility and to the availability of guns rather than the weight of firepower. Frederick the Great neglected his artillery for many years, but at Leuthen in 1757 it was to display the most devastating example of mobility and firepower of the 18th century <sup>(2)</sup>. Two years later, Frederick introduced horse artillery to ensure close fire support for his cavalry, and undertook reforms which reorganized field artillery into batteries, setting the style for the next 150 years <sup>(3)</sup>.

Firepower was limited by the weight restrictions required for mobility, and so other means were sought to increase it. Concentrating fire of light guns was one of these, but given their short range, this could only be achieved by massing the guns themselves. But massing guns did not always create accurate concentrations <sup>(4)</sup>.

The first effective use of massed guns was seen in the destruction of Augereau's corps at Eylau on 8 February 1807 by the fire of 70 guns <sup>(5)</sup>, an example often to be repeated in the Napoleonic period <sup>(6)</sup>. Napoleon himself was the great champion of artillery at this time. The greatest skill lay in deploying this firepower at the decisive point. One method of doing this was demonstrated on 14 June 1807 at the Battle of Friedland <sup>(7)</sup>. Artillery was placed under the central command of Senarum and moved forward ahead of the assaulting infantry corps to within 120 metres of the Russian lines. Marshal Foch spoke of this operation as the forerunner

<sup>(1)</sup> During the Silesian Wars of Frederick the Great, when operations became entrenched, heavier weapons were needed to prepare a way for infantry against extensive field defences.

<sup>(2)</sup> Duffy (1974), p. 120.

<sup>(3)</sup> May (1894), p.2. Other armies followed, but it was not until 1793 that the British, and 1794 that the Russians, adopted horse artillery, the 18th-century equivalent of the SP gun of the Second World War. In 1802 the the British adopted the 6-gun battery.

<sup>(4)</sup> At Zorndorf, on 25 August 1758, the Russians massed over 60 guns, but their fire was dispersed; and at Austerlitz, on 2 December 1805, Liechtenstein made little impact with a battery of 40 guns on the advance of Lanne's corps: Manceron (1963), pp.245-253.

<sup>(5)</sup> Chandler (1967), pp.541-542.

<sup>(6)</sup> At Wagram, on 6 July 1809, 112 French guns were used in a single battery against the Austrians: Chandler (1967), p.725; and at Borodino on 7 September 1812, 200 French guns massed on the Semenoffski ravine devastated the Russian infantry: *ibid*, p.801. Similar massing of guns was seen at Lutzen, Leipzig and Waterloo, but concentration of fire was not enough — accuracy and timing were also important.

<sup>(7)</sup> *Ibid*, p.579.

of the creeping barrage of the First World War <sup>(8)</sup>. It demonstrated a technique for ensuring that artillery provided fire at the point of decision, **but it also demonstrated** how artillery could itself constitute a tactical formation in the hands of a tactical commander <sup>(9)</sup>.

By the 1860s the effects of the Industrial Revolution were being seen in military technology. Before that, artillery had been responsible for about 50% of battle casualties. After 1860, in the American Civil War, the Austro-Prussian War and the Franco-Prussian War, artillery was to cause only 10%, and in the Russo-Japanese War 15% <sup>(10)</sup>, with most of the remainder being accounted for by rifled muskets. The introduction of the conoidal bullet gave **infantry** the range to match artillery <sup>(11)</sup>. Larger industrial populations **swelled** the size of armies, and railways and telegraph permitted rapid deployment over a larger battlefield, increasing the scale of potential carnage. Despite the development of breech-loading and rifled barrels, artillery remained at a disadvantage, and did not re-assert its position until the First World War.

Improvements in small arms forced artillery to review its tactics against infantry, and hence in support of infantry at close quarters. In the 1860s it was suggested that the British Army was "by a long interval the most ignorant in the art of self-defence against the desolating fire of the breech-loading rifle" <sup>(12)</sup>. The new exploding bullets were said to have "so demoralizing an influence on troops and the effects.... so horrible that the use of them has lately been made the subject of an European Congress" <sup>(13)</sup>. In a paper delivered to the Royal United Services Institute in 1869, C.P. Eddy advocated the advantages of an armoured shield for field guns, which might also protect infantry advancing behind. In his view, this protection was necessary as it was "almost if not altogether out of the question to bring artillery drawn by horses within telling distance of a line of infantry" <sup>(14)</sup>. By 1914 gun shields had been widely adopted throughout Europe <sup>(15)</sup>.

More mobile tactics were tried in an attempt to reduce this exposure to infantry fire, but these often reduced the available fire support <sup>(16)</sup>. Mobility was not always readily achieved. In the Austro-Prussian War of 1866, Prussian artillery was seldom in position in time to make adequate preparation for infantry attacks. Ironically, the Austrians achieved artillery superiority by grouping their guns in

<sup>(8)</sup> *Deutsche Militärgeschichte; Band 6 Militärgeschichtliches Forschungsamt* (Bernard und Graefe Verlag, Munich 1983) pp.209-213.

<sup>(9)</sup> It would be 100 years before the Prussian Army was to regard artillery commanders, with the exception of Prinz August in 1815, as commanders in this sense.

<sup>(10)</sup> Balck (1914), p.234.

<sup>(11)</sup> Dupuy (1983).

<sup>(12)</sup> Eddy (1869), p.328.

<sup>(13)</sup> Ibid, p.329.

<sup>(14)</sup> Ibid.

<sup>(15)</sup> Balck (1914), pp.219-220.

<sup>(16)</sup> For example, at **Fredericksburg**, during the American Civil War, **Pelham's** guns had to snatch a fleeting opportunity to come into action at short range: **Trussel** (1949).

static and heavily fortified strong points <sup>(17)</sup>.

The Prussians demanded even greater mobility as a result of this experience, and after the war the chief of their general staff, General **Helmuth von Moltke**, issued new directives for the employment of artillery. He insisted that artillery should always be available to open the battle and that the whole artillery should be employed in preparing for the main attack. Massing guns made it difficult to shift artillery about the battlefield, and as a result it had been usual in the Napoleonic period to keep about half of the guns available in reserve. This type of deployment was now recognized as wasteful and therefore abandoned. The complete corps artillery was now to be used without waiting for the commitment of other arms in reserve. The Prussians later produced ample evidence to vindicate the wisdom of this decision <sup>(18)</sup>. Unified command of guns was judged desirable and found practicable where guns were massed. It was not possible, in this period of relatively unsophisticated communications, if guns were dispersed.

Von Moltke's directives recognized the need for artillery to improve mobility and firepower, and found ways of doing so through a new interpretation of Napoleonic principles rather than new equipment. General von Hintersin developed these ideas, so that the corps artillery became the *Schlachtkörper* (core of the battle), tasked to destroy the enemy at the most effective range, which in the days before indirect fire meant at around 1,500 metres.

The new approach was tested in the Franco-Prussian War, in which the Prussians succeeded in massing large numbers of guns <sup>(19)</sup>. Prussian artillery tactics in the Franco-Prussian War were highly successful, but did not balance the recent technological advances in infantry weapons. The Prussians insisted that their artillery support the infantry at very close range if necessary <sup>(20)</sup>. The Prussians had greatly admired the selfless example of the Austrian artillery at Königgrätz, which sacrificed itself, enabling the remainder of the army to withdraw <sup>(21)</sup>, and so came to believe that no great importance should be attached to artillery casualties or even the loss of guns themselves at decisive moments of battle <sup>(22)</sup>.

Experience confirmed the merit of von Moltke's ideas as subsequently

<sup>(17)</sup> *Deutsche Militärgeschichte: Band 6 Militärgeschichtliches Forschungsamt* (Bernard und Graefe Verlag, Munich 1983) pp.346-348.

<sup>(18)</sup> Balck (1914), pp.297-298.

<sup>(19)</sup> At St. Privat they fielded a battery of 228 pieces and at Gravelotte their artillery occupied a front of 8km. Although these guns were often inferior to French equipments, they were usually better handled, and could prove devastating. At the Battle of Worth, in 1870, the Prussians massed all the artillery of their corps, and were able to concentrate in a few minutes all or any part of it on any section of the enemy; and at Sedan, 600 Prussian guns disposed of the French army at a cost of only 5% Prussian casualties. Even so, there were still problems. At Weissenberg the majority of batteries were brought in too late, because they were too far back in the line of march; and at Spignes in 1871 two Prussian batteries were positioned too far forward, and had to be saved by a cavalry escort.

<sup>(20)</sup> At Geißenberg Castle and Worth, Prussian guns came within 800m of the enemy, and at Borny, Gravelotte and Sedan ranges were sometimes as close as 500m: Hollist (1877), p.829.

<sup>(21)</sup> Craig (1965), p. 170, and May (1894), p.16.

<sup>(22)</sup> Hollist (1877), p.830. In keeping with this doctrine, III Corps was to lose half its batteries at Spicheren, but succeeded in its fire support mission.

developed in “Entwurf zu einem Exercis-Reglement für Feld-Artillerie der Königlich-Preussischen Armee” of 1870-1 and 1876 <sup>(23)</sup>. These continued to stress the need for artillery to fight at short range, providing both moral and fire support at the decisive moment. It was confidently expected that artillery would perform so well “that the infantry has merely to take possession of the hostile position instead of storming it” <sup>(24)</sup>. The seeds of the First World War’s artillery tactics were beginning to germinate. Another practical reason for providing such close support was to decrease the likelihood of fire being masked by other troops <sup>(25)</sup>. Until a way could be found to extend the distance between gun and target without loss of fire control and accuracy, there seemed little alternative to this method of close support.

The mobility of the fighting on the frontier in the war of 1870 and the consequent bias in the Prussian Army, for both military and social reasons, towards the horse-drawn field artillery, impeded the development of the heavy arm to the extent of excluding it from the field force; but by 1911 the recognized power of French and Belgian fortresses necessitated the return of heavy artillery to the field army, despite its relative lack of mobility.

Experience before 1914 determined that when Germany entered the First World War she would have artillery commanders who believed in the commitment of all available guns, and that in consequence these would be well forward in the line of march — which would moreover include a substantial proportion of medium and heavy guns. The basis had been laid for providing effective close support, even though the routine adoption of indirect fire techniques would take much longer.

## Indirect Fire

Indirect fire was the most important innovation in artillery practice for 300 years. Experiments with indirect fire were made by the Russians using howitzers as early as the 1750s, but major technical development was not undertaken until the last decades of the 19th century. Although the principles of the system were already well understood, it was not until the First World War that its potential was realized and the products of the Industrial Revolution accruing to artillery unleashed on the battlefield. Without indirect fire the artillery concentrations of the First World War and of the Eastern Front in the Second World War would not have been possible <sup>(26)</sup>. The ability of the artillery to provide close support would have diminished, and its position in armies have continued to decline.

Direct fire was concentrated by using Napoleonic masses of guns. Had range of guns been greater, this massing would not have been so necessary; but ranges could not increase greatly because even with a telescopic sight guns could not

<sup>(24)</sup> *Ibid.*, p. 834.

<sup>(25)</sup> *Ibid.*, p. 828. This was likely to occur at *Montretout* on 19 February 1871, when Prussian artillery had to stop firing because at 2,000 metres it was impossible, even with field glasses, to tell friend from foe: *Hollist (1877)*, p. 829.

<sup>(26)</sup> *Bellamy (1982a)*.

engage accurately beyond the range of an observer's eye. The conoidal bullet and machine gun were introduced at a time when the new smokeless powder was exposing gunners to enemy view <sup>(27)</sup>. Previously dense smoke had shrouded guns in a protective cloud. If guns could be positioned in cover, smokeless powder would actually assist their concealment rather than compromising their position. A means was required to enable artillery to move back into cover, and to produce accurate concentrations of fire, but without necessarily massing its guns.

The principles for achieving this had been known and practised for some time by siege artillery. Its implications for field artillery were fully described as early as 1882 by a Russian officer, G. Guk, writing in "The Covered Fire of Field Artillery", which discussed the role of the compass, aiming points, crest clearance and the passage of observers' corrections to guns <sup>(28)</sup>. The Prussians pursued this idea and were the first to produce an indirect laying instrument, the "Richtfläche", which was subsequently adopted by the Russians. The British were aware of these devices but viewed indirect fire as an unsatisfactory technique. They lagged behind all other major European armies, and did not produce an effective instrument until the "Number 7" dial sight in 1913.

If the theory was known, its wider acceptance in practice by other arms and their commanders took longer. In 1905, Colonel Belyayev had noted that the Russians were unable "rapidly to assimilate and apply new principles" <sup>(29)</sup>. The Russians did practise indirect fire in their war with Japan from 1904-05, but it was the Japanese who were described as using it first — by Lieutenant Colonel C.V. Hume, a British adviser — and the Japanese based their training on German principles. In early battles, Russian commanders still preferred to position their guns on "commanding ground" and in open positions, suffering severely as a result <sup>(30)</sup>.

The withdrawal of artillery to cover was widely resented by other arms, which still preferred guns to deploy in amongst them. The Gunners were poor advocates of their case. The very social elitism and technical superiority of the Russian artillery officers, all of which encouraged the formulation of the indirect principle, acted as a barrier to its acceptance in practice by other arms. Gunner introspection led Colonel Knox, the British military attache in Russia, to note that the artillery "never thinks of the necessity for practical cooperation with the infantry" <sup>(31)</sup>.

This problem was not confined to Russia. It is ironical that the tool which would revolutionize the provision of close support would be largely ignored until armies were shocked into using it by the First World War. Scepticism about new-fangled gunnery techniques was widespread within the artillery itself, which remained ignorantly conservative.

<sup>(27)</sup> Hoenig (1899), pp.238-246.

<sup>(28)</sup> Bellamy (1982a), p.215.

<sup>(29)</sup> Bellamy (1982b), p.330.

<sup>(30)</sup> Indirect fire was not accepted by the Russians until the battle of Liao-Yang in August 1904, when it was applied with success, using telephoned corrections for shrapnel fire. On occasions, however, telephone lines were blown away and corrections to fire were passed to Russian guns from Cairn Hill by a chain of men lying on their stomachs passing written messages: Warner (1975), p.363.

<sup>(31)</sup> Quoted in Bellamy (1982b), p.334.

In the British Army, the Royal Field Artillery (RFA) was renowned for its unscientific approach to gunnery, admiring intuition and subjective judgement, not calculation, when opening fire. The RFA did not practise temperature corrections, map shooting was unknown, and communications were by visual signal, sometimes by short telephone line, but more usually by megaphone. In comparison, the Royal Garrison Artillery (RGA) approach was relatively scientific. By 1914 it was firing from cover and laying guns on line with instruments on calculated data. It shot from maps and corrected for weather before firing. In May 1914 in a lecture at the Royal Artillery Institution (RAI), Captain Hill of the RGA was met with hoots of laughter by a largely RFA audience when he said that the RFA would be making meteorological corrections within two months of the start of a war <sup>(32)</sup>.

### Close support on the eve of war — 1914

#### *The British Army*

As the First World War approached, British artillery was ill prepared for the future. The principle of massing guns and concentrating fire at the point of decision was known but not followed. British artillery tasks were described as follows: "Till the enemy discloses his dispositions, artillery must usually limit its action to preparing to support the other arms as soon as occasion demands it", and "the duty of artillery is to assist infantry to establish superiority of fire over the enemy" <sup>(33)</sup>, in other words to win the fire fight before an attack. The requirement for close support was thus clearly stated, but fire planning was unknown and field artillery could offer only direct fire support.

The British had learned some unfortunate lessons from the Boer War. One was the paramount importance of mobility and the other was the perceived impracticality of indirect fire when tested on the veldt. The RFA consequently relied on equipment mobility and did not exploit the advances in fire mobility, made possible through indirect fire techniques and increased ranges. Shortly before the war, gun designers had actually sacrificed range when producing a new gun carriage.

Regulations were interpreted to mean close support by the gun, not the shell, with masses of pieces grouped well forward with other arms in the style of the 1870s. Artillery regulations in 1914 called for artillery to move forward to positions during battle to get "a clearer view of the infantry fight", despite the example of the Russo-Japanese War, when this practice was seen to result in the rapid loss of equipment, and so of firepower for the remainder of hostilities.

Defence received little attention. It was intended that artillery would be evenly distributed behind a strong line and allotted to infantry deployed to the front. Defence in depth was not considered.

The BEF went to war with no artillery above divisional level, and artillery advisers at corps and army level lacked staffs and the ability to command. C2 was

<sup>(32)</sup> Kirke (1974).

<sup>(33)</sup> Oldfield (1922).



decentralized except when equipments happened to be co-located. Telephones were used, but line was in limited supply. In a scenario which judged mobile warfare inevitable, decentralization of C2 seemed the only answer. Combined with poor communications, this meant that dispersed batteries could not be used to concentrate fire, and this was one reason why increasing range was judged of marginal importance.

Close support might have been better provided by the heavier guns of the RGA; but these were few in number <sup>(34)</sup>. The importance of heavier weapons was seriously under-rated. Shortly before war broke out, the number of 60pdrs was reduced, as these were considered unsuitable for use with an expeditionary force. The 6-inch howitzer did not even form a part of the Field Army, unlike its equivalent in the German Army.

The importance of heavier weapons was naturally appreciated by the RGA; and although equipment might be scarce, attempts were made to advertise its merits. In a lecture to the RAI in 1908, an officer of the RGA stated the uses of heavy artillery <sup>(35)</sup>. The most important of these in terms of the close battle were: "To search and enfilade points which lighter guns can only reach with frontal fire" and "In the final stages of an attack to support the firing line". If the RFA offered equipment mobility, the RGA offered fire mobility. Unfortunately, the lecturer judged it necessary to end by asking that the means be found to associate the howitzers of the RGA with the Field Army, so as to familiarize all ranks with their duties and to accustom generals and staff officers of other arms with their employment in the combined arms battlefield. Clearly the British Army of 1914 was not preparing to use the RGA in close support. Instead, it planned to rely upon light guns, which combined mobility with a high rate of fire. In peace the cry was mobility; but in war it was to become firepower.

Mobility was in part intended to compensate for lack of numbers. There had been concern in 1893 about the weakness of British artillery in comparison with other arms <sup>(36)</sup>. While the French and Germans were increasing their ratio of guns to infantry, the British were reducing theirs. The answer to this problem was seen to lie in "superior tactical power" and mobility <sup>(37)</sup>. By 1914 the artillery to infantry ratio had improved, but absolute numbers were still lacking, and fire mobility by technical means and heavier equipments neglected.

Firepower could not be generated through mobility if the ammunition were not available. Experience in the Russo-Japanese War had taught that ammunition expenditure could be unexpectedly high. At Lamuntun during the battle of Shaho, Russian guns had fired 166 rounds per gun (rpg) in 40 minutes; but like other

<sup>(34)</sup> In 1914 the British Army could find 72 field batteries but only six heavy batteries. By November 1918 there were 568 field batteries and 440 siege or heavy batteries, and only two-thirds of all pieces were lighter than 60pdrs: Broad (1922).

<sup>(35)</sup> Ibid, pp.64-65.

<sup>(36)</sup> A characteristic of the British Army in peacetime to the present day: "The handling of masses of artillery with reference to the preparation for infantry attack" *RUSIJournal* Vol.37 No. 187 (September 1893), p.956.

<sup>(37)</sup> Ibid, p.957.

European armies, the British learned the wrong lessons, emphasizing the need for fire economy rather than increasing the supply of ammunition <sup>(38)</sup>. Regulations noted that "rapid fire cannot be maintained for more than brief periods without exhausting ammunition" <sup>(39)</sup>. The War Establishments Part I, 1913, noted that every 18pdr field gun should have 1000 rounds, with 300 in the UK and a further 500 to be provided by factories within six months <sup>(40)</sup>. Of all these only 176 were held at battery level, and they could sustain firing for just 44 minutes at Rate 4 <sup>(41)</sup>. Six such periods would consume the ammunition with the force, leaving 75 minutes' worth in the UK and another 60 minutes' worth to arrive within six months. With hindsight, the inadequacy was clear.

All ammunition issued to the RFA was shrapnel, which was to prove the most effective munition of 1914. HE was regarded in many quarters as unsporting, because it gave off yellow fumes which were rumoured to be poisonous. The BEF was to find itself outnumbered, outranged and short of many technical skills, but it possessed one outstanding advantage in its ability to burst shrapnel at an effective height, unlike the German artillery, which burst its shrapnel too high at 30 feet.

The shortage of ammunition meant that British artillery could offer only light fire in the initial phase of an attack, building up to a high rate of fire at the decisive moment. Its aim was therefore limited to demoralizing the enemy and affecting "their fire so as to afford the infantry the opportunity to assault" <sup>(42)</sup>. British artillery expected to neutralize, not destroy, the enemy.

### *The French Army*

The French idea of what a European war would be like was described afterwards by General Herr, formerly the artillery commander of the French VI Corps. The war would "be short with rapid movement... a struggle between two infantries... the artillery will be only an accessory arm, with one task: to support infantry attacks... it will require only limited range... the obstacles which one will meet in the war of movement will be of little importance... field artillery will have sufficient power to attack them... the necessity for heavy artillery will seldom make itself felt... a battery of four '75's develops absolute efficiency on a front of 200m, it is consequently unnecessary to superimpose the fire of several batteries" <sup>(43)</sup>. This inaccurate forecast determined the organization and tactics of the French artillery in 1914.

The French favoured a light field gun for close support, depending on the formidable '75' which was usually deployed in massed open positions. It was very mobile and had a high rate of fire, which at times could compensate for lack of weight against heavier German guns, provided that ammunition was available <sup>(44)</sup>.

<sup>(38)</sup> Brooke (1924), p.254.

<sup>(39)</sup> Oldfield (1922).

<sup>(40)</sup> Brooke (1925).

<sup>(41)</sup> Rates of fire are measured in rounds fired per minute, i.e. one round per gun per minute is Rate 1.

<sup>(42)</sup> "Field Artillery Training: 1914", quoted in Brooke (1924), p.266.

<sup>(43)</sup> Quoted *ibid*, p.263.

<sup>(44)</sup> This allocation of ammunition to the '75' was at 1,248 rpg only slightly better than that of the British

The predominance of the '75' minimized the role of heavier weapons, although their merits had been considered. General Herr visited the Balkan War theatre in 1912 and observed: "Heavy long ranging artillery was an indispensable arm in modern battle and this arm should act in constant liaison with the field artillery", and that it should be organized as a corps artillery <sup>(45)</sup>. These arguments were rejected in a French General Staff Paper of 1914, which asserted the power of the '75': "A mobile artillery, capable of making good use of ground, will seldom require a long ranging gun to place itself within effective range of the enemy" <sup>(46)</sup>. The invention of ballistically destabilizing *pacquettes*, which increased the curvature of the '75' s trajectory, offered what seemed to be a cheaper alternative to a new high angle system. As a result, on mobilization the French Army could field 3,840 '75's but only 308 heavy guns.

The French preferred to fire short "rafales" (bursts of fire), but like the British, they realized that they could not produce a high rate of fire for very long. Their regulations recognized that artillery could only produce a neutralizing effect. As a result, French infantry was trained to attack without any artillery preparation, but with support during the assault phase. This contrasted with the German doctrine, which required maximum support from the outset: "Every attack undertaken without the greatest preparation by artillery is frivolity" <sup>(47)</sup>.

Close support was designed to be so close that a number of casualties among friendly infantry was accepted as inevitable. Although support was close, it was so decentralized that there was no way of concentrating it on to targets of decisive importance, and in that sense it used scarce resources in an uneconomic manner.

The French still believed in maintaining an artillery reserve. They did not commit all available guns, allocating only those judged necessary to provide adequate support <sup>(48)</sup>. In practice the corps reserve was used as an independent reinforcement and was not a means of centralizing fire control or deploying heavier weapons.

The obsession with equipment mobility to provide immediate but local support outweighed the broader considerations of fire power. It is not surprising, given this method of operating, that each battery was issued with only 500m of telephone wire, limiting the scope for indirect fire.

The practice of massing equipment, adopted in the 19th century to implement the Napoleonic principle of concentrated firepower, was seen to be obsolete, but the French, like the British, abandoned the principle with the practice, instead of adopting new techniques and equipment to fulfil it in new conditions.

18pdr, but was considerably higher than that of the German '77': See "French artillery doctrine" *Royal Artillery Journal* Vol.XLVIII No.4 (July 1921) pp.82-91.

<sup>(45)</sup> Quoted in Brooke (1924), p.257.

<sup>(46)</sup> Quoted *ibid*, p.258.

<sup>(47)</sup> Quoted in Hoening (1899), p.306.

<sup>(48)</sup> Rohne (1908), p.363. A corps was usually allotted a 6km front. At 200m per battery a corps would therefore receive 30 batteries. This measured rationing of artillery was balanced within the corps by employing a corps reserve at the decisive point: Kirke (1974).

## The German Army

The German Army also trained for a mobile war, but not at such cost to firepower. It saw firepower as the means to ensure mobility, not as its product; hence the use of howitzers to neutralize the delaying power of the '75', of heavy artillery to destroy obstacles on the Belgian and French frontiers, and the preference for concealing German guns.

In 1908 Lieutenant General Rohne, once described in *Militär-Wochenblatt* as "the highest authority on artillery matters" <sup>(49)</sup>, made a comparison between French and German field artillery <sup>(50)</sup>. He concluded that while the German '77' might be better protected and have greater mobility, the French 4-, as opposed to 6-gun, battery was an advantage. In addition the supply of ammunition for the '75' would give it a decisive superiority in firepower <sup>(51)</sup>. The French had some howitzers at corps level, but the Germans allocated them to most divisions, having withdrawn them from the corps in 1899. The German 4.1-inch field howitzer was designed to reinforce the '77' at divisional level. No other nation could match the potential firepower within a German division or corps.

The Germans intended to use their lighter weapons in a conventional manner. In 1889 Prince Kraft zu Hohenlohe-Ingelfingen advocated the crest of a hill as the most suitable position for field artillery, but he went on to describe the benefits of cover if it could be found <sup>(52)</sup>. The howitzer was specifically designed to fire from covered positions, and destroy enemy guns deployed in the open which could not hit back with their flat trajectory. Whereas faith in the '75' led the French to reject the howitzer, it was fear of the '75' that led the Germans to adopt it.

The Germans were also well equipped to make the most of their firepower. The 1870 model of C2 had been refined by 1914. The former had stressed the need for each mass of guns to be commanded by a senior artillery officer. Revisions emphasized the need for artillery fire to come under the complete control of an artillery commander, using every battery to best advantage. This contrasted with the French decentralized ideal, where batteries would fire under the direction of their supported infantry. The Germans thus possessed a basis for the centralized C2 that would become the norm in the coming war for all sides.

The Germans were sensitive to the problems of deploying and controlling their

<sup>(49)</sup> May (1891), p. 1327.

<sup>(50)</sup> Rohne (1908).

<sup>(51)</sup> The Germans were aware of the higher than expected rates of fire experienced during the Russo-Japanese War, and Lieutenant General Rohne offered evidence for his fears by quoting from a lecture delivered to the St. Petersburg Military Society. This described how during the battle of Tashikiao, batteries supporting the East Siberian Rifles fired 249 rpg and others as many as 628 rpg in two days with guns which were not even quick-firers: *ibid.*, p. 361. The Germans feared that over a period of time, four French guns would be able to generate more fire than a 6-gun German battery, because the latter would not be able to sustain a high rate of fire. The French guns had 432 rpg, whereas the Germans has just 264, and it was easier to control and direct the fire of four guns than that of six.

Using the resources of a corps, a French battery had 1,248 rounds at 312 rpg, while the Germans had 1,132 or 188 rpg: *ibid.*, p. 360; but the Germans enjoyed a sizeable divisional advantage in artillery with 72 as against 24 guns.

<sup>(52)</sup> Kraft zu Hohenlohe-Ingelfingen (1889), p. 890.

masses of guns on a crowded battlefield. In their campaign of 1870-71 they had often experienced difficulty deploying 40-50 divisional guns on a front of about 2,000 metres <sup>(53)</sup>. It was not foreseen that densities many times greater than this would become normal, and that they would be achieved through depth.

If the use of artillery in two dimensions had not been fully anticipated by any nation, the Germans led in the third. The British realized the potential of air observation, but devoted few resources to its development, leaving the problem of air to ground communications unresolved. The Germans meanwhile had devised a system of coloured light signals to indicate the presence of targets <sup>(54)</sup>. War would develop these small beginnings of what would become an important, and might become the primary, means of target acquisition.

### Conclusion

In 1914 European armies and their artillery had little idea what shape the coming war would take. They all regarded artillery as an accessory rather than an essential arm, supporting infantry in mobile operations under what in practice was a decentralized command. There was no question of truly combined arms planning, and while CB fire was deemed necessary, it could not be carried out effectively in the mobile war scenario.

The German artillery was best organized and equipped to deal with the novelties of the First World War, but in 1914 none had settled the outstanding issues: ammunition resupply, the use of heavy artillery, the concealment and protection of guns, the organization of C2 at high levels and the need to improve communications. When war came the resolution of these problems would tip the balance away from mobility to satisfy the imperative — firepower.

<sup>(53)</sup>Forty years later they would have to find space for 72 guns on a frontage of just over 1,000 metres: Balck (1914), p.242. Thirty years later still, densities would on occasions be many times as great.

<sup>(54)</sup> Brooke (1925a).

## Chapter 14: THE FIRST WORLD WAR 1914-1918

### Introduction

This review of the First World War will show how successive events brought about fundamental revisions of tactics, counter-measures and further evolutions. Pre-occupation with fire and manoeuvre of infantry gave way to concern for artillery firepower, machine guns, tanks and aircraft. The art of C2 was seen to lie in the way a commander applied firepower, rather than in the way he deployed foot soldiers.

In 1914 infantry was still required to provide its own covering fire, when artillery was not available. Artillery fire, when provided, was almost always controlled by observed fire; CB fire was advocated but generally impractical; harassing fire, let alone continuous fire, was seldom used, and artillery played little part in battlefield deception.

By 1918 artillery was expected to provide sufficient fire to spare the infantry a long fire fight, thus saving their energy for penetration and exploitation phases of the battle. Artillery was expected to prepare a route through which the supported arm might pass; and to achieve this it was given enormous quantities of ammunition and numerous technical aids. The increase in artillery strength relative to other arms is shown in Figure 3.

Fig. 3 Number of artillery pieces per 1,000 infantrymen in 1914 and 1918

	1914	1918
British	6.3	13
French	4	13
German	6	11.5

Note: Compare with Fig. 13 on p.318 for numbers in 1986.

Advances in technique were such that the greater part of fire was either unobserved or unregistered. CB operations had become a science in fire superiority, with a separate organization and staff involved in a deep battle not previously conducted. The key to surprise and deception was no longer to be found in the placing and use of a 'General Reserve', but in the methods of applying masses of artillery.

This transformation was common in varying degrees to all the belligerents and experienced four phases: the realization in 1914 that existing artillery practice was inadequate, the consequent testing of new methods and build-up of materiel in 1915, the tactics of 'mass destruction' by artillery fire from 1916-17, and finally the adoption of 'neutralization' from 1917-18.

The lessons learned from these experiences shaped the foundations of modern artillery operations, and many are still recognizable today. Manoeuvre is dependent upon firepower, and artillery must achieve equipment and fire mobility if it is to support manoeuvre operations successfully; artillery can be effective against armour as well as infantry; deep attack by artillery can influence the

contact battle decisively; effective operations against enemy artillery are a prerequisite for the success of a combined-arms plan; the acquisition of targets by technical means is essential to successful artillery operations; C2 of firepower is at least as important as the design for manoeuvre in battle; and operations are unlikely to succeed without thorough logistic, and primarily artillery logistic, preparation.

### 1914 — The shock of the new

Four issues of concern to the Close Battle became apparent soon after the outbreak of war: the relative merits and performance of opposing equipment; the novel primacy of firepower over mobility; the need to fight at night; and the construction of obstacles.

The British and French soon appreciated but could not match the power of the medium 5.9-inch howitzer used by the Germans as a field piece. In the case of the BEF it outranged **all** but the 60pdr, which with a flat trajectory had difficulty in hitting back <sup>(1)</sup>.

The value of the howitzer and the need to increase the calibre and range of field equipment was soon realized, but with **different** results among armies. In 1914 the British 18pdr frequently held the line after its supported infantry had been overwhelmed; and the advancing phalanxes of German infantry offered ideal targets for shrapnel. It continued in successful service throughout the war. The relatively disappointing performance of the '77' encouraged the Germans to reinforce the success of their '5.9'. While the howitzer had many advantages, it was to prove less accurate than a gun when used for barrage fire later in the war, and although the Germans stressed the need to keep close behind a barrage, their infantry were to find it harder to do so in practice than did the British. The French '75' was outranged by heavier German guns, and contrary to French expectation could not compensate for lack of range by mobility or high rate of fire. French medium and heavy artillery which might have replied was generally at the rear of the column, and unable to intervene, rather like Prussian guns in the 1860s. As a result, French infantry was often deprived of the support it might otherwise have had, even though trained to assault without artillery preparation if necessary. More often than not such attacks were devastated by German machine gun fire. Infantry firepower, which had been growing for 50 years, still came as a shock to the armies of 1914 <sup>(2)</sup>.

The battles of 1914 demonstrated that mobility was a secondary consideration

<sup>(1)</sup>The Germans frequently managed to position observers on high ground, and the British were forced to **conceal** their guns where possible on reverse slopes, which were less suitable for their flat trajectories. A British pamphlet of 30 October 1914 emphasized the need to occupy reverse slopes in view of the superior range and firepower of the 5.9 howitzers which opposed them: quoted in Broad (1922), p.67. But this was not **always** possible and at Ypres, Messines, Aubers Ridge and in many subsequent battles the Germans won observation over British guns, while their own remained covered from view.

<sup>(2)</sup>It was demonstrated repeatedly that a concealed machine gun, possibly firing on fixed lines and from a position opposite a neighbouring formation, could seldom be destroyed by **light-weight**, short-ranged and unprotected field artillery.

to firepower, and its accomplishment through sound tactical C2. This was evident at the First Battle of Ypres, where the mobility of the German forces, making for the Channel ports, was nullified by combined artillery and infantry fire, and the advance brought to a halt. Armies realized that artillery preparation had become a prerequisite for a successful assault.

At the same time, artillery was revealed as more vulnerable than had been feared. The lessons of the Russo-Japanese war had to be learned at first hand to be taken seriously <sup>(3)</sup>.

The need for artillery to deploy in depth was clear, but this made liaison between artillery and infantry even harder <sup>(4)</sup>. The RFA was compelled to revise its method of operation and issued large quantities of telephone line in an attempt to link the two.

New techniques were developed to quicken the response to infantry requests for fire, particularly at night. The British instituted the 'SOS' mission, which is today generally called Defensive Fire (DF), or Final Protective Fire (FPF) <sup>(5)</sup>.

Trench warfare was the product in the first place of superior firepower over mobility, a phenomenon which ran counter to the doctrine of all sides prior to 1914. Infantry mobility was halted by the power of opposing infantry weapons, and neither side possessed the artillery firepower to silence the latter and restore mobility. The deadlock in the trenches in 1914 reflected the imbalance in infantry and artillery firepower that had existed for fifty years.

Obstacles, and wire in particular, ended the immediate possibility of strategic surprise by stabilizing the battlefield. It was accepted that obstacles covered by fire should not be assaulted by infantry without first being cut by artillery. Liaison and joint planning thus became necessities, and artillery ceased to be merely an accessory on the battlefield. The novel demands made on artillery stimulated the generation of enormous resources and imaginative methods of applying them. The irony was that, in unleashing this unprecedented firepower, artillery might sometimes succeed in breaching an obstacle, yet it almost always created another in the form of a devastated terrain. Attempts to restore mobility often proved

<sup>(3)</sup> At Le Cateau, British artillery of 5th Division deployed in the open within 500 metres of supported infantry and was swept away. If artillery fell back, crests often prevented it from supporting the infantry. To remain forward may have been good for infantry morale, but at a severe price in artillery casualties. The vulnerability of guns deploying in forward areas was demonstrated at Bertrix in August 1914. German guns suffered as they engaged French infantry at 50-1,200 metres and French guns at 400 metres: Bume (1936) and "AGM" (1937).

<sup>(4)</sup> There were many examples of the confusion common to all wars: at Bezu on 9 September 1914, a British battery fired on the Lincolnshire Regiment in error: Edmonds (1922), p.290; and on 10 September an attack on German positions near Priez by battalions of the Sussex and Northamptonshire Regiments was actually forced to fall back under friendly fire: *ibid*, p.309. At the Aisne the artillery of II and III Corps was unable to give proper support to its infantry, which was deployed across the river to the North, because of poor communications between observers and guns.

<sup>(5)</sup> Artillery was laid on fixed lines and opened fire automatically if rifle fire was heard to the front. This was expensive in ammunition but became an important element in defensive plans. 'SOS' fire became increasingly sophisticated, but by 1917 had been largely discredited; nevertheless in 1914 it helped to break the mould of traditional gunnery practice. See also notes 11, 46 and 47 below, and Chapter 16 Section A, at p. 187.



counter-productive as a result. It was not until late in 1917 that techniques of applying artillery firepower were sufficiently refined to help break the deadlock established in 1914 by its deficiency.

### **1915: Fresh resources and new techniques**

Artillery could only deliver the required firepower by concentrating its slender resources on narrow fronts, expanding as industry delivered fresh equipment and ammunition. The limited battles of 1915 were experiments in the application of concentrated firepower, and the lessons learned from these were to shape artillery tactics on all sides until the end of 1917.

The primary lessons were that: artillery required unprecedented supplies of ammunition if it were to win the fire fight; and the resulting firepower could best be exploited if part of a sound tactical plan under a more centralized command; and if the gunners could overcome the technical problems of accurate delivery.

By the end of 1915 it had been determined that the committal of infantry to the attack without a certain number of rounds per metre of front would result in failure, and tactical appreciations became dependent on mathematical formulae. This lesson was learned bitterly during the year, and led to the conviction that there could never be enough artillery support. From this conviction stemmed the gigantic consumption of munitions in 1916 and 1917.

In 1914 the usual allocation of ammunition for a British offensive was up to 100 rpg. By 1915 it had trebled <sup>(6)</sup>, but this was small compared to that of subsequent years <sup>(7)</sup>. The British and indeed the French problem was not in deciding how many rounds to fire but how to find the rounds. Ammunition establishments were inadequate, and by 1 June 1915 there were often less than half of these available in France <sup>(8)</sup>. Both Britain and France initiated major reorganizations of their munitions industries in order to cope with the demand, but quality was often sacrificed to quantity. Hastily manufactured '75' ammunition proved defective. In the first nine months of war the French lost 1,440 pieces, often through accident <sup>(9)</sup>.

All tactical plans were dependent upon ammunition supplies. The British experience in the battles of 1915 shows how this realization dawned and illustrates the new techniques of gunnery that emerged from it. The British learned from

<sup>(6)</sup> Broad (1922), p.70.

<sup>(7)</sup> The French were already firing considerably more. In their offensive in Champagne and Artois, starting on 25 September 1915, 1,100 field guns fired 850 rpg. By 1918 the Germans were producing 11 million shells per month. In July and August 1916 they fired 14 million shells, equal to three times the ammunition reserves of 1914: Meister (1985), p.52.

<sup>(8)</sup> In the worst case, the British 6-inch howitzer with an establishment of 495 rpg had only 73 rpg; Brooke (1926), p.87. The French responded to the ammunition crisis in early 1915 by re-equipping 100 batteries with the obsolete '90 de Bange', which had large reserves of ammunition. This helped to compensate for the inadequacy of French industry, which was producing only 3-14 rpg per day. The British had similar problems and rationed artillery to 5-10 rpg per day.

<sup>(9)</sup> In one morning 10 out of 12 guns in a 'Groupe' burst, a consequence of the pre-war miscalculation of ammunition expenditure rates: *ibid.*, p.80. For a description of accidents in the Second World War, the Korean War, and the Vietnam War see Ostrom (1986), pp.35-37.

French and German experience, at, for example, Perthes and Soissons in January 1915, and Artois in May, that a preliminary bombardment was essential for an infantry assault. The French lacked medium and heavy artillery, and in order to generate compensatory firepower lengthened the duration of their fireplan, sacrificing the element of surprise. The Germans exploited that sacrifice, and at Soissons on 12 January 1915 used massed artillery to straighten a 'bulge' (their preferred choice of location for attack throughout the war). Their aim was to pin down, and shatter the morale of, the defenders and to prevent reserves coming up. Particular attention was paid to maintaining communications with the infantry, and Colonel von Seeckt's plan was seen as a model for its time. The objective was limited, and while artillery had a CB role, its primary aim was the neutralization of enemy infantry firepower <sup>(10)</sup>.

The first British attack of penetration was at Neuve Chapelle from 10-12 March 1915. The attack was by three brigades on a narrow sector with an army in reserve on a 10-mile front. 354 pieces deployed against 60 German on a sector of just 1,200 metres, a concentration not matched until 1917 at Ypres, on a much broader sector; but at Neuve Chapelle British guns could fire only 200-400 rpg, a fraction of what became available two years later. The choice of a narrow sector was in part determined by the shortage of ammunition and indicated an appreciation of the need for concentrated firepower to break through obstacles.

Such an operation required a degree of joint planning not previously achieved. The plan of attack was secret. For the first time detailed maps were specially produced from aerial photography. Unlike the French offensive earlier in the year, the preliminary bombardment lasted only 35 minutes, in order to reduce the time for the Germans to react, and registration was concealed over a period of three weeks. Field guns were brought up to cut the wire with direct fire, and howitzers engaged the trenches. The wire was cut successfully, but the howitzers firing off maps were wildly inaccurate and the trenches were barely damaged.

The preliminary bombardment paralysed the defence and initial objectives were secured, but the advance soon ground to a halt. The problem was that the planners had focused on obstacles as the key to successful defence, rather than on the fire from the trenches, which the obstacles enhanced. If enemy firepower had been tackled effectively, the obstacles would have been of less importance. Where success was achieved, it was through the 'neutralization' of the defence with a short, intense bombardment, not through the 'destruction' of obstacles alone. By 1917 this was appreciated, and short 'hurricane' bombardments became the norm, but in 1915 the lesson was misread.

The failure of the attack was put down to obstacles remaining intact, rather than to the failure of howitzers to hit enemy infantry in their trenches. This experience led to a belief in the need to destroy totally everything that stood in the path of attacking infantry, irrespective of damage to the terrain and loss of surprise. The only arm which could deliver this firepower was artillery, and its massive

<sup>(10)</sup> *Deutsche Militärgeschichte: Band 6 Militärgeschichtliches Forschungsamt* (Bernard und Graefe Verlag, Munich 1983) p.507.

expansion continued, until within a year it had assumed the dominant role on the battlefield <sup>(11)</sup>.

The British plan for the Battle of Loos on 15 September 1915 was significantly different from that of Neuve Chapelle. The front was eight times larger, but with little increase in artillery. Consequently there was only one piece per 23 yards, or one-fifth of what there had been in March 1915. To achieve what was judged to be adequate 'destruction' on a longer front with fewer weapons, it was necessary to reduce the density of fire, but to fire over a longer period, sacrificing surprise. The four-day preliminary bombardment lost not just tactical but also strategic surprise.

The co-ordination of artillery fire was of unprecedented complexity and led to novel arrangements for C2. The preliminary bombardment and initial phases of the assault came under centralized control, but this was decentralized for subsequent phases to accommodate the flow of battle. I and IV British Corps each created artillery headquarters to co-ordinate divisional plans; but the heavy artillery still remained separate from the field branch, which caused difficulties when these weapons were used in close support.

The most significant development in tactics was the use of the 'lifting barrage'. Rather than fire advancing at arbitrary intervals, the 'straight barrage', the 'lifting barrage' moved in parallel lines but from trench to trench, concentrating fire on the lines of greatest resistance. The idea was an improvement on previous practice, but although observers accompanied the infantry, the expertise to make best use of the barrage was lacking. With imperfect indirect fire techniques, map shooting was extremely inaccurate and difficult for infantry to follow <sup>(12)</sup>. By 1916 the

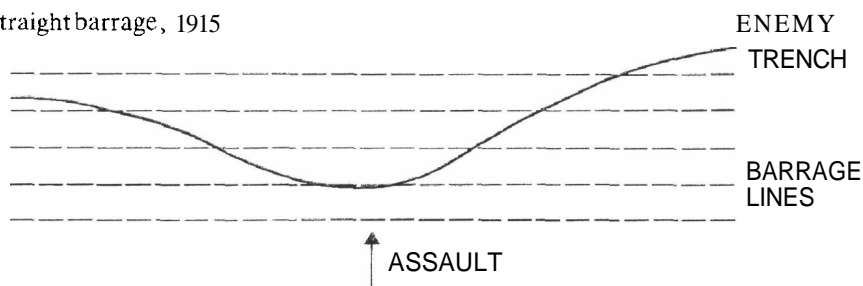
<sup>(11)</sup> The first application of the new tactics of 'destruction' by the British was seen at Festubert in May 1915, when the preliminary bombardment lasted for 48 hours, compared to the 35 minutes of Neuve Chapelle. Despite the cutting of heavy wire obstacles with slow observed fire, the attack was a failure, at a cost of 24,000 casualties. Artillery was held substantially to blame for failing to inflict sufficient 'destruction', although with hindsight it is apparent that better results might have been achieved by an intense, short bombardment and an element of surprise.

Even though the infantry made three successful assaults at Givenchy in June 1915, they were expelled each time from their objectives. This was blamed on artillery's failure to give support on those objectives, and led to the development of SOS fire as a means of crushing counter-attacks. But the practice of SOS fire became so common that large quantities of ammunition were wasted on unwarranted false alarms, and attention was diverted from more important tasks. This problem of defence was not considered fully, the emphasis being on the offence as the British and French planned their operations for the autumn of 1915. See also note 5 above.

<sup>(12)</sup> The French also employed the 'lifting barrage' when they attacked in Champagne and Artois ten days later; but their 3-day preliminary bombardment had also cost them surprise. The warning gave German reserves time, and hence the mobility, to achieve concentration to meet the attack in depth, and it failed despite the expenditure of over one million rounds of '75' ammunition. In January 1916, the French Army published fresh instructions for the conduct of artillery in the close battle. These required that combined offensives take the form of successive attacks, each of limited depth and within range of friendly artillery support. Objectives were to include German artillery positions, which were recognized as the backbone of the defence. This was hard to achieve, as German guns outranged those of the French and were often positioned in depth. It was hoped to penetrate defences by mounting a series of such attacks in rapid succession, maintaining the momentum otherwise lost against a forewarned enemy. A prerequisite for this was that artillery should accompany the infantry advance and have sufficient

'piled-up barrage' had been developed, and later, as enemy positions became harder to locate, the 'creeping' or 'rolling barrage' was adopted. See Figures 4a, 4b and 4c.

Fig. 4a The straight barrage, 1915



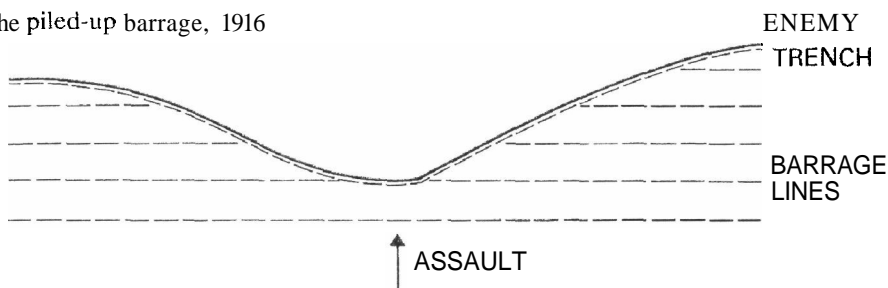
*Characteristics:*

1. Lines of fire are parallel and fire is lifted at regular timed intervals.
2. The infantry advance is parallel to the line of fire.

*Disadvantages:*

1. The whole enemy line is not engaged *simultaneously*
2. Sectors of the assault are exposed to the enemy defence.
3. The terrain is swept by fire indiscriminately.

Fig. 4b The piled-up barrage, 1916



*Characteristics:*

1. Lines of fire are parallel, but lifts are at irregular intervals along the line, fire thus 'piling-up' when it reaches the enemy position.
2. The whole enemy line is hit and then assaulted *simultaneously*.

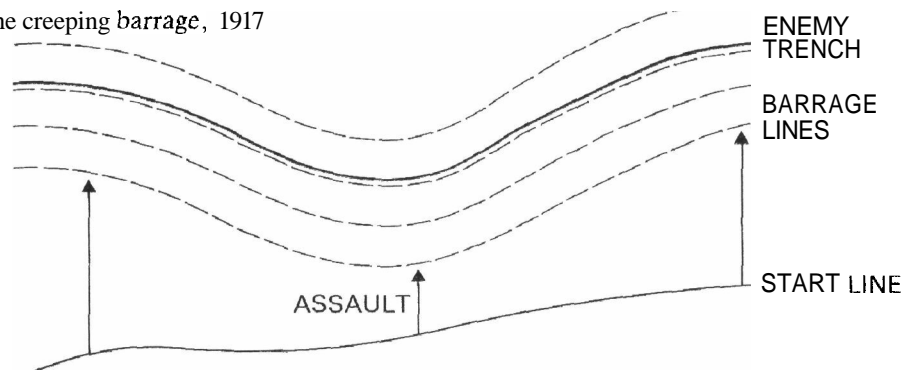
*Disadvantages:*

1. The infantry does not advance until the whole enemy line is engaged by fire. Those with furthest to go must advance first, so that the enemy may be assaulted *simultaneously*.
2. The assault is vulnerable to unidentified enemy positions.
3. The operation relies on accurate intelligence of the enemy's dispositions.

The British reviewed their performance for the year and blamed their disappointment on a failure to win the fire fight before committing the infantry to the assault. Artillery was directed to produce larger and heavier 'destructive' bombardments, and a better barrage to shield the infantry. Attempts to improve the barrage had foundered on technical inadequacy. Communications to control

ammunition to produce concentrated fire. Close liaison with the infantry was also important, and so special liaison detachments and joint command posts were established.

Fig. 4c The creeping barrage, 1917

*Characteristics:*

1. Lines of fire are parallel, matching the shape of the enemy defensive line.
2. The whole terrain is swept by fire.
3. The enemy line is hit and then assaulted simultaneously.

*Disadvantages:*

1. The assaulting troops may have to advance at different times in order to close up behind the barrage together.

fire were rudimentary, but experiments were being conducted by observers in aircraft and balloons using a clock code for ranging <sup>(13)</sup>. Maps made from air photographs suffered from the inaccuracies of camera distortion. As a result, artillery still insisted on registration, with a consequent loss of surprise. Although cartography soon improved, an understanding of the need for deception did not. Surprise, traditionally achieved through infantry mobility, might have been won by the fire mobility which was replacing it. Instead, this was used merely to concentrate fire for mass destruction and surprise was abandoned. To create greater destruction, heavier weapons were introduced, in particular 6-inch and 9.2-inch howitzers, and naval guns on railway mountings. While medium and heavy guns were used for close support, they were also required for CB fire, which had become recognized as a separate but interdependent part of combined operations. By 1918 that deep battle had surpassed close support as artillery's prime activity.

## 1916: "Destruction"

By 1916 British leaders were inclined to think that the effect of a massive bombardment would be to "crush all resistance, and that it would be necessary for the infantry only to march forward and take possession" <sup>(14)</sup>. Artillery was tasked to restore infantry mobility by winning the fire fight at the cost of surprise. The quantity of artillery available determined the scope of operations, and all-arms planning was based on the tasking of artillery. Those tasks were to be conducted methodically on an unprecedented scale, and were best illustrated by the preparation for, and initial experience of, the Battle of the Somme in the summer of 1916.

That battle typified the tactics of mass 'destruction' which required the adoption of novel gunnery techniques and tactics as well as a keener appreciation of logistic problems. The scale of artillery planning and the danger of excessive

<sup>(13)</sup> Kirke (1974), p.135.

<sup>(14)</sup> Edmonds (1922), p.34.

complexity made simplicity essential. This ruled out the use of mass enfilade fire, and encouraged gunners to develop techniques to improve the firepower of whatever pieces were allotted to a particular sector. Aircraft were increasingly used to inspect the effects of artillery fire; but in 1916 observers were still relatively inexperienced <sup>(15)</sup>. When intelligence was produced by aerial observation, artillery needed to react quickly and new, quicker and more accurate methods of calculation were devised.

C2 became more centralized in an attempt to make best use of resources <sup>(16)</sup>. The creation of an artillery commander at corps ensured that improved all-arms liaison would be matched by improvements in co-ordination of the close and deep battles, which had been weak in 1915. Although greater attention was paid to C3 for operations in 1916, it was recognized that it was not possible to guarantee the destruction of all or even most enemy guns, and so the close battle retained prominence. This was divided into three phases: the preliminary bombardment, the barrage, and the exploitation and consolidation phase.

The preliminary bombardment on the Somme lasted for seven days. Its primary aim was the destruction of machine guns, which were the main source of infantry firepower, the obstacles which they covered, and the communications that were needed to control the battle and summon artillery fire. In addition, new varieties of barrage were tested, concealed in the bombardment, and at the same time a number of feints were made in the hope that tactical deception might compensate for the loss of strategic surprise.

HE shells still had no effective fuzes for cutting wire, a task consequently given to trench mortars and 18pdrs firing shrapnel <sup>(17)</sup>. Batteries were allotted sectors of territory and times at which to fire at the wire. The task of destroying trenches and machine guns was given to the heavy artillery under corps command. Infantry units were asked to state the degree of destruction they desired on their objective. This care for good liaison was admirable, but such decentralization incurred penalties. Leading infantry units usually requested as much destruction as possible - which was understandable, given their limited objectives; but the devastation thus caused to terrain militated against the success of subsequent waves of units,

<sup>(15)</sup> Broad (1922), p.72.

<sup>(16)</sup> The artillery adviser at corps headquarters became the commander of all the divisional artillery in that corps. In 1915, after the battle of Loos, all heavy artillery in the divisions had been placed under army command. These pieces were now put under the command of corps, and only the 'super-heavies' remained under army command. This reflected the need for heavier artillery at corps level to assist in close support, but at the same time the corps artillery commander took command of the deep battle, causing some resentment at divisional level, where it was seen that the heavy artillery now relied on for close support was being directed at more distant targets.

Centralized command improved security and efficiency. Corps set the timings for the close support programme and divisions were tasked to carry it out. Corps even allocated FOOs to the batteries in the divisions. It was the corps that issued co-ordinating maps and issued a plan based on divisional requirements, including the desired infantry plan, speed and objectives. There were still conflicts between neighbouring divisions on inter-corps boundaries, but these were later overcome by the army headquarters' issuing comprehensive barrage maps. While artillery might be the dominant arm, it still tried to provide a service, and from this stemmed genuine combined-arms planning. The development of C2 is described in Annex C to Farnham (1986).

<sup>(17)</sup> For a description of wire-cutting techniques in the First World War, see Lewendon (1985).

whose opinions had not been sought. The supported arm did not always know what was best for it.

The week of preliminary bombardment ended with 30 minutes of intense fire, which in effect signalled the start of the assault, and sacrificed the tactical surprise that some had still hoped to preserve <sup>(18)</sup>.

The idea of assaulting with small groups of infantry, rather than in waves, was discussed by British army commanders at a conference on 15 June 1916. All three commanders opposed the idea. They were advocates of the linear artillery barrage, and were reluctant to adopt a plan that would require local concentrations of artillery support which might miss pockets of resistance. They wanted guaranteed and uniform destruction <sup>(19)</sup>.

The barrage of 1 July was relatively simple, but its weakness was lack of speed, which could not be modified as the battle demanded <sup>(20)</sup>, neither was it uniform. Different formations used a variety of shapes, often with very different results <sup>(21)</sup>.

<sup>(18)</sup> On 14 July 1916, the artillery-commanders of 3rd and 9th Divisions protested that this had merely warned the enemy to put down a protective barrage. On 1 July, for instance, 2nd Battalion The West Yorkshire Regiment lost 250 men to enemy artillery before the assault, in which they were to lose only 179 men to machine guns: Edmonds (1922), p.79. This lesson was learned, and when 3rd and 9th Divisions next attacked, the preliminary bombardment was reduced to just five minutes. As a result, much of the enemy return fire fell behind attacking troops, a tactic equally successful at Thiepval on 26 September.

Surprise had been lost on numerous occasions during the Franco-Prussian War through artillery's opening fire: Balck (1914), p.417; and the Germans had further experience of this on the Eastern Front early in the First World War. They were determined to avoid it in their offensive at Verdun in 1916. Their entire preliminary bombardment lasted just 10 hours, as opposed to the 7 days of the British on the Somme and was denser, in order to have an equivalent effect in a shorter time. The Germans were helped by their possession of many heavy pieces, so that, of artillery taking part, 1,500 pieces were heavy and only 500 field. Despite its shorter duration, the bombardment was not judged successful. It proved too long to neutralize the French defence, which recovered from the initial shock, but too short to achieve the level of destruction required for immediate success. In subsequent German attacks the bombardment was denser and shortened still further.

<sup>(19)</sup> A few well-placed machine guns could have held up the offensive on 1 July 1916, and to be sure of hitting every enemy weapon it was calculated that one 18pdr shell would have to fall in every 25 metres of trench, of each successive line of trenches. Accordingly, one 18pdr was allotted to every 25 metres and one 'heavy' or howitzer to every 60 metres. The barrage moved at pre-arranged times from trench to trench in an attempt to keep the enemy from manning his weapons before the attackers could bring their own small arms to bear. At times the lifts were so short, relative to the zone of the pieces, that the whole ground was swept and a 'creeping barrage' created. The development of the barrage in 1916 is described in Young (1943).

<sup>(20)</sup> Many heavily protected German machine guns survived the preliminary bombardment and held up or stopped advancing infantry; but the barrage continued to advance. The further it went, the more enemy were able to emerge from cover, and the more exposed the attackers became. Because of this problem, the speed of the barrage, which had been 100 metres in 3 minutes on 1 July, was reduced to 100 metres in 5 minutes by the end of August. In contrast, there were problems if the barrage advanced too slowly, for this consumed larger quantities of ammunition, whose replacement could delay subsequent phases of battle, perhaps causing a fatal loss of momentum.

<sup>(21)</sup> The 7th, 18th and 34th Divisions used 'creeping barrages', but the 34th had less success than the other two. The 30th and 36th Divisions used 'lifting barrages', but only the 36th made a deep penetration. In 21st Division, 64th Brigade used a successful 'creeping barrage' that swept the entire ground, whereas the 50th Brigade of the same Division used lifts of 500 and 250 metres and was repulsed with heavy loss.

By August 1916, it had become a standard German practice to position machine guns in shell-holes in No Man's Land and between trench lines, making it necessary to clear the whole area in the path of

There were different views on how close infantry should keep to a **barrage** <sup>(22)</sup>, but bitter experience soon taught that troops should keep as close to the barrage as possible. When it became clear that the preliminary bombardment had been insufficiently ‘destructive’ and that surprise had been lost, GHQ urged the infantry to stay close to the barrage, even at the risk of taking casualties from it <sup>(23)</sup>.

When the Germans attacked at Verdun they chose the option rejected by the British at the conference in June 1916 and dispensed with a linear barrage. They preferred to concentrate fire on selected areas of importance. The outcome on that occasion was unsuccessful, since French artillery was not silenced and hit back. In later battles the Germans devoted further resources to **CB fire**, a formula that would prove the basis for their successes of 1917-18.

Fresh issues arose as the Battle of the Somme developed. The British were committed to a battle of attrition in a series of offensives with limited objectives — the product of Anglo-French experience in 1915. The Germans countered by deploying in greater depth. On 12 October machine guns were reported to be firing from beyond the limit of the barrage <sup>(24)</sup>, setting a trend which caused Lord Cavan to advocate a deeper barrage and a smoke screen. It also became standard practice to ‘superimpose’ some guns on a **fireplan** for use against contingency targets, a measure still practised in the 1980’s. The area of immediate importance to the supported arm had stretched further away from the front line, and it became clearer to the infantry that artillery operations in greater depth were not a separate matter, but of direct benefit, through their suppression of weapons in deep defence, and the breaking up of German counter-attacks.

The ‘**protective barrage**’ designed to prevent counter-attacks in the summer of 1916 was far from ideal. It usually consisted of a wall of fire around the objective, but lacked the flexibility to accommodate changes in timing and objective <sup>(25)</sup>. By

an attack. The **18pdrs** firing at Rate 4 had insufficient range to knock out weapons sited in depth, and 4.5-inch howitzers were brought forward to deal with them.

The infantry wanted a barrage to take the shape of the trench **line** it was attacking, and so hit its whole length simultaneously to avoid being taken by enfilade fire. But most trench lines were of irregular shape, and to deal with this the gunners developed the ‘**Piled-Up Barrage**’ (see Figure 2b), which called for artillery to linger when it reached a trench until all other parts of the barrage had reached that line, at which time the infantry would be expected to assault. Unfortunately, gunnery calculations could not match this level of tactical sophistication, and serious mistakes were made in its execution.

<sup>(22)</sup> Brigadier General Jardine, the commander of 97th Brigade of 32nd Division, ordered his men to within 30-40 metres of the enemy trenches before zero hour. As the bombardment lifted, his Highland Light Infantry over-ran the Leipzig Salient in a successful tactic that owed something to its author’s experience as an observer of the Russo-Japanese War: Edmonds (1922), p.400.

<sup>(23)</sup> On one occasion 5th Division ordered its infantry to keep just 25 metres behind the barrage in a **tactic** the French had advocated before 1914. The French later held that if 10-15% of their casualties were not suffered from the friendly barrage, then the troops were not close enough: Wynter (1943), p.274. One French general said that there was “nothing less than the outright massacre of friendly infantry by its own artillery”, quoted in Shrader (1982), p.2. General Percin estimated that 75,000 French casualties in the First World War were caused by ‘friendly’ artillery, largely through lack of co-ordination and the excessive use of heavy **artillery**. This, however, represented only about 1.5% of French casualties, and was a problem common to all combatants,

<sup>(24)</sup> Edmonds (1922a), p.442.

<sup>(25)</sup> As early as 4 September the ‘**protective barrage**’ was seen as a hindrance to exploitation. 95th brigade of 5th Division had reached Leuze Wood, but “here the British barrage prevented further progress”, *ibid.*



the autumn, British bombardments were being fired deep into German defences. This required yet more heavy artillery, which by the Battle of Beaumont Hamel was often being operated as if it were part of the field branch. The guns of a division could cover only 1,200 metres, less than a normal divisional front. It was hoped that the tank, which was still undergoing assessment, might eventually make up for this deficiency in firepower, not so much through its own firepower as by its armoured mobility, making artillery firepower less important. In the meantime, more and heavier guns were required, and to fire at a higher rate. It was also generally accepted that the artillery must not only lead the infantry on to its objective, but also provide fire at least 2,000 metres beyond them, in order to deal with the machine guns in depth. It was also necessary for artillery to move forward to provide support for subsequent, and perhaps unplanned, operations. There was no longer any question of infantry trying to exploit beyond the range of friendly guns.

The tactics of 'destruction' called for vast logistic support, particularly in the supply of artillery ammunition. The weights required and the conditions in which these travelled were largely responsible for the cumbersome character of operations. No attack could be planned until a commander was confident that he had sufficient ammunition, and this often determined the scale of an operation. When planning an attack, Foch was more interested in the numbers of guns than in the number of divisions available. It was useless to have more guns or order a higher rate of fire if ammunition was not available. If supplies were limited, it was sometimes necessary to narrow the sector of attack to generate the required density of fire <sup>(26)</sup>.

Balck had observed before the war that "The line on which artillery is to fight the decisive action forms the framework of every defensive position" <sup>(27)</sup>. It was a characteristic of German planning that a defensive line should optimize the value of artillery support by providing observation, good fields of fire and communications. This was evident from the first year of the War, at Ypres, and in its most dramatic form in the construction of the Hindenburg Line, which was sited with artillery requirements as the foremost consideration. The deliberate siting of defensive lines, often on fresh undamaged terrain, also gave the defender logistic advantages because roads and railways were relatively unscathed. The existence and positioning of field workshops also became tactical matters for consideration

p.258. The next day 15th Brigade was little bothered by desultory German fire; "it was the British 'protective barrage' which discouraged further advance". Poor communications between forward troops and the guns were hard to overcome. Visual signals were easily obscured, and line and runners were repeatedly blown away. The problem was not resolved, and became worse as German procedures improved. By 1917 German defences mounted counter-attacks by a timetable starting automatically at the British zero hour.

<sup>(26)</sup> Appreciation of these problems often caused the Germans to attack on a salient, where the defender would find himself with a narrow line of supply through atrocious terrain. For example, at Verdun most 75's received just 250 rpg, or half to one-third of their firing capacity — poor logistic communications reduced their firepower by half. By contrast, the attacker had more numerous options for re-supply, the advantage of space in which to disperse his assets, and a greater opportunity to concentrate enfilade fire from them.

<sup>(27)</sup> Balck (1914), p.442.

in a commander's plan. The numbers of serviceable guns and the rate at which battle casualties could be repaired were important elements in its formulation.

In 1914 infantry had determined the face of battle. By 1916 only the logistician carried more influence than the gunner; and the infantryman was reduced to carrying out such operations as these two deemed feasible.

The war became what the Germans called a *Materialschlacht*, an attritional contest in which, by fighting on two fronts, they were at a severe disadvantage. They, above all, had an interest in developing more effective tactics to minimize this disadvantage. They had been encouraged by the effectiveness of their machine guns against infantry, but their artillery could not match the support given to British infantry. They therefore sought to nullify the effect of that support by luring British infantry into areas where German infantry could fight on equal terms, or into attacks on elaborately prepared defences.

The British and French, for their part, believed that in their tactics of 'destruction' they had established an admittedly expensive formula for success. They were confident that with sufficient artillery they could take any limited objective. Greater success by penetration would depend upon extending the range of artillery, and upon improving CB fire. Without the latter, an infantry attack could be halted in its tracks by forewarned enemy guns.

1917: Destruction reaches its zenith

1917 was the year in which the tactics of destruction reached their climax, and it was also a year of change. The German Army withdrew to the Hindenburg Line, and the British Army advanced across devastated terrain in preparation for an assault. The offensives which accompanied the German withdrawal illustrated the refinement that had taken place in 'destructive' planning.

The British assault at Vimy Ridge in April 1917 was a success and its limited objectives were achieved <sup>(28)</sup>; but the consequences of 'destruction' were a devastated terrain and a wrecked road system which hampered exploitation. The

<sup>(28)</sup>The offensive on Vimy Ridge in April 1917, which was a part of the battle of Arras, was subsequently used as a model for its highly-centralized C2. Four divisions attacked from positions previously held by just two. The artillery staffs of the latter were tasked to prepare for the arrival of others, after which artillery command was centralized at corps. Artillery assets were distributed to divisions according to their attacking frontage and depth of objective, but every battery position was selected by corps headquarters. In the south, where objectives were too deep for normal artillery support, 90 18pdr guns were sited in silent positions just 1,000 metres from the front line: Brooke (1926a), p.241.

Destruction was still the aim, and the preliminary bombardment lasted for seven days, following a gradual build-up over 20 days. Mortars and 18pdrs were again tasked to cut forward wire, with medium and heavy artillery attacking deeper lines of wire and trenches. Medium and heavy pieces fired 91,000 rounds on 42,000 metres of trench and 8,000 rounds on 8,000 metres of wire. The preliminary bombardment included a more sophisticated deception plan with a number of feint barrages, which rolled forward luring troops to leave shelter, only to roll back on to them again. The logistic effort for this operation was formidable. Dumps were established with 600 rpg for 18pdrs, and the ammunition column to sustain this stretched 10 miles every night during the preliminary bombardment.

The assault was supported by a barrage that took account of the depth of the defence. Two-thirds of all 18pdrs fired at targets immediately in front of the leading infantry, one-third fired on targets 100 metres ahead of that, while the 4.5-inch howitzers and 'heavies' engaged targets not less than 200 metres behind the forward line. Some 18pdrs fired over 1,000 rpg and some 60pdrs 200 rpg: *ibid*, p.244.

destruction of tactical obstacles had created administrative ones, and in the process alerted enemy reserves which moved to block penetration. It was suggested by officers of 3rd Army that this form of attack be replaced by a shorter 'hurricane' bombardment of greater intensity, but the idea was rejected. 'Destructive' firepower had become like an addictive drug. Armies preferred the near certainty of limited, if costly, success to the political and military risks of operations which reduced 'destruction', but which might have achieved penetration and mobility <sup>(29)</sup>.

Despite flaws in its application, the brute strength of Allied artillery ensured that, in a duel, it would defeat German artillery <sup>(30)</sup>. British tactics seemed to offer sufficient return for their high cost, and were consequently repeated at Ypres, but geography multiplied that cost. British positions suffered the inherent logistic and tactical disadvantages of a salient. In addition, the terrain was dependent on a fragile drainage system to remove surface water. There could have been few less promising choices for an offensive, marking the zenith of the tactics of 'destruction'. It soon became apparent that conditions for an offensive were thoroughly unfavourable; but the British persisted with an attack which could have been switched to another area by moving medium and heavy artillery, as in operations earlier that year; and the opportunities for movement were not exploited.

Given that an attack was to be made at Ypres, 'destruction' was probably the only possible option. German positions were protected by such heavy wire that a short preliminary bombardment would have been inadequate, and breaching the wire was still a prerequisite for a successful infantry attack.

The effect of the bombardment was so severe that in the last week of July German troops withdrew from a large area opposite XIV British Corps without orders <sup>(31)</sup>. Artillery fire swept the whole sector of operations, while aircraft sought out dead ground. But a major advance was not achieved, largely because of effective German counter-attacks on 31 July and 15 August <sup>(32)</sup>.

<sup>(29)</sup> The French at this time also adhered to a policy of destruction, and like the British were attempting deeper penetrations, with artillery reaching further into German positions deployed in greater depth. General Nivelle hoped to achieve a decisive breakthrough on the Aisne in spring 1917, starting with a nine-day preliminary bombardment, fired by 5,500 pieces on a 40km front, heavily weighted against deep targets. This idea had merit, but forward targets received insufficient attention, and the attack failed.

<sup>(30)</sup> At Messines in June 1917, X British Corps attacked on a 5km front with 800 pieces, the British for the first time making effective use of air observers to control the cutting of enemy wire: Wynter (1943), p.273. The Germans saw that British tactics were heavily reliant on artillery and had devised new methods of CB fire. Large-scale artillery duels developed, in which the Germans were out-gunned and their artillery withdrawn; but the length of the bombardment disclosed the sector of attack, and the Germans took the precaution of withdrawing their infantry as well before the attack, which then hit 'thin air'.

<sup>(31)</sup> Broad (1922a), p.131.

<sup>(32)</sup> British infantry was operating at the extreme limit of artillery support, and after hard fighting to reach objectives could not hold them against fresh German infantry and artillery — which had often been deliberately withdrawn from the sector under attack as the preliminary bombardment started. German trenches were often sparsely manned but reinforced by concrete pill-boxes. These in effect did away with the concept of tactical linear defence, and once this was realized, the need for a linear barrage was also questioned. It seemed more appropriate to meet concentrations in defence with concentrations of

The ‘clockwork’ German counter-attack could be anticipated, and elaborate precautions were taken by artillery to protect British infantry once they had reached their objectives, so long as these were little more than 1,000 metres from the Start Lines. Another two or three equally limited successive phases were planned once artillery had moved forward. These tactics were tested on 20 and 26 September with great success, but by 2 October the Germans had again developed counter-measures. Reserves for the counter-attack were moved even further back, and, with less fire falling on their forward positions, held these in strength supported by massed machine gun fire from the rear. The British responded by reverting to the tactics of the Somme in 1916, with massive bombardments causing the Germans to change once more to an even stronger checkerboard of concrete strong points.

By 17 October the Germans had taken drastic but effective measures to avoid British artillery fire. They withdrew from their forward line shortly before the anticipated British Zero Hour, and 15 minutes after that brought down a heavy bombardment on British forward positions, through which attacking waves would have to pass. Germans troops retired by another bound and brought down another defensive bombardment close in front of their own positions by light signal <sup>(33)</sup>.

The last months of 1917 marked the end of the tactics of ‘destruction’. By then it was possible, using a mathematical formula of guns and ammunition to length of front and infantry bayonets, to guarantee a local success of 2,000-3,000 metres in depth at the expense of surprise. This enabled an enemy to prepare his defences and to minimize his casualties without fear of strategic defeat. The demands of ‘destructive’ firepower had created a vast munitions industry whose products it consumed voraciously <sup>(34)</sup>. Even if the tactics of applying fire were soon to change, the demand for shells continued to rise until the Armistice.

In 1916 the tactics of ‘destruction’ had been met by deepening lines of defence, the deep deployment of reserves for the counter-attack, and the deeper siting of artillery. Throughout 1917 offensive tactics were modified to tackle this deeper dimension to the battlefield, and the process of tactical action and reaction continued without breaking the strategic stalemate.

### 1917-18: Neutralization — new ideas for the offence

By the winter of 1917 circumstances were ripe for a major change in artillery and all-arms tactics. The nature of these changes was determined by the tactical firepower.

For this reason, and to regain tactical surprise, the British soon stopped the arbitrary bombardment of trenches, firing only on known targets. Pieces engaged in CB fire were withdrawn to thicken up this fire from 15 minutes after Zero and for as long as the infantry was mobile. These then returned to CB tasks and to the bombardment of reserves up to 9km behind enemy lines.

<sup>(33)</sup> The extraordinary conditions of the terrain, which turned any manoeuvre into confusion, made it hard to assess this ploy, but it was used with great success in 1918 by the French General Gouraud, south of Reims, when French infantry withdrew before an attack by German infantry, which was then annihilated by French artillery.

<sup>(34)</sup> At Malmaison, for example, the French fired 360 train-loads of ammunition between 13 and 27 August 1917: Brooke (1926a), p.248.

experience gained earlier in the year, advances in technology, and the realization that strategic success could not be achieved without them. Both sides adopted new but different approaches in the hope of achieving the same end.

The British learned during their advance to the Hindenburg Line that medium and heavy artillery could be almost as mobile as field artillery, given the opportunity. But years of static warfare had discouraged belief in mobility <sup>(35)</sup>.

The advent of tanks revolutionized artillery close support. They had been used in experimental attacks where artillery firepower was lacking, had met with initial success, but had then been stopped by artillery. The idea that the firepower of a tank could equal that of artillery was a mistake, frequently repeated since.

The Battle of Cambrai, which opened on 20 November 1917, tested the new ideas and equipment in a full-scale operation, intended to gain both strategic and tactical surprise. Tanks were used to break through the obstacle belt, dispensing with a bombardment by artillery before zero hour. Despite limited firepower, the 'shock' of their armoured mobility was judged sufficient to 'neutralize' that of infantry in their path, which in the event proved little threat to the tank, which could be stopped only by direct artillery fire or mechanical failure.

The relationship of artillery to other arms was thus redefined. Artillery was not required to aid mobility for the infantry by destroying obstacles and machine guns. Instead, it aided mobility by destroying or 'neutralizing' enemy artillery, and whatever infantry firepower might escape the tank. Surprise could not be achieved without forbidding registration. In earlier battles the techniques of predicted fire were too crude to guarantee accuracy, but by November 1917 major progress had been made. Target location for CB fire, which did not exist in 1914, had been transformed from an art to a science. Indirect fire, which had proved dangerously inaccurate in 1915, was a routine and reliable method of fire; and gas and smoke shells had become available in quantities that made 'neutralization' with these munitions a feasible alternative to 'destruction' with HE. Accurate maps were available and compensation was routinely made for meteorological conditions and variations in ammunition and the muzzle velocities of individual guns.

Artillery's efforts were not reduced but redirected. The same mass of guns and equipment was still required, whose observation by the enemy might have compromised operations. All unit moves therefore were made in darkness and at the last possible moment, with great attention paid on arrival to camouflage. Artillery was unlikely to neutralize all opposing pieces with HE, so extensive use was made of gas and smoke <sup>(36)</sup>.

<sup>(35)</sup> In many cases, artillery positions were quite literally dug into the trench system, and took orders only from a centralized command system. Few junior commanders had training or experience of the mobile operations which had been the norm before autumn 1914. To re-educate the Gunners, special schools were set up in France, to instruct officers in the mobile warfare which might bring the war to an end.

<sup>(36)</sup> At Cambrai seventy 60pdrs fired 16,000 rounds of tear gas to force enemy gunners into respirators, to reduce their efficiency, and a smoke screen was planned to cover the advance. 18pdrs spaced every 25 metres fired smoke 300 metres ahead of the tanks, lifting from trench to trench along a 10,500-metre front, firing 93,000 rounds. At the same time the 6-inch howitzers fired 500 metres ahead of the tanks and the 'heavies' fired 15-minute concentrations on selected targets.

The Battle of Cambrai showed how the strategic stalemate might be broken if a variety of innovations were developed further. Infantry was no longer dependent solely on the artillery, but looked to the tank for support as well. The role of artillery in the design for battle was undiminished; the tank needed artillery support as much as the infantry, and the possibility of a decisive breakthrough was opened up by the decision to allow artillery to turn its attention to the deeper battle.

In 1917 the German Army in the West was still on the defensive, but experiments had been made on the Eastern Front which were to form the basis for future offensives in the West. Their aim was to break the strategic stalemate, but without the help of the tank <sup>(37)</sup>.

By the end of 1917 the Germans had moved away from the thinking of *Materialschlacht*, of limited gain through attrition, to a more flexible concept: "To fire merely in reply or reprisal while the enemy is firing is misconceived. Surprise, co-ordination of fire according to space and time, and regulation of fire according to the right moment, are often decisive for effectiveness" <sup>(38)</sup>.

The pioneer of the new thinking was Colonel Georg Bruchmüller, nicknamed 'Durchbruchmüller' ('Breakthrough-Müller'), who later described his ideas in *Die Deutsche Artillerie in den Durchbruchschlachten des Weltkrieges*<sup>(39)</sup>. He did not advocate the complete destruction of enemy trenches and obstacles, rather the shattering of the morale of their defenders and their defeat by unexpected assault—in other words, 'neutralization'. The weight of a bombardment was not enough, it was necessary to apply it in a manner that would demoralize an enemy. This principle was not new and had been described by Balck before the war <sup>(40)</sup>; but it was Bruchmüller who incorporated it into a broader concept of artillery operations applicable to the World War <sup>(41)</sup>.

<sup>(37)</sup> Artillery was still a relatively neglected arm in the German Army, although it was recognized that artillery was no longer a mere accessory, but an offensive arm able to engage targets on its own initiative. This called for a greater rather than a lesser appreciation of the tactical scene, and closer liaison with the supported arm; but the supported arm remained supreme. German battle regulations, *Gefechtsvorschrift für die Artillerie*, still cast artillery in a secondary role, which caused resentment during the *Materialschlacht* of 1917, when clearly its operations were of primary importance: *Deutsche Militärgeschichte: Band 6 Militärgeschichtliches Forschungsamt* (Bernard und Graefe Verlag, Munich 1983) pp.513-514.

<sup>(38)</sup> A report by Army Group Crown Prince Rupprecht on 14 December 1917 stated that for a powerful breakthrough surprise was most important, and that in consequence preliminary bombardment should be heavy but short: quoted *ibid.*, p.514.

<sup>(39)</sup> Warburton (1921), p.123.

<sup>(40)</sup> Balck (1914), pp.427, 439 and 440.

<sup>(41)</sup> Bruchmüller had commanded the artillery of the 86th Division in March 1916, at Narotchsee on the Eastern Front, where three divisions had attacked across the River Dvina on a 9km front. The registered preliminary bombardment lasted just five hours and proved successful. It was repeated at Riga in September 1917, except that the registration was conducted during the bombardment itself. Artillery was divided into four groups: *Infanteriebekämpfungsgruppe* (IKA), primarily for infantry support, accounted for one-fifth of his assets; *Artillerie in Artilleriebekämpfungsgruppen* (AKA), primarily for CB operations, three-quarters; with *Fernkampfgruppen* (FEKA) for harassing fire and *Schwerste Flachfeuergruppen* (SCHWEFLA) for deep tasks taking up the remainder. The Russians copied Bruchmüller's ideas for their own artillery support for Brusilov's offensive against the Austrians, 22 May-31 July 1916.

The preliminary bombardment was not aimed just at obstacles and defending troops. Its first two

Bruchmüller's successful experiments on the Eastern Front were transferred to the West, where he was artillery adviser to General Ludendorff for the German counter-attack at Cambrai on 30 November 1917, on the Somme in March 1918, on the Lys in April, at Chemin des Dames in May, at Noyon in June and on the Marne in July of that year.

The German attacks seldom faced obstacles on the scale found by the Allies. Their lack of tanks was consequently less of a handicap, but they had seen that even an Allied trench system could not be penetrated without speed and surprise, so secrecy became a paramount consideration. Artillery avoided deployment on the night before an attack lest this congest the road for advancing infantry. Rather, it deployed early but in hides near or on its platforms.

Prejudice in favour of registration persisted in 1917, but was soon to weaken. During the preparation for an attack on 21 March 1918 an army is reported to have sent a letter to the headquarters of Prince Rupprecht's Army Group stating, "It is wished to take exception to the new method of attack supported by unregistered artillery fire and to press to be allowed to order accurate registration". The reply stated bluntly: "If registration must be carried out, the Army Group will not attack" <sup>(42)</sup>.

C2 was made more flexible. On one hand a highly centralized system was essential, since many junior commanders deploying for an offensive had little knowledge of the ground or time to acquire it; but on the other, orders were kept brief. Bulky, voluminous orders were replaced by a succession of short orders to be executed according to their importance at different phases of the battle. The system could work only if all commanders had a thorough knowledge of the overall plan <sup>(43)</sup>.

By March 1918, the Germans had begun trying to devise new ways of controlling barrages from the Front Line, although the British experience was that this was not possible in a large centralized plan, since information rapidly became out of date <sup>(44)</sup>. Great attention was paid to co-ordinating the close and deep

hours were targeted at the enemy's nervous system — command posts, telephone exchanges and observation posts. There followed four phases in which different sectors were attacked with different combinations of weapons by hurricane bombardment. It closed with ten minutes of intense fire, *Sturmreifschieszen* reinforced by the majority of the AKA, temporarily diverted from CB fire. The attack phase was supported by a 'creeping barrage', the *Feuerwalze*.

<sup>(42)</sup> Registration was eventually replaced altogether by a system of predicted fire devised by a Captain Pulkowski: *Deutsche Militärgeschichte: Band 6 Militärgeschichtliches Forschungsamt* (Bernard und Graefe Verlag, Munich 1983), p.522, which was similar to that of the British, and required sound methods of calibration and survey, accurate meteorological data and ammunition consistency.

<sup>(43)</sup> Bruchmüller was adamant on the need for close artillery and infantry liaison. Before every attack artillery commanders were dispatched to lecture formation staff and infantry officers of every participating regiment, who were expected to pass on the information to subordinates. Artillery commanders were in turn briefed on the all-arms picture, in particular on the role of infantry trench mortars contributing to the fire plan. IKA assets were placed in groups under divisional command and divided into sub-groups to support each infantry regiment. Each sub-group was then divided into two parts, one to strike the first objective and one to attack subsequent objectives. A few batteries of the divisional artillery were assigned to accompany the infantry and played no part in the *Feuerwalze*, but wailed in cover to advance.

<sup>(44)</sup> Where forward observers had succeeded in modifying a fire plan, there were often adverse effects on neighbouring units. The Germans tried to organize a system of control on a precise, narrow, but decisive

battles. The neutralization of enemy forward positions would have offered little advantage had enemy guns been left intact and its C3 system **unparalyzed** <sup>(45)</sup>.

In 1917-18 German tactics evolved quickly, in imaginative ways requiring great skill. For example, divisions deployed in echelon, passing through one another, a tactic which the Allies did not attempt. They also chose routes for advance with the aim of creating decisive **encirclements**, by-passing and capturing strong points rather than destroying them. Apart from infiltration, German troops also made good use of combined arms tactics at low level. **Bruchmüller's** tactics of neutralization formed an essential part of this overall design, sometimes known as '**Hutier tactics**' <sup>(46)</sup>, which often succeeded without the use of the tank.

Ironically, it failed not because of tactical invalidity, but because Germany had already lost the *Materialschlacht* in 1916 and 1917. This became clear only in 1918, after both sides had abandoned the tactics of attrition, which had in the long term proved decisive. The new tactics of neutralization were in part an expedient to derive greater tactical efficiency from expensive (and in Germany's case dwindling) logistic resources. The significance of the new thinking of 1917-18 lay not so much in how it determined the outcome of the First World War, but in how it formed the seed-bed for the new techniques of fire and manoeuvre developed in the 1920s and 1930s and practised in the Second World War.

### 1917-18: Neutralization — new ideas for the defence

In 1917 both sides had studied new offensive techniques, but in the winter of 1917/18 it became clear to the British that their defences would soon be put to the test by the switching of German strategic efforts to the West. British defences had remained virtually untested for three years, having dealt only with small raids, and with warding off counter-attacks. It had grown used to feeding on vast quantities of ammunition provided by an elaborate logistic machine; and the concentrations of guns at vital sectors assured mutual support. The standard defensive tactic was to bring down heavy fire at a density of one field gun per 20 metres; but on many quiet sectors of the front the British had just one field gun per 300 metres and could not achieve adequate defensive densities if the Germans should mount a major offensive.

To ease this problem, artillery was reorganized to concentrate on vital areas, sector. Each battery had one or more observers in the front line, often advancing with the infantry. Communications were by line via an '**anchor OP**' or through signalling detachments, which were collocated at every battalion headquarters with an artillery liaison officer. But these communications proved inadequate, and the Germans had limited success, although they did indicate artillery's desire to establish a closer relationship with the infantry after a period when it had often seemed to operate as an autonomous arm.

<sup>(45)</sup> An attacking corps would usually take over a divisional front. The divisional artillery commander and his staff would plan all phases of the battle, based on local knowledge, and he would then become corps artillery adviser and commander of the CB battle once the operation had commenced.

<sup>(46)</sup> General von Hutier commanded the German offensive at Riga in September 1917. His concept, termed '**Hutier tactics**', formed the basis for the German tactics of 1918. He selected a small sector of the front for a breakthrough, which was achieved after a short but very intense suppressing artillery bombardment, which was exploited by small groups of infantry employing aggressive techniques of fire and movement. **Bruchmüller** provided the artillery element of this concept.



leaving the intervals to be covered by the machine guns and mortars of the infantry. The power of concentrated artillery in the offence had raised the stakes in the fire fight to a level where artillery in defence could not provide a comprehensive response. It had to be supplemented by infantry firepower, which had first caused the growth of artillery offensive power.

Defensive fire was most effective when used against troops preparing for attack, and was termed 'counter-preparation' fire. It was extremely difficult to time such fire correctly, especially if the enemy were taking precautions to disguise the end of his preliminary bombardment. It was also hard to judge when to switch fire away from counter-preparation, to the defensive barrage, brought down close to defending positions at the decisive moment. By 1917, SOS fire, which had been practised since 1915, was seen to be a handicap <sup>(47)</sup>. The right to call for SOS fire had been devolved to units in the Front Line, who (understandably) often called for it at the slightest indication of increased enemy activity, even if that turned out to be merely reconnaissance. Numerous false alarms drew artillery assets away from counter-preparation fire, and consumed large quantities of ammunition at the expense of the main defensive barrage when it was required.

Given the power of infantry weapons in defence it is arguable that British artillery should have left the leading waves to be dealt with by the infantry, and put its main weight into attacking the succeeding echelons, which constituted the greater threat. An appreciation of the need for deep attack had come from British experience against German counter-attacks. Objectives could seldom be held without artillery support, so had usually been of limited scope, enabling supporting artillery to reach reserves assembling in depth for the counter-attack <sup>(48)</sup>. Without the range to strike deep, the equivalent of depth was created artificially by limiting the advance of the infantry and hitting targets in relative depth, which could be predicted readily, given foreknowledge of the objective.

In the defence of linear positions, where the attacker held the initiative, it was harder to predict suitable deep targets, since intelligence and techniques of target acquisition were inadequate <sup>(49)</sup>. From 1917 the Germans practised a more open form of warfare in defence as well as offence. The vulnerability of shallow linear defence using deep dug-outs, and the terrible effects of 'destructive' bombardments, caused them to reduce the manning of forward areas and to increase the strength of concealed infantry and artillery reserves for the counter-attack <sup>(50)</sup>.

<sup>(47)</sup> See also note 5 on p. 129.

<sup>(48)</sup> The Germans noted that their counter-attacking forces barely reached their own front line without heavy losses in a situation where the British were content with limited territorial gain: Broad (1922a), p.134.

<sup>(49)</sup> A situation analogous to that 60 years later.

<sup>(50)</sup> This policy had been successful in the summer of 1917 when the British advance inflicted relatively few casualties. As the British tried to strike deeper against these reserves, the latter were pulled yet further back. The Germans calculated that they would have two hours from the outset of a British attack to bring up these reserves, positioned up to 9km to the rear. As the British limited their advances and covered them with massive fireplans, reserves sited so far back became ineffective. For example, on 23 September 1917 a superior force of German infantry advancing to counter-attack on Poelcapelle was annihilated by artillery fire: Oldfield (1922). For a time during the battle of Passchendaele the Germans had returned to their old tactics of holding forward in strength, but had been smashed by 'destructive'

## 1918: Neutralization — the fruition of new ideas

The new ideas tested in 1917 came to fruition in the great German offensive of spring 1918 and the Allied sweep to victory which followed. Despite an awareness of the force massing against them, and fresh thinking on how to meet it, the British were ill-prepared to meet the threat, and were surprised by the offensive tactics used. Artillery densities were generally low in the sectors attacked, and obstacles insufficient to stop infantry attacking after a hurricane bombardment. British defences did not restrict German manoeuvre sufficiently to make their firepower surrender surprise with a lengthy preparation. The depth and size of British reserves eventually halted the offensive, but not until spectacular German successes had vindicated their offensive tactics.

The lessons of spring 1918 were that artillery in defence must produce sudden and annihilating concentrations of fire on demand; that it must be sited in depth; and that artillery commanders should use their initiative to influence the close battle. To do this they needed good observation and communications. Their primary task was to delay attacking infantry, and put it out of synchrony with the supporting barrage, thus making it vulnerable to infantry firepower. It was also appreciated that as offensive mobility returned to the battlefield, artillery in defence would have to respond with greater flexibility and a capacity to react to the unforeseen.

The return of mobility through German shock tactics brought fresh perils for artillery. British pieces had to be positioned within 2,000 metres of their infantry if they were to engage enemy infantry assembling to attack, yet this proximity made them vulnerable to enemy trench mortars and even to capture. How to balance the deployment of field artillery became a fine decision.

There were several ways of employing close support artillery in these circumstances. It could withdraw, or, like the Germans in 1917, remain in position as the backbone of defence after most friendly infantry had withdrawn to the reserve. The British favoured holding forward, it being considered bad for morale to see some troops withdrawing. The best method was judged to be the creation of strong points with heavy artillery support. Unfortunately, the Germans infiltrated these positions and large numbers of encircled troops were captured. Nevertheless, in many places artillery played a key role in defence <sup>(51)</sup>.

The experiences of spring 1918 brought about the final demise of SOS fire. By the summer of that year, calls for SOS fire by the infantry were for artillery information only, not executive orders to fire <sup>(52)</sup>. For the first time the fire of dedicated close-support artillery was denied to its infantry on grounds of higher intelligence affecting their interests, and artillery commanders played a more

fire. By October 1917 the Germans had settled for the withdrawal of forward troops as the British attacked and the summoning of defensive barrages by light signal.

<sup>(51)</sup> For example, at a crossing over the La Bassée canal near Hinges on 12 April 1918, two observers of the RFA held their position for six hours after their supported infantry had virtually collapsed: *ibid.*, p.470.

<sup>(52)</sup> It could be fired only on the order of the artillery commander, and special authority was required before fire could be switched away from counter-preparation.

decisive tactical role in the close battle <sup>(53)</sup>, where artillery was asserting itself as an autonomous arm <sup>(54)</sup>.

By the end of the war, however, British defensive tactics placed greater emphasis on artillery's deep battle than on the close. Fire was concentrated on 'counter-preparation', which continued deep into enemy lines, striking succeeding echelons with intense bursts, instead of shifting merely a defensive barrage. Artillery fire was no longer so important on targets which the infantry could handle; instead it found targets which the infantry was unable to engage.

The British advances of the summer of 1918 displayed an awareness of lessons learned by artillery of all sides. There were initially no preliminary bombardments, so as to preserve strategic surprise. Batteries deployed at night, ammunition dumps were concealed, comprehensive and accurate survey was completed to ensure the accuracy of predicted fire, and infantry StartLines were designed to fit in with convenient artillery barrage lines <sup>(55)</sup>.

Once strategic surprise had been lost, artillery bombardment returned to a normal pattern, but not to cutting wire. This task was carried out by tanks which also destroyed the machine guns covering it. Artillery's main task was to support this armoured mobility against the threat of enemy artillery <sup>(56)</sup>. The role of artillery might have changed, but not its importance. The speed of the advance was still governed by artillery and the ability of the logistic organization to sustain it.

The new role of artillery was seen in its deployment for the Battle of Amiens, which opened on 8 August 1918. Despite the large force of tanks, artillery density was only slightly less than it had been in 1917, and because there was no preliminary bombardment the number of guns and the weight of fire generated during the assault was far greater <sup>(57)</sup>.

The infantry sometimes resented the apparent loss of heavy pieces in close support in the battles that followed. It failed to appreciate the importance of the

<sup>(53)</sup> For example, in April 1918, three German companies moved to attack opposite positions of the British 61st Division defending a bridge near Pacaut. The divisional artillery commander put down a bombardment in an area of 1,000 metres square inside enemy lines and destroyed two companies. The third advanced and surrendered *en bloc*: *ibid*, p.469.

<sup>(54)</sup> This trend has a parallel in the British Army of the 1980s, where the ties between infantry battalions and the fire of **affiliated** batteries have been weakened to ensure that fire is concentrated on targets of highest priority on the direction of the artillery C2 organization.

<sup>(55)</sup> An example of what could happen if surprise were compromised was seen on 15 July 1918, when the French Fourth Army received advanced warning of German attack and withdrew its **infantry**, putting down a massive counter-preparation and CB fire programme just before the German '**hurricane**' bombardment. The attack **failed** on a 90km front.

<sup>(56)</sup> The success of the lone German gunner who held up the tanks of 51st Division at **Flesquières** on 10 November 1917 had not been forgotten. 60% of artillery was engaged on CB fire missions, and others on smoke missions to mask the advance of the tanks. Other tasks included the disruption of C2 and **harrassing** fire to lower enemy morale. It should however be noted that after the first day of an attack few tanks remained in action, because of mechanical failure and crew exhaustion.

<sup>(57)</sup> At Passchendaele 75% of **18pdrs**, 65% of **6-inch** howitzers, and 35% of 60pdrs had been used. At Amiens 98.5% of all artillery was used on the day of the assault: Brooke (1926b), p.333. Like the Germans, the British favoured shorter **and** more intense bombardments; but the weight of munitions was still formidable: Fourth Army fired 3,700 wagon-loads of **18pdr** ammunition on 8 August alone.

deep battle, which occupied the majority of artillery assets; even though deep operations played a direct and important part in the close battle, by reducing casualties from enemy artillery <sup>(58)</sup>.

Preparations for the attack were carried out at army level, but corps controlled the deployment of its own artillery. Once the assault had commenced, C2 was decentralized to divisions and the two artillery brigades which supported each of them. Poor communications made it impossible for advancing troops to modify the close support fire plan on demand, and consequently one of the two divisional artillery brigades advanced with the assault, one and a half hours after Zero Hour, to permit closer all-arms liaison. Artillery was once again faced with the problem of how to keep up in a mobile battle, a problem it had not faced for over three years. By September 1918, gun sections were being deployed with the infantry, but suffered heavy casualties without adequate protection. The need for mobility and protection was identified, but this problem was not to be properly addressed for many years.

After the early success in August 1918, artillery staff turned their attention to deeper targets for subsequent phases, in particular the Hindenburg Line, which was assaulted on 26 September. By that stage strategic surprise had become unimportant, and there was every advantage in reverting to a massive 'destructive' bombardment. This lasted for 56 hours and was fired by over 1,000 guns on a 21,000-metre front, concentrating on lanes through the defence and on demoralizing the enemy as much as possible.

By November massive destructive artillery fire was seen as a means of reducing unnecessary infantry casualties, and artillery densities relative to infantry reached their highest levels. For example, at Valenciennes on 1 November 1918, 1,500 men of the Canadian Corps were supported by one gun to every 6 men on a front of just 2,500 metres. Artillery not only reduced infantry casualties, but also made up for infantry losses which might otherwise have slowed the offensive.

## 1914-18: Conclusions

Clausewitz asked, "How much artillery can one have without inconvenience? An excess of artillery is bound to cause operations to partake more and more of a defensive and passive character. A shortage of artillery will on the contrary enable us to let the offensive, mobility and manoeuvring predominate" <sup>(59)</sup>. The experience of artillery in the First World War challenged this assertion. Artillery was not responsible for the onset of static trench warfare in 1914. That was the result of insufficient artillery firepower, in particular a shortage of ammunition. Trench warfare brought about a burgeoning of artillery resources in an attempt to break out of the stalemate with massive 'destructive' firepower.

This firepower was generated in many ways: the size of the artillery in relation to other arms was greatly increased. In the British and German Armies the number

<sup>(58)</sup> The British Fourth Army reported few cases of shrapnel wounds, and 70% from small arms. In contrast, the Germans reported an exceptionally high incidence of shrapnel wounds.

<sup>(59)</sup> Quoted in Balck (1914), p.241.

of guns per 1,000 riflemen doubled, and in the French army it trebled, illustrating the tendency in peacetime to underestimate the importance of firepower <sup>(60)</sup>. Not only were there more guns, but they became heavier and more destructive. The First World War demolished the prejudice against 'Siege' or 'Foot' artillery, which was seen to have similar tactical mobility and considerably more effect than the traditional 'Field' Branch. Indeed the distinction between branches became blurred as medium and heavy guns were handled as field pieces. While the number of guns increased, it also became clear that standardized equipment yielded logistic advantages.

Firepower was reliant on the provision of ammunition, which made unprecedented demands on logistic services, teaching perhaps the most important lesson of the war. The type of ammunition required also changed. British field guns had started with shrapnel, which proved highly successful; but trench warfare and a shortage of heavier pieces hurried the development of HE rounds, which arrived in 1915. The development of the instantaneous fuze enabled artillery to create similar effects to that of shrapnel, but without the skill required to fire it effectively. It made it possible to cut wire in depth by indirect fire, sparing the close deployment of field guns in the direct fire role. The instantaneous fuze marked a qualitative improvement not matched until the radar-controlled variable time (VT) fuze appeared in the Second World War <sup>(61)</sup>.

The application of firepower was enhanced by technical advances. The machine gun made the high velocity gun obsolete at close range, a logical continuation of a process started in the 1860s. The low-velocity curved trajectory howitzer was developed in response, but this required improved accuracy for predicted fire, and better communications. When these were achieved, artillery regained the ability to concentrate fire as in Napoleonic times; but now, through fire mobility, not just the massing of equipment.

Before 1914 predicted fire was known but seldom practised, through technical inadequacy. By November 1918 all British pieces were calibrated for MV variations; and meteorological corrections were applied and ammunition was issued by uniform weight and batch of manufacture, principles which have lasted for over 60 years. In 1918 an 18pdr was expected to achieve an accuracy of 80 metres at a range of 4,000 metres through prediction, a similar performance (in terms of accuracy if not range) to modern guns. The days when a battery commander was judged to have used underhand methods by measuring distances off a map were long gone. Experiments with wireless had proved disappointing, and telephones remained the primary means of communication throughout the war, although liaison officers were regarded as the most reliable medium <sup>(62)</sup>. Before 1914 aircraft played little part in artillery operations. By 1918 they were the primary source of battlefield intelligence, used for fireplanning and an

<sup>(60)</sup> In peace the mobility of troops can be exercised and readily appreciated, while the value of firepower and fire mobility is harder to demonstrate.

<sup>(61)</sup> See Chapter 16, p.201, on VT fuzes.

<sup>(62)</sup> In 1918 the French had 50,000 telegraph engineers. There were up to 200 signallers in every artillery regiment, and many French houses had been stripped of wiring to provide communications.

important means of controlling artillery fire.

New tactics were required to make best use of the firepower thus harnessed. At first these were characterized by the 'destruction' of everything in the path of advancing infantry, which had become impotent without artillery support. The vulnerability of attacking infantry forced artillery to devote the greater part of its effort to the close battle; but it was slow to learn that this effort would be better deployed against the men who manned the obstacles than against the obstacles themselves. Lengthy destructive bombardments sacrificed surprise, granted the enemy time to mobilize his reserves, and caused such damage to the terrain that the attempt to create tactical mobility created administrative problems, thwarting mobility on a grander scale and the possibility of a strategic penetration.

These problems generated serious study of fire and movement at unit and formation levels, and as a result all-arms planning became routine. This was seen from 1915 onwards in the efforts to develop barrages best suited to the needs of the infantry. Success was not so much dependent on the tactical handling of troops as on their handling in conjunction with the application of artillery firepower.

Realization that 'destructive' tactics carried severe penalties led to the adoption of 'neutralization' in its place. These tactics called for greater flexibility. The French, for example, urged that "the distribution in groupings must never be according to a fixed rule, but must be capable of modification according to the course of events" <sup>(63)</sup>. The use of short but heavy bombardments restored the element of surprise, and the possibility of achieving deeper penetrations.

These tactics generated a greater awareness of the need for depth in attack and defence. Artillery remained the primary means of destroying machine guns throughout the war; but it was realized that enemy artillery and following infantry echelons were of equal importance to (and often of greater importance than) the leading waves of attackers. As a result, fewer resources were devoted to the close battle, and eventually the greater part to the deep battle, in particular to CB fire <sup>(64)</sup>.

The deep or long range battle was the creation of the First World War, made possible by new techniques of target acquisition and increased range. Never before had so large a proportion of artillery resources been devoted to targets out of the sight of the infantry. Although artillery fought the deep battle without infantry assistance, it was fought with the intention of directly influencing the close battle. In this way artillery achieved still greater importance as an offensive arm in its own right and with it recognition not seen for 100 years.

By 1918 all armies maintained a reserve of artillery at army level provided with strategic mobility by either road or rail. French field guns were carried 'portee' on trucks with 200 rpg and could cover 100km per day; and by 1918 US artillery was heading towards full motorization. Tactical mobility was improved by using tractors, overcoming the limits on weight and calibre imposed by a team of horses.

Greater mobility created problems for C2. Throughout the war the latter had become increasingly centralized; but with poor communications it was difficult

<sup>(63)</sup> "French artillery doctrine" *Royal Artillery Journal* Vol. XLVIII No.4 (July 1921), p.84.

<sup>(64)</sup> These developments are analogous to those in the 1980s, if the infantry ATGW is substituted for the machine gun in the close battle.

to effect modifications to fire plans as the battle progressed. Despite technical experiments and the use of FOOs accompanying advancing troops, control remained poor unless pieces themselves moved forward into vulnerable forward areas, where they were likely to suffer the same fate as artillery deployed in open positions in 1914.

The tank was seen by many as a means of providing protected firepower in close support of infantry, as well as a means of breaching obstacles. The seeds of later debate were thus sown on how artillery might be used in armoured warfare. Should it accompany tanks to protect their flanks; should it hold back and destroy anti-tank weapons with indirect fire, or was it no longer required in the close armoured battle at all, because of an over-ruling concern with the deep battle? A German order at the end of the war declared that "The first duty of the field artillery is to keep off the enemy tanks. All other duties must give way to this" — in other words, counter-mobility <sup>(65)</sup>. The value of indirect fire against tanks was questionable, while the advantages of direct fire systems were clear; but these would need to be deployed forward, and whether they should be manned by the infantry or artillery was again open to debate.

The relationship between field and siege artillery had been settled by 1916; but the introduction of the tank stirred up fresh uncertainties, and the possibility of SP and anti-tank branches of artillery. The war had caused rapid developments in all areas of technology and tactics, but after five years it had created at least as many fresh problems as it had resolved, which were to receive intense study in the years which followed.

<sup>(65)</sup> Quoted in Hay (1920), p.112.

## Chapter 15: 1918-1939

### Introduction

After the Armistice the possibility of another continental war seemed remote; moreover, political and economic constraints militated against major re-equipment and reorganization<sup>(1)</sup>. But the recent war had brought changes and stimulated ideas that would not be quickly forgotten, and posed questions it had not answered. Artillery had emerged as the dominant arm on the battlefield, ending the pre-war pre-eminence of manoeuvre over firepower; but the future role of artillery and its relationship to other arms was unclear.

Was it still the role of artillery to breach obstacles through which infantry and armour might pass? Was artillery still to neutralize enemy infantry in covered defensive positions? Should artillery neutralize or destroy enemy firepower? Was artillery to provide close support for tanks in the mobile operations that were anticipated, and was artillery responsible for anti-tank defence? If artillery was to carry out any of these tasks, what types of equipment should be provided, and should these constitute discrete branches? Artillery had proved its worth in the deep battle, but where lay the division of responsibility with air forces for harassing and counter-battery operations; and how far could artillery rely on air power for target acquisition? Great improvements had been made in gunnery techniques, but these had been developed in relatively static operations. Could artillery deliver accurate observed, let alone predicted, fire in mobile operations? If artillery moved forward to keep in touch with the battle, was it too vulnerable, and if so, was it possible instead to use wireless as an electronic means of bridging the greater distances between gun and observer? Would manoeuvre re-assert itself over firepower?

In the immediately post-war years ideas on artillery tactics followed logically from recent experience. In 1921 the British Artillery Training Volume III set artillery two aims: the first was to assist the movement of infantry. "Artillery cannot ensure decisive success in battle by its own destructive action. It is the advance of the infantry that alone is capable of producing this result". The second was to prevent the movement of enemy infantry. In mobile operations these aims could be achieved only through close liaison with other arms. Quick and accurate artillery response depended upon 'shortlines' between infantry or tanks and guns, and hence placed increasing pressure on the gunners to operate as far forward as possible.

The French Centre of Tactical Artillery Studies at Metz examined the future requirements of artillery in the early 1920's. It recognized the need for more technically-trained soldiers, the importance of mobilizing industry, and of bringing flexibility to regulations to allow for unforeseen developments<sup>(2)</sup>. But the

<sup>(1)</sup> It was pointed out, for example, that in 1921 there were fewer rounds in India than were fired in the 36-hour crossing of the canal north of St. Quentin in 1918: Budworth (1921), p.359.

<sup>(2)</sup> "French artillery doctrine" *Royal Artillery Journal* Vol. XLVIII No.4 (July 1921) pp.82-91.



modernization of French artillery was slow<sup>(3)</sup>, and throughout the inter-war years its thinking was either out of date or, in sharp contrast to that of 1914, unduly weighted towards the defence<sup>(4)</sup>. The *Instruction Générale sur le Tir de l'Artillerie* of 1936 described the three tasks of artillery as: the destruction of obstacles in preparation for the attack; the support and protection of infantry and tanks in defence; and CB and harassing fire. The importance of offence in mobile operations and how artillery or airpower might lend their support was not properly addressed. The French tactical concept of 1936 stressed the need for fire mobility and concentration of fire, but emphasized their achievement in a scenario of Counter-Preparation and Defensive Fire. Fire mobility and concentration are much harder to achieve in mobile offensive operations, but it was the latter that were to prove decisive when supported by such firepower.

## Mobility

As the mobility of the supported arm increased, the techniques that had produced fire mobility and artillery concentrations in static operations proved wanting, pointing to the need for tactical and strategic mobility of artillery to match. The possibility of motorizing artillery had been recognized before the First World War<sup>(5)</sup>. In the final years of the war artillery regained a measure of mobility, and all armies recognized that they would have to become more mobile in the future. In 1926 J.F.C. Fuller was to write that "The superior weapon of the future is the gun, the superior soldier is the Gunner and the superior army is a force based on mechanically-propelled guns"<sup>(6)</sup>. But in 1927 Lieutenant Colonel A.F. Brooke warned against repeating the errors of thought prior to 1914, which had sacrificed firepower to mobility. He contended that firepower led to mobility<sup>(7)</sup>.

The argument against the horse was obvious and overwhelming. The limited weight pulled by a team of horses restricted the calibre of the gun available to support cavalry; mechanical transport was seen to require less manpower; men carried to battle on wheels were fresher than those who walked; fuel was less bulky and could be stored for longer than fodder; maintenance of vehicles was dictated by mileage covered rather than the clock; the space occupied on the road was 10:1 in favour of mechanized transport; and under attack mechanical transport was less prone to casualties and panic<sup>(8)</sup>.

For tactical mobility, the advocates of mechanized transport agreed on the need

<sup>(3)</sup> Rimailho (1925).

<sup>(4)</sup> Poydenot (1938).

<sup>(5)</sup> A wheeled SP anti-balloon gun was under trial in Germany in 1914; Balck (1914), p.221, and as early as 1907 General Richter had suggested mounting artillery pieces on automobiles to accompany infantry: *ibid.*, p.425.

<sup>(6)</sup> *Royal Artillery Journal* Vol.LIII (1926-27), p.30.

<sup>(7)</sup> Brooke (1927), p.482.

<sup>(8)</sup> The strategic mobility of motorized transport had already been proved. In September 1918 the Bulgarian Army retreated with the British XVI Corps in pursuit, but the latter's horse-drawn 60pdrs could not keep up after 80 miles. Motor-drawn 6-inch howitzers were summoned from Salonika and travelled 300 miles by road to the Bulgarian-Turkish frontier with all their equipment in just eight days: Crofton (1921), p.135.

for tracks, but were divided on the merits of tractors or self-propulsion. In 1918 the French Army had eight types of SP gun, ranging in calibre from 75mm to a 280mm piece mounted on a 7-ton light tank chassis <sup>(9)</sup>. After 1918 the French ceased development of SP artillery, retaining only a few 194mm and 280mm pieces, which were to be used in the Second World War.

The US Army conducted numerous experiments, producing 12 different models, until 1922, when the SP was dropped in favour of tractors, on the grounds that SP automotive unreliability put guns at risk. The Germans had also abandoned their SP experiments by the mid 1920s.

The British had produced what was arguably the first SP gun, the Gun Carrier Mark I, in 1916, designed to take a 60 pdr or 6-inch howitzer, but only 48 vehicles were produced, and these were generally used as logistic carriers. Nevertheless, the idea of an SP gun gained ground in Britain after the First World War <sup>(10)</sup>.

In 1924 the RGA and RFA were amalgamated, effectively doing away with mobile heavy artillery, which was judged impractical in mobile operations. Mobility was reserved for lighter calibres, and in 1925 the British Army produced the 18pdr SP 'Birch Gun', designed to provide close support for tanks. It was incorporated into the 'Experimental Mechanised Force' set up by the Chief of the Imperial General Staff (CIGS), Field Marshal Sir George Milne, with a group of officers known as the 'Armoured School'. But plans to expand this formation into an armoured division fell foul of conservative opinion, and it was disbanded in 1930 <sup>(11)</sup>.

With close support for armour no longer required, the British Army discarded the 'Birch Gun'. It had some technical problems, but its chief offence was to be 15 years ahead of the time. British artillery was left in disarray. The Duncan Essay winner of 1930 complained of there being too few guns in a division, too little training with other arms, bad communications, lack of air liaison and lack of

<sup>(9)</sup> In 1923 Lieutenant Colonel Rmailho wrote enthusiastically in support of mechanization and the SP concept which included an SP infantry vehicle, the 'Chenillette St Chamond': Rmailho (1925). The French Inspector of Artillery envisaged a complete fleet of SP guns, but was opposed by many of his own arm and the French High Command: Ogorkiewicz (1951). The case against the SP was based on the cost of importing fuel, unproven automotive reliability and the belief that in positional warfare the motor fixed to the gun would be superfluous.

<sup>(10)</sup> In 1921 it was suggested that all field and medium artillery should be SP, replacing horses and tractors. This SP would look rather like a tank with a gun inside, have 360-degree traverse, a speed of 25mph, and be supported by an armoured limber: Crofton (1921). The call for such a limber was repeated in 1923 by Lieutenant General Rohne in Germany: Rohne (1923), p. 133, but it was 65 years before such a vehicle was introduced, and it is still awaited in most armies.

<sup>(11)</sup> The 'Armoured School' saw tanks as cavalry, not as armoured artillery, aiming to make deep thrusts into rear areas. They saw no place for heavy field artillery, with its clumsy logistic support. B.H. Liddell Hart maintained that fire support should be provided by SPs and aircraft. Another member, Colonel (later General Sir Charles) Broad, also advocated the SP gun in his 'Armoured and Mechanised Formations' in 1929, urging direct fire tactics in the assault, more characteristic of 1943 than expected in 1929. But in 'Modern Formations' two years later, Broad abandoned SP artillery, seeming to accept the growing consensus view that tanks possessed sufficient mobility, armour and firepower to defend themselves without artillery support, which was consigned to the defence of rear areas. Some armour enthusiasts such as Hobart believed, rather as the Germans did, that air power could replace artillery

confidence in field artillery in anti-tank defence <sup>(12)</sup>.

The post-war enthusiasm for achieving tactical mobility had found expression in the development of the SP. Its fall from favour in the face of prejudice, often from the arm it was intended to support, set back the case for artillery mobility, although it should be noted that many gunners also opposed it lest it enable the Royal Tank Corps (RTC) to usurp an artillery role. It was not until 1934 that the French *Division Légère Mécanique*, a permanent mechanized formation, could boast motorized towed artillery. The German Panzer Division of 1935 also relied on towed artillery, and continued to do so for two years of war, despite protests from Panzer commanders. The British, who had led the way after the First World War, could not produce motor-towed artillery for their two mechanized divisions until 1937. Britain's defence priority was Imperial defence, the requirements for which were very different from fighting a continental war. Without a clear role on the continental battlefield and with memories of the First World War fading, they had devoted their attention to the real and more immediate problems of low-intensity operations in colonial policing <sup>(13)</sup>.

### Artillery in the armoured battle

In 1918 the British Army had the greatest experience of armoured warfare. The vulnerability of tanks to direct artillery fire had been recognized in the First World War, and British armoured doctrine described artillery's primary role as the protection of tanks from observed fire by means of CB attack, smoke and the destruction of anti-tank guns. The gunners agreed, and the result was the 'Armoured School' draft pamphlet 'Mechanised and Armoured Formations' of 1929 <sup>(14)</sup>.

When field artillery operated in forward areas during the First World War, it had often suffered severe casualties, and the 'Birch Gun' was developed in the hope of reducing these. For a period after 1931 the RTC abandoned artillery support, forgetting too quickly its own vulnerability to direct fire; but the formation of mobile divisions in 1937 revived the debate on co-operation between artillery and armour <sup>(15)</sup>.

support under some circumstances, and he included three squadrons of close support aircraft in his notional organization of a tank division.

<sup>(12)</sup> *Royal Artillery Journal* Vol.LVII (1930-31), p. 183.

<sup>(13)</sup> A criticism also levelled at the British Army after 1945: Perkins (1978) p.13.

<sup>(14)</sup> The unity of purpose was such that there was initially some debate whether the RTC should man its own close support artillery, rather as the infantry had acquired its own guns: Crofton (1921). In France the first tanks were regarded as a form of artillery, and the first armoured units were termed *Artillerie d'Assaut*, and used as such. 25 years later Soviet SP assault guns were to be manned by tank troopers rather than by artillerymen.

<sup>(15)</sup> Two mechanized RHA regiments armed with the 3.7-inch howitzer were given the task of "the support by fire of the attack of the tank brigade" (Field Service Regulations, Vol.III (1935), p.4), but the 3.7-inch howitzer was quite unsuited for the direct fire role and was replaced in 1938 by the 25pdr and 2pdr. Their task was given as the safeguarding of flanks and communications, the securing of defiles to the rear and the covering of resting brigades. They were not to be used to knock out enemy anti-tank weapons to the front, even though in 1938 the British deemed their own 2pdr able to knock out a tank.

The idea of providing tanks with armoured SP artillery support, which came so close to realization in Britain between 1925-30, had been allowed to wither. It was artillery's answer to the problem, set in 1917, of how accurate and timely fire could be provided in support of an attack in mobile operations; but it was 1942 before experience recalled the SP to the battlefield.

The SP was a victim of the idea, which gained prevalence in the 1930's, that artillery was again but an ancillary on the battlefield, and even out of date in *Blitzkrieg* operations. In the German Army, faith was established in the mobility of the tank and the firepower of close air support. The 'Stuka' dive-bomber took over the role of close support and heavy artillery, pinpointing targets in front of advancing armour. The artillery was decentralized and consigned to the engagement of opportunity targets, assuming it could keep up with the battle. The Czech officer Ferdinand Miksche, an advocate of *Blitzkrieg*, was to write in 1941 that the artillery bombardments of the First World War were "merely interesting phenomena of the past"<sup>(16)</sup>. *Blitzkrieg* was an attempt to fulfil such a wish, a means whereby wars of attrition and unacceptable losses might be avoided by applying force more effectively. In 1932 Hitler had said that "The next war will be quite different from the last world war. Infantry attacks and mass formations are obsolete. Interlocked frontal struggles lasting for years on petrified fronts will not return. I guarantee that... we shall regain the superiority of free operations"<sup>(17)</sup>. By the time the importance of concentrated artillery firepower had been re-learned in the Second World War, it was too late for Germany to develop the organization and equipment in sufficient quantities to match her opponents'<sup>(18)</sup>.

Artillery had failed the Russian Army in the First World War largely because of its own poor logistic organization. Afterwards, the Soviets studied the lessons of the war and, rather than discard artillery for armour, combined the two in a single concept of operations. For many years political upheavals prevented the realization of these ideas, which included designs for anti-tank, SP guns and multiple-barrel rocket launchers (MBRL). The ideas of the 1930s were tested in the Second World War, and survive essentially intact in the Soviet Army in the 1980s.

Soviet regulations of 1936 ruled that artillery was the arm that would clear the way for armoured mobility, agreeing with Brooke that firepower creates mobility. Artillery would not only destroy anti-tank defences, but would also hit deep targets, destroying enemy artillery and isolating areas of the battlefield with a screen of fire. Artillery was recognized as the supreme arm, and tanks were not

<sup>(16)</sup> Bellamy (1983), p.270. Miksche advocated the use of SP guns in close support, but the idea of concentrated artillery fire under centralized control played little part in this concept.

<sup>(17)</sup> Quoted in Strawson (1985), p.44.

<sup>(18)</sup> Mobility and **airpower** were outstandingly successful in Poland and the West; but in the East, German mobility was reduced in relative terms by the vast distances encountered. In addition, only a small part of the **Wehrmacht** was **motorized** and the deficiency of the majority was soon revealed. The strategy of rapid movement and avoidance of strong points was pursued in the belief that time would not permit development of **siege operations**, but the shock of *Blitzkrieg* was absorbed at great cost and followed by a war of **attrition** which it had been designed to avoid, and which Germany was ill-placed to win.

to attack on the main defensive line without artillery support <sup>(19)</sup>. The Soviets provided artillery to accompany armour and infantry, but, unlike the Germans, they retained a higher centralized command structure and large masses of equipment to produce heavy concentrated fire. The Soviets achieved the best of both worlds in this way only by devoting unequalled resources to the artillery. Until 1937, political upheaval prevented reform and re-equipment, but the appointment of Nikolai Voronov as Chief of Artillery in that year brought rapid change. By 1939 Marshal Voroshilov could report to the Supreme Soviet that in two years the firepower of Soviet artillery had trebled. Soviet artillery resources continued to multiply and the German Army was never able to match it in quantity of equipment or munitions.

### Artillery and infantry

Operational thinking between the World Wars was dominated by ideas of armour and movement. In parallel with this, efforts were made to improve infantry mobility. Tanks had proclaimed their independence from artillery in the 1930's, so now the infantry proved eager to regain the autonomy lost in the First World War. It did this not so much by improving its mobility as by enhancing its firepower, and in this the Germans led the way <sup>(20)</sup>. Placing guns under infantry control was likely to require more, rather than less, artillery, but the danger was that such decentralization would reduce the quantity of artillery under central control. While close liaison and support of infantry was desirable, the dissolution of the centralized apparatus, which multiplied *its* effect through fire mobility, was likely to weaken the support provided <sup>(21)</sup>.

The Soviets saw the benefits of decentralizing their field artillery, and created the infantry artillery, but not at the expense of the artillery with larger formations, and they retained C2 at the highest level to direct it.

The British infantry, like the German, demanded more autonomous firepower. General Wavell's motto for the infantry was 'self support, not close support' <sup>(22)</sup>. Infantry battalions were given mortars and anti-tank guns. The light artillery

<sup>(19)</sup> Bellamy (1983).

<sup>(20)</sup> Their infantry was the first to make every fourth company a heavy machine gun company and to give each section a sub-machine gun. Each battalion received six 81mm mortars, each regiment a twelve-gun anti-tank company and six 75mm and two 150mm howitzers: Ogorkiewicz (1951). These reforms were the product of the long debate over 'infantry guns'. In the 1920s it was commonly held in France and Germany that the whole field artillery should be taken over by the infantry: Rowan-Robinson (1928), pp.408-409, leaving the divisional artillery to carry out the "deep battle", and close support tasks only in special circumstances.

Major General von Amman went further and advocated the allocation of even divisional artillery to infantry regiments, retaining only a small reserve at division: *ibid*. He proposed that field artillery should become an integral part of the infantry regiment, and hoped that artillery commanders in such units would be more likely to act on their own initiative and in the interests of the infantry than if artillery remained under divisional control.

<sup>(21)</sup> The danger of splitting up artillery piecemeal had been recognized by the French and Russians before the First World War: Edmonds (1922), p.294. Improved communications and gunnery techniques might have overcome this problem, but these were not yet available.

<sup>(22)</sup> Quoted in Bidwell (1967), p.20.

brigades of 3.7-inch howitzers which had been allocated to every infantry division in 1920 were diverted to other tasks in 1937, and their obsolete weapons taken out of service, except in India. This represented a severe setback in artillery/infantry liaison, disrupting all-arms anti-tank planning, which was ironically made yet worse when the infantry anti-tank 2pdr was passed to the artillery in 1938.

### Anti-tank fire

In 1920 the British Secretary of State for War described how on a moonlit night or a foggy day a thousand tanks might be launched to the deep attack, cutting rapidly through the 'body' of an army to strike at its 'brains' <sup>(23)</sup>. This image had been conjured up by Fuller in 'Plan 1919', and reflected the view of the British Army at a time when it led the world in armoured warfare. Armour was seen as the means of paralyzing an army by deep penetration without a prolonged battle of attrition.

The corollary of such a concept was the need for artillery anti-tank defence, since artillery was seen as the only means of stopping the tank. In 1920 Major Hay called for the introduction of a gun specifically for anti-tank defence <sup>(24)</sup>, but the need for this was hotly debated. The addition of further types of equipment and ammunition ran contrary to the desire to standardize, and it was argued that a specific anti-tank gun would be no good for other artillery tasks and was thus a luxury. There was a most urgent need for an anti-tank weapon, but it was feared that the creation of a relatively static anti-tank force would restrict armoured offensive operations by friendly forces.

Ideas of anti-tank gunnery in armoured warfare were remarkably sophisticated. As early as 1920 it was argued that an SP anti-tank gun was required to accompany and defend tanks, and the idea of their use in active defence was well established <sup>(25)</sup>.

It was appreciated that indirect artillery fire had little effect on tanks, and that to stop a tank attack, field artillery should move forward to prepared direct fire positions. In the 1920s it was generally accepted that tanks needed the close support of artillery since their mobility was bought at the expense of their firepower. The fire of tanks was less effective on the move, and it was considered that artillery should provide accurate and heavy firepower while light tanks manoeuvred <sup>(26)</sup>.

<sup>(23)</sup> Quoted in Hay (1920), p. 109.

<sup>(24)</sup> *Ibid.*, p. 111.

<sup>(25)</sup> It was also proposed that a force of tanks be held in reserve to execute the 'Counter Stroke', and that anti-tank artillery be attached to support the operation, the techniques of which are still controversial and unresolved 65 years later.

<sup>(26)</sup> In his Duncan Silver Medal essay of 1929, Major R.G. Cherry described this requirement and even suggested the use of air OPs to call for concentrated indirect fire against masses of enemy armour behind the 'contact zone', an operation that would require artillery to increase its range, and improve its technical procedures and co-operation with the RAF: Cherry (1929). The concept of artillery in deep attack on armoured targets acquired from the air has survived as the most important issue in fire support in the 1980s.

The doctrine of armour and artillery co-operation was proclaimed in 'Mechanised and Armoured Formations' of 1929, but dropped two years later in 'Modern Formations', which advocated 'undiluted' armoured warfare. Artillery was regarded as too slow and unreliable in mobile operations, and tanks were judged to be self-sufficient in firepower.

Faith in the tank, which caused the abandonment of artillery in offensive operations, created, by the same token, the belief that artillery was indispensable in defence against armour. The logical inconsistencies of this analysis were not exposed until 1939. In the meantime the debate on how best to provide anti-tank defence received the greater attention of gunners, now barred from offensive mobility.

In January 1938 a conference at the British Army Staff College argued that "neither infantry nor guns are suitable for cutting wire, save in very exceptional circumstances"<sup>(27)</sup>. This was the task of the tank, and the task of artillery was to stop the tank. Artillery firepower was to take the place of obstacles against a mobile attacker.

The first anti-tank guns were just miniatures of existing field guns, and were of calibres between 25mm and 47mm. As the British led in tank design, so the Germans led in anti-tank ordnance, equipping each division with the 75mm anti-tank gun. In 1933 the Germans produced the 8.8cm Flak Model 18<sup>(28)</sup>, which could be used in the anti-tank role. The Germans were not content with passive defence, preferring an active and mobile role using motorized 'tank hunters', often in support of infantry units. It was a small step for them to adopt the SP anti-tank gun in 1940 ahead of the British, French and Americans.

British infantry under Wavell's command was equipped with the 2pdr anti-tank gun, which was to prove at least the equal of the German 3.7cm gun, though unfortunately it was not part of a series of equipment with larger calibres<sup>(29)</sup>. In 1938, the infantry gave up their 2pdrs. P.C.S. Hobart, the Inspector RTC, had recommended that tanks be armed with the 2pdr to defeat other tanks. It therefore seemed logical that the artillery, which lacked an anti-tank gun, should be issued with this equipment, although it had been designed for close combat in forward infantry locations, and not as a powerful long-range defensive weapon. Outraged by its quarry, it was ill-advised to disclose its position, until enemy armour had approached to fight on equal terms. The British were thus led to adopt static defensive tactics rather than active defence with 'tank hunters'. At first British tactics often proved highly effective, but by the outbreak of war many tanks carried

<sup>(27)</sup> Quoted in Pemberton (1950), p.16.

<sup>(28)</sup> This was tested in Spain by the Kondor Legion, where its potential as an anti-tank weapon was noticed, and in various derivatives it went on to become the outstanding anti-tank gun of the Second World War: *History of World War Two: No.95 "The Guns"* (Purnell) pp.2643-2652 (issued between 1966 and 1969).

<sup>(29)</sup> When the artillery light brigades were converted in 1937, the whole all-arms anti-tank plan was disrupted. These brigades had been intended to switch when necessary from offensive close support to defensive anti-tank fire. Their departure removed the capacity for central planning, leaving brigades responsible for their own anti-tank operations using the 2pdr. Behind them the G staff were nominally responsible for anti-tank defence, but had no specific assets for the task.

up to 60mm of armour against which the 2pdr was too light at ranges over 500m. A 6pdr gun was designed, but was not approved until 1941. In the meantime commanders were tempted to draw their field guns forward in the anti-tank role to bolster their defences at the expense of regular close support of the infantry.

### Artillery and air power

The relationship between artillery and air forces had two aspects. Firstly, artillery relied upon aircraft for the acquisition of deep targets, and the control of fire beyond the sight of ground observers; and secondly, aircraft were expected to provide 'aerial artillery' to acquire and engage deep targets, which artillery could not locate or hit with accuracy <sup>(30)</sup>.

As war approached the RAF was preoccupied with matters other than close support, and opinion in the RAF seemed to be that close observation of fire over enemy territory would be impractical without the air superiority which it did not expect to achieve. With the RAF apparently not interested, artillery turned to its own resources <sup>(31)</sup>, but when war broke out the organization of aerial observation was ill-defined and equipment inadequate.

There were hopes in 1918 that aircraft combined with artillery would provide the firepower to prepare for and cover the advance of armour. In 1918 the RAF had 99 squadrons, but by 1920 it was reduced to 22 squadrons, and little progress was made in the practice of close air support, although (as in military matters) this was a time of adventurous thought <sup>(32)</sup>. The liaison between artillery and aircraft which looked so promising in 1918 withered in Britain between the wars. By 1939 the RAF was unable to provide either fire control for the close battle, or firepower

<sup>(30)</sup> In Britain during the 1920s the 'clock code', used by observers to report fall of shot, and the 'strip system' for indicating events on the gun position to the aircraft, were improved. The problem in mobile warfare was that when working with a battery whose location was unknown, an air observer did not know when a battery was ready to fire. To overcome this, a fixed time interval of four minutes was set between notification of a target and the firing of the first ranging round; but this system depended upon continuous wireless communication.

<sup>(31)</sup> In 1934 the Royal Artillery Flying Club was formed at Larkhill, and from 1936 experimented with observation work using its own aircraft. By 1938 one hundred artillery officers in Southern Command held pilots' licences: Hickey (1975), p.16, and by 1939 the Gunners had perfected methods of controlling fire, using two-way radio. Their technique depended on the use of a light (and therefore unarmed) aircraft. The RAF *Lysander*, designed for air observation, was an excellent aircraft but it was too heavy for the techniques of artillery observation developed at Larkhill; yet its lack of armament left it too vulnerable for the RAF's requirements.

<sup>(32)</sup> The leading British writer on air power was Wing Commander Slessor, later Marshal of the RAF Sir John Slessor, the RAF instructor at the Army Staff College. In his farsighted work *Air Power and Armies* (1936), he declared the prime task of an air force to be the destruction of enemy airpower, which would enable friendly aircraft to turn their attention to the destruction of enemy ground forces — though not at the expense of undue casualties from hostile air defences. His ideas were well received in Germany, but largely ignored in Britain. The RAF became preoccupied with the concept of strategic bombing, which some officers held would prove so decisive as to render land war obsolete. This extreme and misguided view held up the strategic bomber as an alternative to both artillery firepower and armoured mobility. By 1939 Slessor's views had earned a measure of acceptance, but the RAF lacked the aircraft to realize them. The 'Fairey Battle' failed to come up to the Royal Artillery's expectations of aerial artillery and met with tragedy in 1940.



for the deep battle; and while the Gunners might produce makeshift arrangements for the former, resources were lacking to fight the latter. The consequences of this weakness were revealed when the Germans demonstrated the potential of close air support in their early victories of the Second World War.

### **The application of artillery fire**

Although the mobility of the supported arms encouraged the de-centralization of artillery, the principle that artillery fire should, where possible, be concentrated was not challenged. The problem was how to achieve this on a changing battlefield. Advances in technical gunnery pioneered in the First World War continued in the times of economic austerity which followed, as a cheap but effective way of improving the application of artillery fire.

Re-organization also offered the possibility of improving artillery response without high capital cost; but such measures were not revolutionary. Wireless communications on the other hand promised a complete change in the practice of close support, if they could be perfected. By the end of the First World War it was routine for artillery to fire on predicted data, and some gunners supposed that in future all fire would be 'unobserved' <sup>(33)</sup>. Throughout the 1920s there was intense interest in improving the accuracy of predicted fire <sup>(34)</sup>. The artillery became so survey-conscious that there was a danger that operations might be delayed while lengthy calculations were completed, but the dividend from such calculations could be dramatic <sup>(35)</sup>. In an attempt to speed up the response in the 'Encounter Battle' the British Army introduced 1:25,000 scale maps in 1936. These made hasty concentrations possible, if not to the same accuracy as with survey.

Accurate survey would have been wasted if variation in muzzle velocity were not corrected. From 1927-39 Royal Artillery training memoranda stressed the need for thorough calibration for all types of charge and ammunition; but the fact of peacetime gunnery was that with so little ammunition to fire there was insignificant barrel wear, and hence an ever-present temptation to ignore calibration in training. Attempts were made to standardize the issue of ammunition to improve accuracy, particularly for 'Proximity' shoots <sup>(36)</sup>, but peacetime shortages of ammunition made this hard to achieve. From 1928 meteorological telegrams were issued on exercise at regular intervals. These came from the RAF; but they covered an area and period so large that they were of limited value.

The technical enthusiasm of the 1920's did not continue into the next decade. As the memories of practical gunnery problems in the First World War faded,

<sup>(33)</sup> Others thought this too optimistic. Lieutenant General Rohne, for instance, thought predicted fire in mobile warfare unrealistic in the absence of adequate maps and survey, and others maintained that without better means of target acquisition predicted fire would waste ammunition, Rohne (1923).

<sup>(34)</sup> The British Army was prepared for operations anywhere in the Empire, and in 1925 developed 'silent registration' with a range-finder, director and artillery-board as a means of locating targets without the use of large-scale maps. Brigade survey parties were also introduced in that year, and by 1937 survey units accompanied leading artillery units.

<sup>(35)</sup> Once surveyed in, a whole divisional artillery could be concentrated on a target within 30 minutes.

<sup>(36)</sup> Now generally called 'Danger Close' missions.

many British officers reverted to the style of earlier times. It became fashionable once more to disparage professionalism, and the horse received undue attention<sup>(37)</sup>.

Technical advances were made but fell far short of what was necessary to achieve accurate predicted fire in mobile operations. What were required were sound communications between an observer and the gun position, which would allow the rapid adjustment of fire despite initial inaccuracy.

In 1938 the French still relied on pre-planned defensive fire (*tir d'arrêt*) which could best be achieved by centralizing control at brigade level and observing its fire. With good communications they hoped it would be possible to avoid the massive ammunition expenditure of predicted fireplans<sup>(38)</sup>.

German gunnery regulations of 1937 also believed in concentrating fire at brigade level, but not in the defensive operations envisaged by the French. German artillery believed its task was to achieve rapid reaction in mobile operations, providing fire on the decisive sector at the critical moment. The only way to achieve this was through forward planning and study of the ground, laying down *Zielpunkte* or target reference points for observers<sup>(39)</sup>.

British artillery principles were described in Field Service Regulations (FSR) 1935 thus: "Command of any body of artillery should be centralized under the highest commander who can exercise effective control"<sup>(40)</sup>. Artillery Training Volume III was derived from FSR and identified the concepts of concentration, surprise, economy of fire, and the mobility of fire which enables artillery to engage and disengage at will, and hence to keep no massed reserve. It maintained that these qualities of artillery could best be expected through command at the highest level<sup>(41)</sup>.

Until 1935 the British regarded the battery as the basic fire unit, largely as a result of their colonial experience; but by 1937 the brigade, with 24 guns and renamed regiment in 1938, was recognized as the ideal to support a division. This was organized into two twelve-gun batteries to simplify survey and to improve the fire-power of the battery, which remained the standard fire unit.

This made it easier to link each battery command post where technical staff were responsible for calculations. Unfortunately, the two-battery regiment did not match the three-battalion brigade, and with four OPs per regiment, two troops had none. This organization became widely unpopular and was changed in 1941 to three batteries of eight guns.

One way of increasing the effectiveness of artillery fire was to increase the range and calibre of equipment and the lethality of munitions; but such enhance-

<sup>(37)</sup> Even the commander of 9th Brigade, the Experimental Mechanised Force, told a Staff College audience that it was essential for officers to spend half, if not three-quarters, of their time hunting. Quoted in Bidwell & Graham (1982), pp.156-157.

<sup>(38)</sup> Poydenot (1938).

<sup>(39)</sup> Schlieper (1937).

<sup>(40)</sup> Field Service Regulations 1935, Chapter 1, Section 5.

<sup>(41)</sup> So far as British artillery is concerned, these principles are still generally valid, although the idea of maintaining a reserve of artillery is regaining favour in the British Army.

ments were expensive. Shrapnel was taken out of British service in 1935, its place being taken by HE and the instantaneous fuze. These rounds operated best with a high angle of descent, giving the howitzer an advantage over the gun. Designers tried to combine the best of both in a single equipment, producing the British 25pdr and the comparable German 10.5cm gun/howitzer. Attempts were made to increase the range of British medium artillery, but programmes for the modernization of the 60pdr and 6-inch howitzer were disappointing, and it was not until August 1939 that the 4.5-inch and 5.5-inch pieces were in production <sup>(42)</sup>. These excellent guns might have made a significant impact in early engagements of the War, but it was 1941 before they arrived in quantity.

The idea of aircraft taking over deep attack tasks from heavy artillery was popular after the First World War. In Germany substantial resources were allocated to air support, but not in Britain. In 1937 the issue was reviewed and the importance of heavy artillery was re-affirmed, but it would be years before new equipment entered service <sup>(43)</sup>.

All new ideas on how to concentrate firepower in mobile operations would have foundered without improved communications. In the First World War the power of small arms had driven artillery back from the front line, increasing the distance between gun and target. While operations were relatively static, communication by telephone was adequate, but mobility made this hard to establish, slow and unreliable. The simplest answer was to close the distance between gun and target by pushing artillery forward, but this made artillery vulnerable. A better answer was to bridge the gap by radio communication.

The British Army issued radio sets in 1928 for brigade trials the following year. There were some technical difficulties, but the potential advantage of radio communication was clear. Radio was not just a substitute for old methods of control; it facilitated new ones such as the broadcast of information, and lateral communication between OPs. Flags and heliograph were withdrawn in 1935, and by 1939 each British OP had a radio.

Lieutenant Colonel A.F. Brooke, writing in 1929, suggested that if communications could be perfected the need for artillery below divisional level would disappear, since any FOO could call down divisional fire <sup>(44)</sup>. The support of all pieces, whether guns or howitzers, could be summoned and adjusted, avoiding the waste of ammunition of the predicted barrage.

The supported arm required timely concentrated artillery fire on targets of its choice, but the scattering of artillery amongst forward units made it impossible to concentrate the fire of those guns. Being part of a swift-moving 'Encounter

<sup>(42)</sup> The 6-inch howitzer threw a 100lb shell 9,800 metres, whereas the 5.5-inch could achieve 16,000 metres, and the 4.5-inch had similar advantages.

<sup>(43)</sup> The matter was discussed in a CIGS committee on 25 April 1938. This concluded that heavy artillery required long range and heavy shells; and that two types of weapon were thus required: one to fire a 100lb shell 26,500 metres and one to fire a 300lb shell 16,000 metres: Bidwell (1967), p.21. But as the Second World War opened there was still no heavy artillery piece in sight, and the Royal Artillery had just one heavy regiment equipped with 8-inch howitzers and 6-inch guns from the First World War.

<sup>(44)</sup> Brooke (1929).

Battle', in which it was frequently manoeuvring, this artillery spent a large part of its time out of action and unable to offer fire support. While assault or anti-tank guns would always be required forwards, radio offered guns providing indirect fire the chance to stay back in surveyed positions, from which they could offer accurate support <sup>(45)</sup>.

Radio communications were less liable to disruption by enemy fire, but even in 1929 the dangers of enemy interception and eavesdropping were realized. On the other hand, the passage of information by radio speeded up the collection of intelligence, and hence the targetting of artillery.

In the hands of air observers and forward air controllers, radio became the vital link between the air and land battles. If used successfully it could improve the control of artillery fire and integrate air and artillery into a common fire support programme. These opportunities were appreciated and tested ten years before the Second World War, but only Germany took full advantage of them.

## Conclusion

The First World War demonstrated the importance of firepower and firemobility, but revealed the difficulty of providing these in close support during mobile operations. After the war political and economic constraints thwarted the realization of the ideas of armoured warfare that were widely discussed. By the late 1920's experimental armoured formations existed with integral, and in some cases SP and anti-tank, artillery. These formations and their tactics were the logical consequence of the experience of the First World War, and were artillery's attempt to maintain close fire support by equipment mobility rather than fire mobility.

By the early 1930s imagination had outstripped experience. Both armour and infantry sought independence from artillery firepower, either by enhancing their own, or by calling on aircraft. The SP was abandoned, and wheeled artillery left vulnerable in the forward combat zone, assuming it could keep up with the battle. Having lost equipment mobility, artillerymen tried to compensate by improving fire mobility.

In mobile operations fire mobility could be achieved only through improvements in radio communications, survey and accuracy; but these were hard to perfect. The shortcomings of armour and airpower operating alone would be revealed in the Second World War; and the mobility of artillery equipment soon restored to improve support for them. The return of equipment mobility coincided with the development of improved techniques of gunnery, and was to revive artillery's influence on the battlefield in a way that few would have predicted ten years earlier.

<sup>(45)</sup> Although field guns could fall back to safer areas of the battlefield, they would depend on FOOs with the supported arm. The introduction of radio therefore reinforced the need for an armoured cross-country OP vehicle. This was given to British FOOs in April 1939 in the form of armoured scout cars.

# Chapter 16:

## THE SECOND WORLD WAR 1939-1945

Artillery in 1939 was a neglected arm, whose proven value in the First World War had been questioned in peace, often because its firepower had seemed to characterize the horrors of that war. The theories of armour and mobility that flourished in the 1930s were seen as alternatives to the dominance of firepower and, with the exception of the USSR, the armies of the major powers were organized and equipped to fight accordingly. The lessons of the First World War were thus discarded.

In the Second World War artillery planners had to re-learn those lessons and make the necessary changes in tactics, organization and equipment. Soviet artillery had the least adjustment to make, because of its adherence to the doctrines of the First World War, while the American and British artillery had to undergo complete transformations. The Germans also realized the need for change, but their transformation was more painful, in view of the early success of *Blitzkrieg* tactics, and they never mustered the resources to reform as they might have wished. The Japanese found themselves in an even worse predicament, having adopted the principles of rapid movement from the Germans, and adapted them to the Far East theatre. By the time firepower had re-asserted its dominance on the battlefield in the hands of the allies, it was too late for the Japanese to respond effectively.

The lessons re-learned in all theatres were similar, but the experience which taught them, and the practice which resulted, varied considerably. The issues at stake were: the ability of artillery to give fire support in mobile operations; the ability of artillery to counter mobility with anti-tank fire; the application of firepower through the generation of masses of artillery; its enhancement by fire mobility and co-ordination through centralized command and control, and the techniques by which this could be employed in offence and defence.

### A: THE WAR IN THE WEST

#### 1. France 1940

##### Mobility

In peace the British Army had planned and trained for mobile offensive operations, but months of 'Phoney War' altered perceptions<sup>(1)</sup>. Ten years of mobility theory were overthrown, and the artillery of the British I and II Corps deployed as if in preparation for a repeat of the First World War, and not so differently from forty years later. Alternative and dummy positions were laid out, and orders given that

<sup>(1)</sup>Royal Artillery Training Memorandum No. 1 of December 1939 noted that "the type of war we must now consider is not the highly mobile type, but a more ponderous war of masses". Indeed, only one armoured division was sent to France in May 1940, and its motor battalions were despatched to defend Calais.

main battle positions were to be occupied only after the main attack had begun. In the meantime, batteries and FOOs were ordered to deploy in concealed forward positions.

Throughout the winter of 1939-40 the BEF trained for static defence, not mobile armoured operations — preparing barrage programmes and improving lengthy predicted fireplans<sup>(1a)</sup>. When war came, it proved to be as pre-war theorists had predicted, not as the BEF had more recently expected; but even pre-war theory had paid little attention to mobile operations in defence. The BEF which was originally designed for mobile offence was now trained in anticipation of static defence. Because the BEF expected operations in the style of the First World War, greater emphasis was placed on the role of the lightly armed if heavily armoured 'I' tank, rather than on the operations of whole armoured formations<sup>(2)</sup>.

The Wehrmacht once again demonstrated its prowess in mobile offence, in which artillery played only a secondary role, its position being largely usurped by airpower, and against which no effective answer had yet been found. The Germans did not have superior numbers, or quality of equipment, but rather the ability to concentrate force at the critical point and time by all arms in concert. The Allied failure was the result of eight months of inactivity, failure to learn the lessons of the Polish campaign, misguided defensive thinking and political weakness. The true nature of the threat had not been appreciated, nor had a means been devised to defeat it.

## Counter-mobility

The BEF did not expect mobile operations largely because it had confidence in the measures it had taken to counter German mobility. It occupied many physical obstacles and deployed anti-tank forces behind them<sup>(3)</sup>. These tactics often proved effective in detail but failed *in toto*, because there were insufficient anti-tank guns to meet the threat<sup>(4)</sup>.

<sup>(1a)</sup> These fireplans show how, despite the trends against sophisticated fireplanning in the 1930s, the winter of 1939/40 saw a return to First World War thinking. For example, the 'crooked barrage' (two examples of which are illustrated in Figures 5a and 5b on p.170) were, in effect, sophisticated developments of the fireplans diagrammed in Figures 4a, 4b and 4c on pp. 133-134.

<sup>(2)</sup> Indeed the armoured divisions did not arrive in France until May 1940. These divisions lacked experience in combined-arms training with their support groups. The 25pdr regiments had been sent ahead to reinforce the BEF and the motorized battalions were in Norway.

<sup>(3)</sup> The anti-tank regimental commander was responsible for advising the divisional commander on the co-ordination of the brigade anti-tank plans. These took into account the nine 25mm Hotchkiss guns of the brigade's infantry anti-tank companies and his own 2pdrs. The 2pdr was able to stop most German tanks with armour-piercing (AP) rounds when well-sited, as they generally were, but only at less than 600 metres. The guns were usually sited singly on reverse slopes or in defiles to maximize the advantages of a short effective range; and in practice were often able to engage with surprise at as little as 200-300 metres. Deployment was made with interlocking arcs of fire in conjunction with mines laid to channel armour on to the guns.

<sup>(4)</sup> The BEF's frontage allowed only one anti-tank gun per 180 metres. The Germans, who were most conversant with the threat, advocated one gun per 35 metres. On 25 July 1940 the Commander-in-Chief of the BEF blamed setbacks on the shortage of guns: "No guns were available for the defence of the corps or rearward areas...": Pemberton (1950), p.36. Although two-thirds of German tanks were light enough to be vulnerable to well-sited 2pdrs, the British realized that improved German armour would make their

German mobility was effective in 1940 because the opposing side had insufficient firepower. The reasons were partly difficulty in concentrating adequate static defence in the path of a concentrated mobile offensive; and partly a failure of ordnance itself. Hence, the British learned that they needed more and heavier firepower, and that against a mobile enemy a mobile gun would have outstanding advantages.

### Massing artillery

The British Army of 1939 was in no position to generate the firepower required for successful static defence. In September 1939 no new 25pdr or field gun anti-tank ammunition had been issued; the 2pdr was in short supply; and medium artillery was provided in the main by the old and short-ranged 6-inch howitzer, whose replacement had yet to start production. A lesson of the First World War, that standardized equipment was essential for battlefield efficiency, had been ignored and divisions had been issued with a pot-pourri of equipment<sup>(5)</sup>. In the German victories of 1940 the BEF lost 60% of the Royal Artillery's world-wide ordnance, including nearly all the modern equipment; but it also lost much which was obsolete, and this stimulated a re-equipment programme which was to produce the mass of artillery that proved decisive after 1942.

In the French campaign, the Germans seldom concentrated their artillery or achieved better results than the British. Their decisive advantage in fire support lay in other sources of firepower: the infantry mortar and airpower<sup>(6)</sup>.

The BEF recognized at an early stage that it would lack the mass to deal with its opponent, and so attempted to optimize techniques of command and control. During the months before the German offensive it went to great lengths to exercise these in the hope of creating greater firepower through fire mobility<sup>(7)</sup>. Trials were

anti-tank gun ineffective. Demands were made for the introduction of the 6pdr anti-tank gun at corps level with an SP anti-tank battery at division.

<sup>(5)</sup> Many Territorial Army regiments were unfit for active service, being armed with only the 18pdr or 4.5-inch howitzer. These shortcomings were fortunately not immediately exposed, since the Germans delayed their offensive and the BEF was able to reorganize and make limited reinforcements to its artillery.

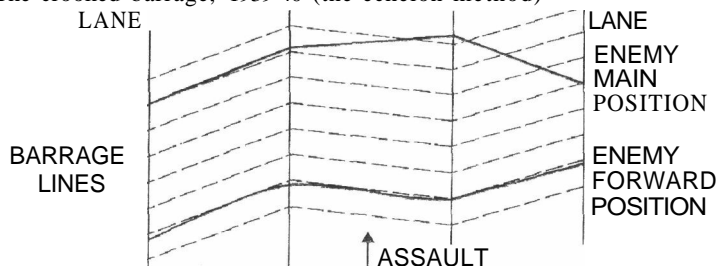
<sup>(6)</sup> The British were so impressed by the effectiveness of the German mortar that they recommended the issue of 3-inch mortars to battalions be increased from two to six. Pre-war British doctrine acknowledged the role of close air support in mobile war, but few practical measures were taken to provide it. The comparative results were not surprising. The RAF lost 40 of its 71 'Battles' in a desperate attack on German crossings of the Meuse on 14 May 1940. In contrast, the Germans could concentrate 1,000 fighters and 1,700 bombers in support of their army, all under universal radio control and available at 25 minutes' notice.

The impact of this powerful arm was demonstrated at Sedan in May 1940 when two French divisional artilleries were routed before German armour had even crossed the river. General Baudet, commanding X Corps defending Sedan, said on the morning of 13 May, "The enemy will not be able to do anything for four to six days, as it will take them that long to bring up heavy artillery and ammunition and to position them" (quoted in Goutard (1958), p. 132), even though at that time 400 tanks were on the far side of the river, and assaulted that afternoon with the support of shock air attack and smaller amounts of field artillery. This operation also demonstrated German ability to conduct combined-arms operations, with both air and artillery support tabulated jointly on a common fireplan.

<sup>(7)</sup> The speed of a barrage in 1940 was still set at 100 metres in three minutes for infantry and 100 metres

undertaken in 1939-40 using an air OP to fire regimental concentrations on to previously unlocated targets; but in May 1940 such experiments came to nothing in the face of overwhelming German air superiority. Radio was potentially the

Fig. 5a The crooked barrage, 1939-40 (the echelon method)



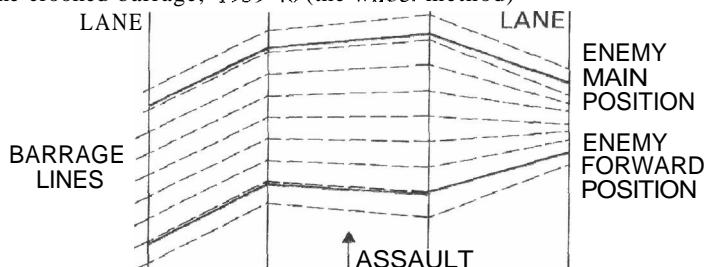
*Characteristics:*

1. Lines of fire are parallel to the enemy's forward position.
2. The pace of assaulting troops is not disrupted.
3. Artillery computation is simple.

*Disadvantages:*

1. Fire does not fall on the main enemy position simultaneously.
2. The main enemy position is not assaulted simultaneously.

Fig. 5b The crooked barrage, 1939-40 (the wheel method)



*Characteristics:*

1. Lines of fire are not parallel, but change to match the shape of successive enemy defensive positions.
2. Enemy positions are hit and then assaulted simultaneously.

*Disadvantages:*

1. The correction for fire of units in a given lane is different for each lane.
2. The assaulting troops have to vary their pace to maintain a constant distance behind the barrage.

in one minute for tanks. As in the First World War, the starting point for calculations was the creation of a given density of fire. A 25pdr could not put down an adequate number of shells in less than two minutes, so for the support of advancing tanks artillery was directed to lift every 200 metres.

The infantry was expected to keep 150 metres from a 25pdr barrage, rather further than in the First World War. In addition, the infantry was no longer expected to deploy at the convenience of artillery, and there were few occasions when hostilities conformed to the straight lines of 1914-18. As a result artillery was asked to provide 'Crooked Barrages'. Two methods were devised to provide these. The first was 'The Wheel', which required all the infantry units to arrive on their objective simultaneously by increasing the speed of those with furthest to travel. The second was 'The Echelon', which maintained parallel barrage lines and rates of advance, but which resulted in units arriving on their objectives at different times; see Figures 5a and 5b, and note (1a) above.

Such complications made fireplanning a laboriously slow process. In 1940 it was still estimated that it would take three hours to prepare data for a regimental barrage, 10 to 12 hours for a divisional barrage, and 24 hours for a corps barrage: Supplement No.2 (1940) to Artillery Training Volume II (1934).



greatest contributor to fire-mobility, but shortages during the first 8 months of war led to severe restrictions on their use<sup>(8)</sup>. Sets proved unreliable and were frequently discarded, breaking the link between guns and supported arms. As a result guns were often reduced to firing on the closest DF task.

The training for predicted fire and barrages proved largely a waste of time. When the German offensive came, artillery resources were stretched so far that there was no British artillery C2 above regimental level, and counter-attacks were on a relatively small scale. During the withdrawal, co-ordination was often lost altogether, as single guns sought to defend themselves and gunners often acted as infantry. Attempts to fight the deep battle were doomed, since the locating organization had no radio, heavier British pieces lacked mobility and range, and the enemy had air superiority.

The BEF of 1940 lost its offensive capability. It was unable on the one hand to practise mobile armoured warfare, and on the other to generate sufficient firepower to succeed in static defence; and like other armies it had not yet found a way of combining the two with improved equipment and fire-mobility. On the credit side, important lessons were learned. The necessity for heavier artillery equipment was recognized, the technical failure of radios was remedied, and fire-planning was simplified; but most importantly the confusion over the role of artillery in close support was ended, with enemy tanks and mortars clearly identified as the prime targets.

## 2. North Africa 1940-43

Errors and misconceptions in pre-war doctrine were identified in the light of experience in North Africa, where the British Army was transformed into an effective force practising traditional artillery principles. This transformation was delayed because of startling early victories over the Italians in 1940; and false lessons were later learned against the Germans, where expediency and the unorthodox seemed sometimes the only answer to German tactical skill and overwhelming firepower.

### Mobility

In France there had generally been a continuous defensive line. In North Africa there were localized bases and defensive lines and campaigns of movement in a vast terrain with the southern flank always open. The British Army facing the Italians was outnumbered and possessed very little artillery<sup>(9)</sup>. The only hope of achieving success lay in speed of movement against an enemy apparently content to sit in static defence positions.

In September 1940 there emerged the concept of the 'Mobile Division' operating out of the fortified base at Mersa Matruh. This force became known as

<sup>(8)</sup> Royal Artillery Training Memorandum (War), No.2 (July 1940).

<sup>(9)</sup> The medium artillery of 4th Indian Division, for example, consisted of steel-tyred 60pdrs and 6-inch howitzers with no second or third line transport, which restricted their movement to a radius of 25 miles from a railhead.

the 7th Armoured Division, and it eventually contained two regiments of Royal Horse Artillery and a regiment of anti-tank guns. It conformed in many ways to the German concept of a combined arms unit, and like the Wehrmacht it was to practise highly mobile warfare to compensate for numerical inferiority <sup>(10)</sup>. Artillery played only a small supporting role in this concept, and the tactics chosen were a means of compensating for a lack of firepower.

When the British attacked Bardia and Tobruk on 19 January 1941, Matilda tanks were available, and more infantry was required. These in turn needed more artillery support. It took 16 days to bring up the 300 rounds per gun allotted for the attack, and consequently surprise was lost. As in the First World War, the demand for ammunition was to grow with each successive battle, along with a tendency to slow the pace of operations.

The problem was how to maintain speed and surprise without sacrificing firepower. Some still held to the pre-war idea that the tank could operate alone providing its own firepower, but such views were contrary to the experience of the Armoured Division in January-February 1941. Middle East Training Pamphlet No. 10 claimed that "the fear that the presence of artillery units would cramp the style of the AFVs is groundless. The two are complementary". Armour came to expect mobile artillery support, and it was soon realized that this could be properly provided only if the FOO was mounted in a tank rather than a Bren gun carrier <sup>(11)</sup>.

Highly mobile tactics had proved effective in attack against superior forces. After April 1941 the British Army was thrown on to the defensive against a background of ominous defeats, withdrawing to the Egyptian frontier in the face of Rommel's rapid advance. After the heavy loss of equipment in Greece and Crete, and with resources tied up in Tobruk, there seemed little prospect of winning a war of materiel. The British Army therefore continued to practise mobile tactics, but now in defence.

The basic unit for such tactics was the 'Jock Column', consisting of one squadron of tanks, six 25pdrs, a troop of 2pdrs, one company of motor infantry and some air defence pieces. These had a degree of success, but conducted no more than harrying tactics, suffering heavy casualties themselves. With experience the field guns came to be recognized as the most valuable component of the 'Jock Column', and in effect the other arms accompanied them in a supporting role. Their mobility was an advantageous means of deploying artillery firepower to compensate for lack of mass; but these decentralized, piecemeal tactics had little prospect of inflicting a major reverse on the enemy.

By summer 1941 artillery had proved that its fire was essential to successful armoured operations, and that in certain circumstances it could match the mobility of armour, and with the support of other arms undertake major tactical responsibilities itself.

The mainstay of British artillery at that time was the 25pdr, an admirable gun,

<sup>(10)</sup> This style of operation proved remarkably successful in Cyrenaica in September 1940 and at Sidi Barrani from 9-11 December 1940, where speed, secrecy, simplicity and careful planning proved decisive.

<sup>(11)</sup> The desirability of FOOs' being equipped with tanks was described 30 years later in Fandale (1975).

but not designed for such tasks. The German 8.8cm gun was able to defeat British tanks while itself remaining out of range, and the German MK IV tank enjoyed a similar advantage in range over the British 2pdr. The solution was to increase the range of British equipment, so reducing its vulnerability, and to increase the weight of anti-tank firepower. The SP 25pdr combined these advantages<sup>(12)</sup>. The Germans already had an SP 150mm assault gun, which was in effect a howitzer mounted on a light tank, when the British introduced their 25pdr SP 'Bishop' in October 1941, sixteen years after the pioneering Birch gun<sup>(13)</sup>.

In September 1941, the 2pdr was given self-propulsion by wheeled 'Portee' on a truck, but without armour. It was intended for use in hastily deployed anti-tank defensive screens, but it proved too vulnerable and was taken out of service in December 1942. The 25pdr was given SP mobility to compensate for poor target acquisition and accuracy at long range, but the 2pdr 'Portee' was introduced to compensate for lack of numbers, inadequate range and firepower against its quarry the tank.

Training pamphlets in 1941 still advocated the siting of single guns in depth with mutual support, but there were so few 2pdrs available that they were often deployed in groups of four or six, leaving uncovered gaps between groups. In fluid operations the 2pdr 'Portee' was frequently used as a tank, contrary to accepted teaching, which emphasized concealment, depth and use of ground at the expense of movement, which was liable to disclose its position. Static defence in France failed through lack of mass, while in North Africa the attempt to balance a similar situation with mobility failed through vulnerability to superior firepower.

German anti-tank guns with their superior firepower were not called upon to imitate armoured tactics like the British. They relied on the mobility of their own armour to lure British tanks on to their positions. These were generally laid with maximum concealment and protection, as the British themselves preferred.

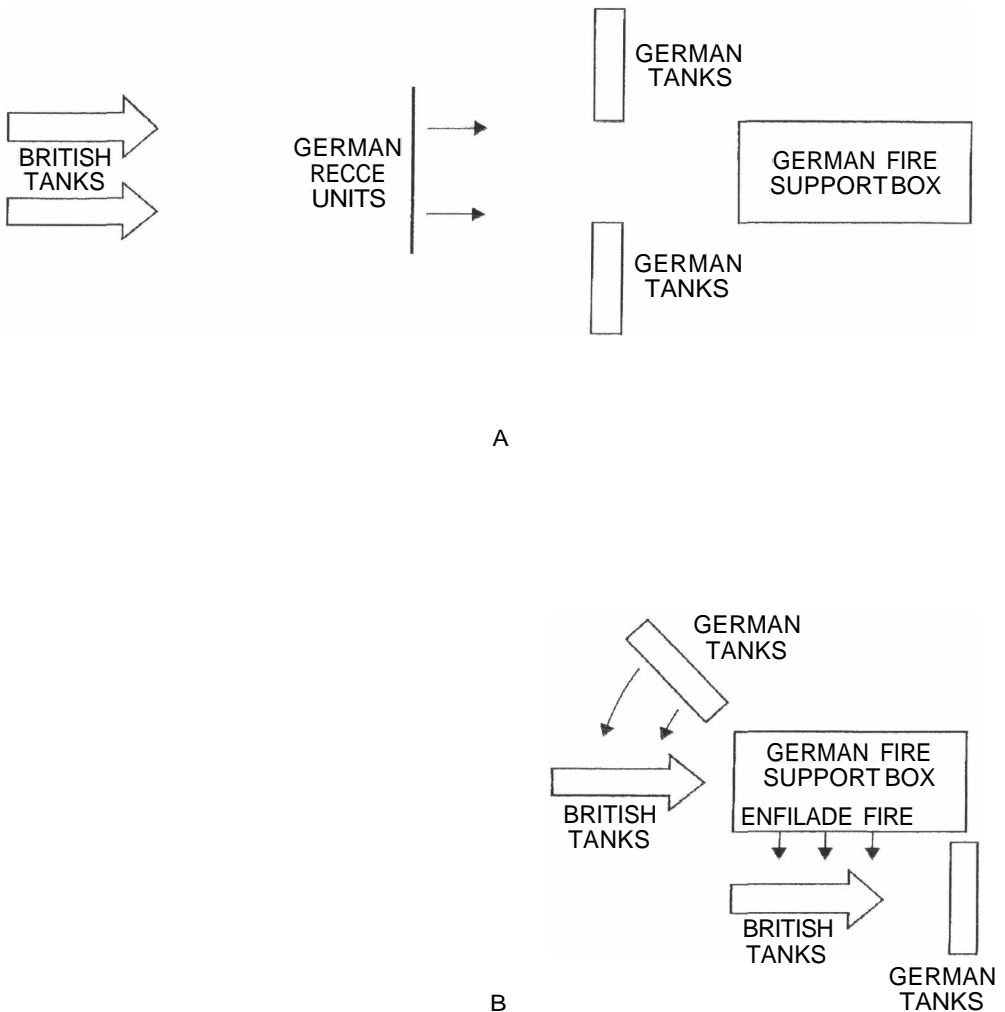
An effective solution to the problem of providing artillery support in defence of a mobile armoured formation was demonstrated in November 1941 by 1 South African Brigade with a device known as the 'Moving Box', by which armour moved rather as a 19th century infantry square with artillery distributed within it.

The Germans practised a similar technique, but their 'Moving Box' contained much greater firepower, with 5cm and 8.8cm anti-tank guns and field artillery, including some 15cm SPs. German tactics in Libya in 1941-42 were very different from those they had practised in earlier campaigns. In Europe the seizure of ground or deep penetration of an enemy position had great significance, but the price of achieving these objectives was often the separation of fast-moving tanks from slower artillery support. In the desert there was still a place for the rapid strategic blow, but terrain itself held fewer features of tactical significance, and could more readily be surrendered to achieve greater tactical benefits. Armoured mobility gave a commander wider options for accepting combat; and rather than use

<sup>(12)</sup> A contemporary view of British SP developments is given in Hordem (1943) and Hordem (1944).

<sup>(13)</sup> The 'Bishop' was an acknowledgement that artillery support was indispensable in mobile operations, even though the equipment itself was flawed, having too high a profile and limited mobility, which restricted its value in armoured formations.

Fig. 6 German tank and anti-tank tactics in Libya, 1941-42: the defence



armoured mobility to fight on important terrain, perhaps without artillery support, German commanders used that mobility to draw combat on to the source of their less mobile firepower.

German doctrine in the desert acknowledged that the tank was primarily a means of defeating infantry and generally advocated avoidance of other tanks, recognizing artillery as the primary means of the destruction. In the advance tanks led the 'Moving Box', supported by a few field guns (see Figure 6). On contact the Box would take up position for all-round defence, covered by tanks deployed on a wide front. The tanks then withdrew to positions on either side of the Box. As enemy armour attacked those tanks on one side they would be hit in their flank by artillery fire from the Box. Those tanks on the other side of the Box, not yet engaged, would swing round and hit the attackers in their rear<sup>(14)</sup>. In attack tanks would engage the enemy at long range, providing a screen while the guns from the Box deployed. These would then engage the anti-tank defences in preparation for the final assault by the tanks.

Although some British units were proficient at all-arms co-operation on this scale, such skill was rare. British anti-tank guns often took part in battles completely separated from their infantry and armour, and lacked the speed and mobility to take over ground won by armour, often at great cost, after an engagement in which field artillery had played no part.

Where the British did succeed in all-arms co-operation was at low level. In December 1941, faced with a deteriorating situation, they again resorted to the 'Jock Column'<sup>(15)</sup>. These manoeuvred and harassed the enemy for ten days, but on 20-21 January 1942 Rommel attacked with 35,000 men and 100 tanks. Concentrated mass and firepower overwhelmed agile but essentially light-weight columns, which were designed not for defence against armour but to attack soft-skin targets in the enemy's rear.

British disenchantment with mobility was complete, and so instead of trying to muster resources at critical points through manoeuvre, static concentrations of force were created, such as the defended localities on the Gazala Line and at Tobruk, with the intention that armour should move between them<sup>(16)</sup>. Unfortunately these positions, known as 'Tobruk Boxes', were often widely spaced, lacked mutual support, and the armour which might have bound them together was often split into small packets and poorly co-ordinated<sup>(17)</sup>.

A number of incidents occurred as a result, which were to give static defence

<sup>14</sup> Pemberton (1950), p. 110.

<sup>15</sup> 1st Support Group and 201 Guards Brigade put together 8 columns, each based on a 25pdr battery and each tasked to cover 25 miles of front.

<sup>16</sup> The success of this form of defence had been demonstrated on 14 April 1941 at 'R33' at Tobruk, where carefully co-ordinated artillery fire separated German infantry from armour and the Australian defence held: Smith (1983). This form of defence was an expedient soon to be adopted by the Germans themselves, for similar reasons if on a greater scale, on the Eastern front.

<sup>17</sup> On 20 June strong positions at Tobruk fell, not because artillery was poorly deployed but because the garrison, having been deployed forward, was unable to conduct a well co-ordinated defence on its hasty return to deteriorated positions. To compound matters, the great benefits of concealment and protection which accrue to static defence, and which should have given a significant advantage to guns occupying

a bad name; but in many cases where careful preparation had been made the decision to abandon mobile operations was vindicated. For example, 'Knights-bridge' was well sited, every vehicle was dug in below ground level, and wire and mines were in good supply. The position never fell to an attack, and was abandoned only as part of a general withdrawal.

British setbacks were frequently the consequence of a failure to co-ordinate artillery and armour. Artillery in a Box without armoured support was vulnerable, and there were frequent examples of armour failing through lack of artillery support. The first serious British attempt at fireplanning was made at 'The Cauldron' on 5 June 1942, but was mis-targetted. 22 Armoured Brigade advanced unsupported and was repulsed, as it had been in a similar attack on the Italian Ariete Division the previous year <sup>(18)</sup>.

When Tobruk was lost, 'digging' and static defence were widely criticized, but there was no return to high mobility as a substitute for protection. As industrial production expanded, the British Army was able to rely more on mass, which it combined with protection in defence.

The British reverted to the tactics of the First World War based on static defence and infantry assault supported, in case of need, by massive artillery firepower. This combination, not the tank, was responsible for almost every major British success until 1945.

The new tactics were put to the test at Alam El Haifa between 30 August and 6 September, when British positions were well prepared for defence, dominating enemy approaches; and pre-planned fire was supplemented by aircraft enjoying air superiority. The position was assaulted by an enemy force committed to armoured mobility but lacking adequate fire support. Formerly the Germans had used armoured mobility to bring the British on to their guns, but with the British renouncing manoeuvre, the Germans threw themselves on to the British guns and suffered accordingly. It was a triumph of mass and firepower over mobility.

The war would not be won by occupying defensive positions, and the British had to find a way of adapting their successful defensive tactics to the attack. The first problem was how to launch an attack from static defences to break through German positions. The chosen method was copied from the First World War, a massive artillery bombardment and barrage, breaking the deadlock and regaining mobility for the infantry and armour. This was demonstrated at El Hamma on 26 March 1943, when armour advanced successfully behind a barrage, challenging

these positions, were sometimes lacking because of poor choice or availability of ground. For example, on 6 June 1942 the Germans attacked British guns. These had not been dug in and lacked armoured support; 64 field guns and 100 anti-tank guns were destroyed or captured. On 1 July a Box at Deir El Shein fell, largely because it had been impossible to dig in on the rocky ground, and the guns had been left exposed to superior enemy firepower.

Such experiences attracted criticism of static tactics from those still supporting mobile operations; but such criticism was substantially unfounded. The fall of Deir El Shein was not as catastrophic as it might have been. Artillery fire from other positions was able to cover the gap in defences, and counter-attacks on 10-27 July stabilized the position.

<sup>(18)</sup> Bidwell (1967a).

the pre-war view of the Armoured School that armour did not need artillery <sup>(19)</sup>.

Once a breakthrough had been achieved and a role for armour restored, the problem of providing mobile artillery in close support arose again. From static positions it was possible to organize thorough defensive fire plans based on good target information. In a rapid advance this was not possible, and the British were conscious of the threat posed by German anti-tank artillery. The threat was analogous to that posed in the First World War by the concealed machine gun sited in depth. The solution then had been to push artillery forward with leading units. In September 1942 three types of weapon were considered for a comparable task: the SP field gun, the light SP infantry gun, and the 'Portee' field gun. The SP field gun was selected, even though its use appeared to challenge the prevailing orthodoxy of concentrating firepower. At the same time, however, other arms were developing their own firepower. The new Grant and Sherman tanks could provide greater firepower than other tanks in British service, the latter having a 75mm gun with a range of 8,000 metres and an indirect fire capability. Meanwhile the infantry's three-inch mortar became available in greater numbers <sup>(20)</sup>.

These improvements in the autonomous fire of supported arms were beneficial to field artillery. They made it possible for the SP 'Priest', and the new SP 6pdr 'Deacon', to operate as the Gunners would wish, and not to be mis-used as 'infantry guns' or makeshift tanks <sup>(21)</sup>. Even if enemy anti-tank screens could eventually be destroyed, they often imposed serious delay. By keeping well up with armour, SP field artillery was able to provide a smoke screen at short notice. This tactic proved so effective in shielding armour that one-third of artillery ammunition carried by 23rd Armoured Brigade was smoke-filled.

The working relationship between tanks and SP artillery was so close that the SPs became more the property of the armoured brigade which they supported than of the CRA of the division. This decentralization was essential in fast-moving operations; but would have entailed severe penalties had improvements not been made in C2, whereby all field artillery could be concentrated on demand by radio <sup>(22)</sup>.

By 1943 so much artillery was SP that it became necessary to distinguish more clearly between the roles of tanks and artillery. The US, like the Germans, favoured the use of SPs as independent tank hunters, taking on what had formerly been tasks for tanks <sup>(23)</sup>. They proved their value in battles such as El Guettar on

<sup>(19)</sup> But the lesson was slow to be learned, and as late as April 1943 two armoured brigades attacked an anti-tank screen in Tunisia while six regiments of artillery stood by idly: *ibid*.

<sup>(20)</sup> This weapon could deliver 200lb of projectile in one minute, against just 125lb from the 25pdr. Over a short period six 3-inch mortars could therefore deliver heavier fire than an 8-gun field battery.

<sup>(21)</sup> 'Deacon' arrived at the end of 1942 and was held as an anti-tank reserve force to be deployed in support of Shermans against German anti-tank screens. In time 'Deacon' was replaced by the US 3-inch SP M10, which was easier to conceal and less vulnerable in forward areas.

<sup>(22)</sup> The Soviets solved this problem by holding large masses of artillery at all levels, and despite highly centralized C2 achieved relatively little fire-mobility through radio.

<sup>(23)</sup> Thorner (1943). For a full description of the US Army's tank destroyer concept see Gabel (1985). The concept called for these weapons to operate as a separate arm. It failed because it was designed to counter offensives by enemy armour, rather than to conduct offensive operations itself. It assumed that the enemy operated tanks unsupported by other arms, when in fact German success relied on combined

23 March 1943, against the German 10th Panzer Division<sup>(24)</sup>. The British preferred to use them against tanks at long range or against strong points.

In the advance to Tunisia the British were occasionally guilty of using armour without proper artillery support, and paid a predictable price. The lesson was much harder for the Germans to learn, as they had been used to two years of warfare in which they could move about the battlefield with relative impunity, given the inferiority of British firepower. After Medenine on 6 March 1943, when attacking armour was decisively beaten by guns in defence, the mistake was seldom repeated.

In 1940 the British defeated superior Italian forces with highly mobile tactics. In 1941 the Germans used the mobility of their armour with great skill to optimize their advantage in firepower. In desperation the British responded by adopting highly mobile operations with small combined arms units, but these failed. In a complete reversal of tactics the British abandoned mobility and opted for static defence, with scattered concentrations of firepower.; but these were often also unsuccessful, largely because of poor all-arms co-ordination. By the summer of 1942 the British had settled for tactics based on their successes of the First World War. These sought to achieve a decisive result, not through armoured mobility, but by maximizing the effect of firepower in defence of prepared positions. The decisive offensive which followed was initiated by an infantry assault supported by heavy artillery fire, which enabled tanks to break out and exploit the mobility won for them. This plan owed more to the doctrine of 1917-18 than to that of 1930-39. Once armour had broken out in pursuit of the enemy, the need for mobile artillery in close support, predicted in the 1920s, was realized, and the self-propulsion pioneered at that time and then rejected was re-introduced. The lessons were that armoured mobility was best employed as a means of enhancing the firepower of artillery, that tanks were highly vulnerable in mobile operations without artillery's close support, and that the arm to which they were most vulnerable was artillery.

## Counter-mobility

As pre-war theory had predicted, and experience in France demonstrated, the best means of countering armoured mobility was the artillery anti-tank gun. In Europe, visibility and the choice of reverse slope positions had usually limited engagements to less than 800 metres; but in the desert anti-tank positions were often exposed and vulnerable to fire at 2,000 metres<sup>(25)</sup>. The British had lost 509 2pdrs

arms units and formations, and only 10% of German forces were ever mechanized. Being a quasi-arm, other arms were encouraged to neglect anti-tank operations. The defeat of a combined arms enemy requires a combined arms force. In practice, US commanders seldom used their tank destroyers in discrete units, and despite lack of technical progress between 1942 and 1944, the weapons themselves often fought successfully on the battlefield.

<sup>(24)</sup> Mayberry (1943).

<sup>(25)</sup> The British demonstrated the effectiveness of artillery in anti-tank defence at Sidi Barrani between 13 and 17 September 1940, where two batteries of 3rd Royal Horse Artillery (RHA) halted 50 Italian tanks at 200 metres; but in 1940-41 the Germans increased the thickness of their tank armour, enabling



in France, and since it was estimated that for every 100 6pdrs produced, a factory could turn out 600 2pdrs, they decided to continue the manufacture of the 2pdr at the expense of the 6pdr. The 6pdr project had remained dormant since 1938, and the equipment was not issued until mid 1942. Since almost all the German tanks by 1941 were armed with 5cm or 7.5cm guns, there resulted a yawning gap in British anti-tank capability, which they tried to bridge by mis-using field guns <sup>(26)</sup>.

The Germans on the other hand possessed a large stock of 3.7cm anti-tank guns, and felt no need to produce more at the expense of heavier weapons, such as the long 5cm PAK and 8.8cm FLAK guns, and later the 7.5cm PAK guns. They also had large quantities of captured Soviet 76.2mm field guns, whose performance was similar to that of the 8.8cm in the direct fire role <sup>(27)</sup>. In 1941, therefore, British anti-tank guns were vulnerable to their quarry, and British tanks were soft targets for the majority of German anti-tank pieces. The long-term British response was to produce better and heavier equipment, the 6pdrs and 17pdrs; but in the meantime the 2pdr was made 'Portee' to compensate for lack of range by mobility. The need for all field guns to operate in a primary role as anti-tank guns was realized in spring 1941 at Tobruk. Field guns were carefully sited in conjunction with minefields, and on 1 and 2 May 39 German tanks were destroyed, of which only seven were accounted for by British tanks. A temporary answer had been found to the threat of German armoured mobility. Unfortunately the Germans had a better solution in their 8.8cm guns, which stopped British tanks trying to relieve Tobruk.

Attempts were made to hold off German counter-attacks with indirect fire concentrations, but these were discovered to have been largely ineffective as a means of destroying German tanks, although the latter could be diverted or delayed with great expenditure of ammunition. The British therefore restricted their indirect anti-tank fire to attack against tanks advancing in defiles, or to tanks moving up behind those already being engaged directly. This perceived inadequacy of indirect fire against the greatest threat reinforced the view that field artillery should best be employed in the direct fire role, and militated against a broader vision of how it might be used in combined arms operations.

Artillery achieved primacy on the battlefield in 1941-42 as the only means of countering mobility, a lesson learned on the Eastern front as well as in the West. This was appreciated by the Germans, even though their own tanks often enjoyed superiority over their counterparts in the desert <sup>(28)</sup>.

Guns in the desert ran a great risk of being outflanked, and so positions of all-round defence were favoured. British guns usually deployed in a diamond

the Panzer Mk.III and IV to defeat the British 2pdr at ranges over 1,000 metres with their own 5cm and 7.5cm guns.

<sup>(26)</sup> See Chapter 8: Direct Fire.

<sup>(27)</sup> This gun was originally produced by the Germans in the 1920s, and subsequently copied by the Soviets: see Hogg (1975), pp.205-206.

<sup>(28)</sup> Just as in the First World War the supported arms came to modify their deployment to optimize artillery support, so by 1942 the CRA would lay out the anti-tank defence of a position, and other arms would deploy to defend them. A similar pattern emerged in the USSR, where German 10.5cm field guns became the foundations of defence.

formation, by troops, with 800 metres between troops, and with 2pdrs on the flanks. Some field guns would fire smoke at 300-1,000 metres, masking the position from attacking tanks until they had advanced through the screen and into effectiveness range of the defences.

The CRA of 4th Indian Division defending Sidi Omar against a German counter-attack said: "The primary object of these operations is to destroy enemy armoured fighting vehicles. It is our object to lure enemy tanks within decisive range and then to destroy them, not to engage them at extreme range and deflect them away from our defence" <sup>(29)</sup>. The British had learned from the Germans that the tank could best be beaten by firepower, not by badly co-ordinated armoured manoeuvre.

At times this lesson was not obvious, and practice fell short of principle. On 12 December 1941, 31 Field Regiment was completely over-run and destroyed by 40 enemy tanks supported by their own artillery. The true lesson from this encounter was the need for co-operation between arms, and for a purpose-built anti-tank gun to relieve the 25pdr, whose real task was arguably the suppression of enemy anti-tank guns impeding the mobility of friendly tanks.

Theory was thwarted by lack of resources, which led to the widespread adoption in February 1942 of 'Tobruk Boxes', but even these were often inadequately armed, and it was hard to ensure mutual support. Experience in the desert in 1940-42 demanded more and heavier equipment, which would allow sound tactics and a coherent strategy to replace expediency.

In August 1940 the Director of Army Fighting Vehicles had asked for an SP anti-tank gun for offensive operations. In September 1941 General Staff policy directed that this equipment be used to exploit mobility in defensive operations, but the project was temporarily abandoned. However, by mid-1942 the 6pdr had begun to enter service, and progress was well under way with the 17pdr, whose design had been initiated in April 1941, and which started to arrive in January 1943. Infantry firepower was also enhanced by the 4.2-inch mortar, which was widely used at El Alamein to thicken up artillery fire. Although manned by infantry, mortar control was very similar to that of artillery, and to ensure their efficient use, some Divisions made the CRA responsible for training.

The arrival of the fresh equipment changed British anti-tank tactics. In attack, field guns could be used to suppress anti-tank defences in support of tank assaults, and anti-tank guns to protect their flanks and consolidate positions on the objective. In defence anti-tank guns had often been used to guard the flanks of field guns in direct fire positions, and the latter could now be used according to the pre-war concept by deploying in depth behind the new equipment.

The tactics were put into practice at the battle of Alam el Haifa on 30 August-6 September 1942, where German armour was halted as it tried to assault prepared anti-tank defences; and at the battle of El Alamein on 26 October, when, for example, German counter-attacks were broken up by field artillery released from

<sup>(29)</sup>Pemberton (1950), p.105. In the battle that followed German tanks advanced firing from 2,000 metres at a field regiment which held its fire until its target was just 800 metres away.

the direct fire role<sup>(30)</sup>. The contrasting but complementary virtue of indirect fire was confirmed at El Alamein, where 50% of German anti-tank guns were destroyed by indirect fire.

At the end of 1942 the Germans still had the best anti-tank guns, ammunition and sights, but they could no longer employ them as effectively as they had at the First Battle of El Alamein on 22 July 1942, when 23rd Armoured Brigade lost 116 out of 140 tanks in an unsupported charge of a German gun line. The British became less prone to such mistakes, and their positions acquired the firepower to repel German armour, which itself lacked the fire support to suppress anti-tank defences.

In 1943 Brigadier H.W. Wynter asserted that the tank/anti-tank battle had swung 6:4 in favour of the defence<sup>(31)</sup>, a view that surprised Fuller, even though it was he who had claimed that armour and shock weapons would be overcome by advances in defensive weapons<sup>(32)</sup>.

From a British point of view the arrival of the 17pdr was an important factor in the technological race between gun and tank. One hundred of the weapons were hurriedly despatched to meet the threat of the German MK VI Tiger tank; but in combat it was found that even the 6pdr could penetrate the Tiger's 80mm flank armour at a range of 500-900 metres.

The supremacy of the anti-tank gun was proved at Robaa in January and at Sidi Nsir in February 1943; and in April and May of that year it was found that the 17pdr could knock out Tigers which were standing back at 1,500 metres, expecting to engage British infantry unchallenged; but of all anti-tank engagements in the Desert war the battle of Medenine on 6 March 1943 best illustrated the shift of power in favour of the well-sited anti-tank gun<sup>(33)</sup>.

<sup>(30)</sup> At El Alamein the artillery of two divisions and three medium regiments fired on one map square containing sixty tanks of 21 Panzer Division. They inflicted only slight damage, but forced the tanks to close down, halt and change direction. So, although indirect fire might on occasion prove a useful aid to counter-mobility, that responsibility fell primarily on the anti-tank gun, whose value was demonstrated by 239 Anti-Tank Battery, and the guns of the Rifle Brigade, on the 'Snipe' feature in October 1942: Smith (1983) and Bidwell (1967a).

<sup>(31)</sup> Wynter (1943).

<sup>(32)</sup> The story of the tank versus anti-tank gun is discussed in Appendix 8 to *History of the Second World War: The Mediterranean and Middle East: Volume III* (HMSO, 1960).

<sup>(33)</sup> At Medenine, for the first time, British guns were deployed to give each the best opportunity to knock out enemy armour rather than to protect infantry positions. The infantry was uneasy about this decision, as it had been in different circumstances 40 years earlier, when artillery apparently abandoned it to fire indirectly from the rear. In both cases the supported arm lost the close physical presence of artillery equipment, but reaped far greater benefits as artillery assumed a leading role through the generation of firepower.

At Medenine the Army commander agreed to the deployment of 467 anti-tank guns and over 360 field and medium guns on a corps front. Anti-tank guns held their fire from defiles until targets were just 300-400 metres away. Indirect fire meanwhile was directed on infantry behind the tanks, lest dust obscure the armoured targets. In four major attacks the Germans lost half of all their tanks engaged in the battle. As the CO of 1 RTR would admit, the artillery plan was "the basis of the victory at Medenine": *Proceedings of the Royal Artillery Historical Society* (24 April-20 November 1975), p.77. 21 Panzer Division reported that British artillery had put it out of action, and a member of 10 Panzer Division, which had also served in Russia, reported that artillery fire at Medenine was "beyond all its previous experience": *ibid*, p.87.

In a theatre so ideally suited to the mobile operations of the tank, the counter-mobility of the anti-tank gun proved the greater. The only means of restoring mobility for offensive operations lay in the firepower of indirect artillery, in close support and counter battery fire, and in the establishment of air superiority.

### Massing artillery and C3

*Mass:* From 1940-43 the British strove to make up for their losses of equipment in 1940, and to provide their army with the firepower so neglected in the 1930s, so much so that by mid-1943 artillery was, at 22%, the largest arm of the British Army. The Germans on the other hand struggled to maintain their initial advantage, but at the end of over-extended and vulnerable logistic lines.

In 1940 the British lacked the resources to man a continuous defensive line. Instead, they concentrated in positions of all-round defence based on a nucleus of guns. Italian columns which advanced and deployed slowly in rigid formation were ideal targets for British artillery. British deployment was based on small mixed detachments decentralized from divisional control, and enjoyed none of the advantages accruing to massed artillery and fire mobility, yet was effective<sup>(34)</sup>.

In the reverses that followed in 1941 and 1942 the British seldom managed to concentrate artillery firepower, partly because of the short range of the 6-inch and 155mm howitzers, but mainly because of their limited numbers. By May 1942, however, the 4.5- and 5.5-inch pieces began to arrive and concentration became possible<sup>(35)</sup>. The arrival of new medium artillery coincided with the release of the 25pdr for indirect fire tasks. The separation of field and anti-tank branches of artillery permitted the orthodox use of field artillery developed in the First World War<sup>(36)</sup>, and it was on this that the actions of autumn 1942 were based<sup>(37)</sup>.

The battle of El Alamein resembled a First World War action in many ways,

<sup>(34)</sup> The British made similar economic use of scant resources at Sidi Barrani on 9-11 December, where they deployed 122 guns, a number which does not bear comparison with even minor engagements in the First World War, but significantly these weapons were employed on a front of just 1,500 metres, producing a high density of equipment. The fire generated, however, was low, since only 50 rpg were available. Before the First World War, General von Rohne had pointed out the futility of massing equipment if ammunition supplies were inadequate, and although the evidence of that war had supported his view, the British Army now found itself at war, having grossly underestimated future ammunition requirements. The misjudgement was readily acknowledged, but industry took time to meet the requirements of war. An early indication of the logistic effort that would be needed was seen at the battle of Keren, where from 15 to 27 March 1941, 110,000 shells were delivered by 1,000 trucks after a journey by rail of 150 miles. In that battle there was no possibility of achieving surprise, which helps to explain the need for 500 rpg, ten times that of Sidi Barrani.

<sup>(35)</sup> The first significant occasion came on 5 June 1942, when the British counter-attacked supported by 64 field and 100 anti-tank guns; but in the fighting which followed artillery and armour became separated; and on 6 June in a catastrophic loss the entire artillery position, on exposed ground without field defences, was overrun, and armour which had been withdrawn earlier was unable to intervene.

<sup>(36)</sup> See "Open sights or mumbo-jumbo" *Military Review* Vol.23 No.3 (June 1943) pp.66-67.

<sup>(37)</sup> At Alam El Haifa between 30 August and 6 September, the British massed the greatest firepower to date in the Desert War, with 250 field guns and 300 anti-tank guns, reinforced by 400 tanks, which had been dug-in. The battle proved a triumph of concentrated firepower over mobile armour without adequate fire support.

with an assault on trenches by infantry supported by artillery. The more infantry that were involved, the greater the need to suppress defences with artillery fire. This was provided by 1,000 field and medium guns at the principal point of attack. There were no restrictions on ammunition at El Alamein, and in 12 days the British 25pdrs fired over one million rounds, although this consumption was small by the standards of the First World War. On the other hand, this fire was relatively more effective, since air reconnaissance enabled it to be targetted more precisely, avoiding wasteful area saturation. The Germans could reply with only 250 guns, and these were severely mauled in a burst of accurate CB fire in the 15 minutes before zero hour. As a result, the British were able to achieve an artillery superiority of between ten and twenty to one at critical points. General von Thoma was to attribute his defeat to this destruction of his anti-tank guns by indirect artillery fire. In the largest tank clash of the battle, on 2 November, German tanks sustained intolerable losses in an attack on massed artillery and armour positions<sup>(38)</sup>. In 1940-41 some commanders had sought to avoid tactics reliant on massed firepower, which had created such carnage in the First World War; but by 1942 it became clear, as it had in 1918, that for the side which could establish fire superiority, artillery saved lives.

Close air support provided an important supplement to artillery firepower. In 1941 air support had been limited, and Middle East Training Pamphlet No. 10 noted that the British did not have "that dovetailing of inter-tactical activity to which the Germans and Italians have accustomed us". In March 1941 the Germans and Italians were able to deploy 400 aircraft, while the British could put only 14 into the air per day. By 7 April of that year the British 2nd Armoured Division had been virtually destroyed by these aircraft acting in concert with Rommel's rapidly-moving ground forces<sup>(39)</sup>.

A British directive of September 1941 noted that bombing was less accurate than artillery, lasted a shorter time, and was not available in poor weather; but by November 1941 the British had acquired more air support assets to compensate for their weakness in artillery. Techniques soon improved, so that whereas in 1941 it had taken 3 hours to summon air support, by summer 1942 over 'Knightsbridge' this had been reduced to just 35 minutes. The new tank-busting Hurricane out-classed the German Stuka and could engage targets with an accuracy and depth beyond that of artillery. But artillery co-operation was essential for air support operations. In static periods, letters were often laid out on the ground for use as recognition points, and in mobile operations artillery would fire smoke to indicate the target area, allowing aircraft to engage individual targets with greater accuracy. Bombing might have disadvantages, but, with medium and heavy artillery in short supply, 250lb bombs were a welcome addition to firepower. The

<sup>(38)</sup> The British actually lost more tanks than the Germans, but British strength continued to grow and German losses could not be replaced. For example, in the assault on the Mareth Line in March 1943, densities were just one gun per 100 metres, but a concentration greatly superior to that which the Germans could muster; and on 12 May 1943 in the final engagements in North Africa observers could call on the fire of 650 guns and 2,000 aircraft against just 250 German pieces.

<sup>(39)</sup> As it had been in France, German air-to-ground liaison was excellent, and proved particularly useful in Greece in April 1941, given the difficulty of providing artillery support in mountainous country.

role of close air support expanded as German air power waned. Aircraft played an important part in the deep battle, flying CB missions at El Alamein and breaking up counter-attacks as they assembled <sup>(40)</sup>.

Air support in the desert compensated for inadequate medium and heavy artillery, eventually fulfilling the role prescribed for it by the theorists of the 1930s, and acquiring in the process the skills which had earlier been neglected. Aircraft had the advantage of range and accuracy over unobserved artillery fire; but, as was noted by the British in 1941, in many respects it was less reliable and effective. Its success depended upon air superiority and close integration with artillery fireplanning. As these developed, air power took on a greater role, particularly in the deep battle, at which it excelled, enabling artillery to concentrate on the close battle, and so reversed the trend that had developed in the First World War for artillery to strike deeper.

*Command, control and communication:* Firepower could be maximized through sheer mass alone, as favoured by the Soviets, or by multiplying the effect of lesser resources through fire-mobility, made possible by more sophisticated C3. In 1940 there was no British survey unit in the Middle East, and hence no possibility of firing large concerted fireplans; but at Bardia and Tobruk survey data was available, and at Keren meteorological data was provided. In the context of the mobile decentralized operations usually adopted against the Italians, technical data mattered little. The emphasis was instead on developing speed of response rather than fire-mobility.

The 'Quick Barrage' was developed in the UK in 1941, based on a standard layout around a point or points, halving the time needed to produce battery gun programmes and reducing to just 10 minutes the procedure for producing a quick smoke screen with the 25pdr. These measures had great tactical advantages, but at the expense of accuracy; and the distance set between friendly infantry and a 'Quick Barrage' was increased to 500 metres.

By early 1942 'Quick Fire Plans' had become the key to success in mobile desert operations, and new drills emerged to maintain the vital link between FOO and the guns. These depended on close communications between FOO, supported arm and the guns, and were achieved by using armoured OPs with radio <sup>(41)</sup>.

<sup>(40)</sup>In the advance to Tripoli in November 1942, British aircraft often operated from airfields forward of the main body of ground troops, termed 'tentacles', in an equivalent role to close support artillery. The shortage of long-range British artillery was again compensated for during the attack on the Mareth Line, when 16 Kittyhawk and 5 Spitfire squadrons were available, controlled for the first time by an airborne command post and ground OPs, with RAF liaison officers equipped with HF radio. Concentrated firepower was as advantageous when provided by aircraft as by artillery. On 6 May 1943 the breakthrough to the Tunisian Plain was assisted by an unprecedented 2,000 British air sorties on a front of just 3,000 metres; and on 12 May massed aircraft attacked targets just 1,500 metres from friendly troops with target boundaries marked by a 2,000-metre line of artillery smoke.

<sup>(41)</sup> By October 1941 battery commanders controlled their OPs by radio and all armoured OPs had a No.18 set on the infantry net to battalion or company headquarters. A troop of guns would keep its FOO informed by radio of the bearing on which it was moving. The FOO would move on the same bearing

Meteorological data were unreliable in the desert, and correcting from fire on a fixed datum point was impossible when datum points did not exist<sup>(42)</sup>. Accuracy could be guaranteed only by observed and corrected fire. Where it was not, for instance at Sidi Omar on 22 November 1941, the penalty could be severe.

By the spring of 1942 progress was being made to centralize and speed up fire control, thanks largely to the teaching of the Middle East School of Artillery. The reorganization of April gave the divisional CRA and each brigade its own artillery. This was a reaction against the dissipation of resources exemplified by the 'Jock Column'. In practice, however, centralization was still not achieved as artillery continued to fight at brigade, not divisional, level. Auchinleck managed to achieve concentrations of fire by up to 200 guns at the First Battle of El Alamein; but it was not until later in 1942 that artillery fire plans were satisfactorily integrated with the concept of operations.

Montgomery knew well the importance of concentrated artillery fire. In October 1940, following British experience in France, he wrote: "The concentration of artillery and mortars is a battle-winning factor of the first importance... so long as communications will allow of centralized control of the artillery, a division on a reasonable front has little to fear from enemy frontal attacks. In mobile operations it will be necessary to decentralize artillery control so as to ensure close co-operation and quick action. In general it can be said that artillery control should be centralized in the highest command who is able effectively to exercise that control. No more artillery should be deployed in action than is suitable for the amount of ammunition available". In short, artillery could beat an armoured attack if C2 were centralized and logistics allowed<sup>(43)</sup>. Montgomery consequently accorded artillery the major role in his plans for autumn 1942. He directed that the divisional CRAs have centralized command of their divisional artillery, which was to be used as a 72-gun battery; and the establishment of corps artillery communications at the same time made corps fire plans possible.

Improvements in accuracy were important to the success of such plans. At El Alamein target intelligence was good; and thanks to improved photography and printing, air photographs were available to intelligence staff within five hours of an aircraft's landing. Registration was restricted to one gun per regiment, but all guns were calibrated, in the case of medium guns every third day; frequent meteorological corrections were issued, and all guns were on a common communications grid. Timings were synchronized by using the BBC radio time signal, and specification of Time on Target (TOT) became standard when calling for fire<sup>(44)</sup>.

at a constant distance from the guns, and on identifying a target send them an opening bearing and range. This technique could produce a round in the air in two minutes.

<sup>(42)</sup> The Germans overcame the problem by using cross-observation of an airburst round which could be observed from cover. The British tried to adopt this technique in February 1941, but it required a special time fuze, which was not supplied until later in the year.

<sup>(43)</sup> Wilks (1978).

<sup>(44)</sup> The confidence enjoyed in these techniques was demonstrated on 28-29 October, when the Australian 9th Division assaulted, supported by a series of timed concentrations, fired by guns on a line at right angles to the arcs of advance, and at one time in the face of an attack.

The inflexibility of centralized fire planning evident in the First World War had been overcome by radio communication between FOO and gun. Barrages could be modified by a FOO up to brigade level, which taken to extremes gave each FOO the power to call on the firepower of the whole brigade, and not long after that the division and corps <sup>(45)</sup>.

The fast-moving operations that characterized the advances of November 1942 required quick actions and small rapid fireplans; but the organization and experience so recently acquired was not neglected. Montgomery's chosen set-piece encounter at Medenine was founded on centralized artillery C2 which linked all sub-units by cable and radio. XXX Corps artillery was controlled by a Commander Corps Royal Artillery (CCRA), who delegated the issuing of fire orders to CRAs. By then, practice had reduced the time for preparing a divisional concentration to less than one hour, and a quick barrage to less than two hours. This compared with the 10-12 hours specified in 1939. The new techniques were a logical progression from the orthodoxy developed in the First World War; and the decentralized experiments of the 1930s and early war years were revealed as the aberrant consequences of numerical inferiority, equipment failure and organizational weakness.

In Tunisia in early 1943 the Germans succeeded in establishing strong defensive positions in mountainous country. The air OP became indispensable and, protected by air superiority, was used to full effect. Each corps had an air OP squadron piloted by artillery officers, trusted to control regimental or divisional concentrations; but these aircraft did not replace other aircraft at army level, which flew deeper over enemy territory for CB reconnaissance.

Given the strength of German positions in Tunisia, there was a natural tendency to fire large quantities of ammunition before an assault. While artillery continued to be commanded at a high level, its control, delegated to the lowest, was improved by the super-imposition of more senior officers on the existing OP organization. These were usually experienced majors or lieutenant colonels, who were especially authorized to initiate quick observed divisional concentrations <sup>(46)</sup>.

In the mobile operations that followed El Alamein, lengthy survey was not possible. A battery would usually advance with reconnaissance; the regimental survey officer would fix the position of one gun and fire two groups of airburst 40 degrees apart at 6,000 metres. The other troops would lay their directors on these bursts and deduce their own positions relative to the 'pistol gun'. A whole divisional artillery could be brought on to common grid in one hour, using a survey beacon subsequently erected at a prominent position. The 72-gun battery fire mission could thus become the standard method of support, which could be applied to a map reference by template in what was known as a "stork", or even as a quick smoke screen.

<sup>(45)</sup> Centralized C2 was most evident in the deep battle, where at El Alamein all medium artillery was concentrated with XXX Corps, linked by buried cable and commanded by a Corps Commander Medium Artillery (CCMA).

<sup>(46)</sup> This system was used for the first time by 6th Armoured Division at Bou Arada on 4 January 1943. Its success was such that it remains essentially the same in the British Army today, where relatively senior officers are authorized to fire concentrations from forward positions. It contrasted with the US tradition established at the same time, which entrusted authority to fire to an officer in the FDC rather than to their more junior FOOs. The US system ensured that decisions were based on wider intelligence, but was significantly slower to respond.



## Tactics

Artillery tactics used in the British success at Sidi Barrani from 9-11 December 1940 bore little resemblance to those of the First World War. The preliminary bombardment lasted just 20 minutes, and the plan had been so thoroughly rehearsed that on the day the only orders required were the time of zero hour and the initiation of Phase 2, the attack on Tummar West.

At Tobruk on 21 January 1941 traditional planning re-emerged with a 3-phase infantry assault, supported by a Creeping Barrage, selected concentrations and greater emphasis on CB fire. But this was an exception, and fireplanning in 1941-42 was characterized by short rapid fire missions in support of armoured operations.

Towards the end of the First World War, 'SOS' fire had been discontinued. In the Second World War it was revived under the name of 'Defensive Fire' (DF) to complement Counter Preparation fire. Counter Preparation fire was delivered in anticipation of an attack on forming-up places (FUPs), while DFs were fired on the enemy during the assault; but in July 1941 Army Training Memorandum No.40 said that the distinction was artificial and Counter Preparation fire was abolished. DF planning proved itself at Alam El Haifa and Medenine, and remains essentially unchanged to this day.

The battle of El Alamein proved that an infantry assault could succeed in a war previously characterized by armoured mobility, if supported by concentrated artillery fire. As in the First World War, the structure of the battle was determined by artillery fire, with infantry dependent on the barrage to its front. When there was no clear Start Line, artillery fired for 55 minutes on a line 1500 metres from the enemy, allowing the infantry to form up behind it.

Despite the massive artillery attack, there were complaints that artillery killed few of the enemy, but as in the First World War the lesson was that artillery should be judged not on casualties inflicted but on its neutralizing effect. Unlike the Soviets', British artillery did not expect to achieve destructive effect. The neutralizing effect was maximized when infantry was close behind the barrage, and again there was discussion on how close it should be. 1st South African Division maintained that to achieve best effect some casualties to its own troops should be expected<sup>(47)</sup>; but the danger experienced in the First World War of being hit, held up or abandoned by an immutable friendly fire plan was largely overcome by the ability of FOOs to send modifications by radio. Radio also enabled troops to report their progress and call for the support of divisional protective fireplans,

<sup>(47)</sup> Such views were not uncommon in the Second World War. On 1 July 1944 the commanding officer of the 2nd Battalion of the US 9th Infantry said, "we must teach our soldiers to remember that when they follow the artillery barrages and air strikes closely, they eventually suffer fewer casualties, even though an occasional short may fall on them": quoted in Shrader (1982), p. 17. At Guadalcanal in December 1942, the commanding officer of the US 132nd Infantry Regiment ordered the commander of his 3rd Battalion not to order artillery support to cease fire until "...you've had six casualties": Rowse (1948) p.67. For a description of artillery amicide in Europe see Shrader (1982), pp.3-10, and in the Pacific, pp. 10-14. For incidents of artillery amicide in the First World War, see Chapter 14, note 23.

once on their objective.

The assault on the *Mareth Line* in March 1943 saw a traditional combination of concentrations and 'Box Barrages' fired against prepared defensive positions, before an infantry assault. At Wadi Akaritin April 1943, three divisions attacked, supported by a complicated fireplan using 450 guns<sup>(48)</sup>. The breakthrough to the Tunisian Plain in May 1943 followed a similar pattern, with a deliberate attack by two divisions on a 3,000-metre front supported by 444 guns<sup>(49)</sup>.

El Alamein was the turning-point in British artillery fire-planning. Principles, essentially unchanged since the First World War, continued as the basis for British operations until the end of the war. Terrain in Italy and Normandy was less suited to large-scale mobile operations, particularly where defences had been well prepared; and in the slower, more deliberate, operations that resulted, thorough artillery preparation and support were even more highly valued.

## Conclusion

Early German successes in the desert were usually the consequence of an ability to concentrate greater firepower at a critical point than the British. This was not achieved so much by moving equipment within range of the target, or by creating fire mobility from relatively static positions, but by enticing a mobile enemy on to that source of firepower. The Germans recognized that firepower was decisive, and exploited the technical superiority of their guns to the full. By winning the fire fight they won the freedom to make dramatic advances into British territory.

British failures were often the result of allowing inadequately controlled armour to roam the battlefield without adequate fire support. The shortage of artillery and its technical inferiority encouraged mobility and hence yet further decentralization. The failure of small roaming concentrations led to the adoption of static, but isolated, concentrations in Tobruk Boxes. The latter enjoyed mixed fortunes but were superseded by a return to the successful tactics of the First World War, as equipment became more plentiful.

Well chosen defensive positions, provided with comprehensive artillery support, were used to halt a mobile attacker deploying inadequate firepower. Anti-tank defences were then destroyed by systematic indirect artillery fire in preparation for an infantry assault. Whenever enemy defences were destroyed, armour was able to exploit its mobility. When the Germans counter-attacked they were stopped, not by tanks but by the anti-tank defences they were unable to suppress. Tactical priorities in the desert were: firstly, the destruction of tanks, usually by anti-tank artillery; secondly, the destruction of anti-tank guns usually by field artillery; and thirdly, the destruction of field artillery usually by its counterpart. By 1943 artillery had therefore acquired an importance beyond that envisaged in 1939, but equal to that attained during the course of the First World War. In the First World War this importance had led to an increasing emphasis on CB fire; but

<sup>(48)</sup> The artillery of 51st Division, for example, fired concentrations and five barrages, including elements of the so-called Crooked Barrage, advocated in 1940 but still unused in practice.

<sup>(49)</sup> The 25pdrs actually fired more rounds than at El Alamein, and concentrated on close targets, leaving deeper missions to aircraft.

in the Second World War there was usually insufficient medium and heavy artillery to carry out this task effectively. The Germans were initially well equipped to conduct the deep battle, but their capability waned as that of the Allies belatedly rose. The deep battle retained the importance it had held in the First World War, and the Germans' inability to prosecute it effectively, through insufficient firepower, was a major cause of their defeat. For the Allies, air superiority not only resulted in success in the deep battle, but also allowed artillery to concentrate its efforts on providing decisive fire support in the close battle.

Close support was made more effective by measures taken to speed the planning of artillery fire, the co-ordination of massed fire, and its modification by radio as tactical circumstances required. The principles of fire support which emerged in the First World War had not changed; they proved to be sound foundations for operations 25 years later. The success of these principles in the desert, and in other theatres, set the pattern for the remainder of the war, making those of 1939 seem as dated as those of 1918 had appeared in the 1930s.

### 3. Sicily and Italy

The campaigns in Sicily and Italy bore little resemblance to the mobile operations in the desert of 1940-42. They were more akin to the Tunisian campaign, with its slow-moving deliberate operations in broken country, favourable to a well-sited defence. The artillery problem was therefore not so much support for mobile operations, as imposition of counter-mobility in defence, and breakthrough of defences to restore mobility in offence.

#### Mobility and counter-mobility

The operations in Sicily offered relatively little scope for mobility, enabling artillery to keep up with the armour it supported. The tactical mobility of the SPs proved useful in the rough country, giving them access to superior gun positions<sup>(50)</sup>.

With terrain unsuited to movement of mass armoured formations, the Germans adopted a decentralized deployment for their SP artillery, and abandoned the massed mobile tactics for which their tanks were designed. SP guns and tanks were used as static 'pill-boxes' supported by machine-guns<sup>(51)</sup>. The use of German tanks in this way was an inefficient but expedient means of converting a system designed for mobility into one generating more firepower. They caused the British considerable local difficulty, but such isolated positions could not compete in the fire-fights that resulted, given the purpose-built firepower deployed against them<sup>(52)</sup>.

Scattered deployment early on bought the Germans time to construct major

<sup>(50)</sup> At Salerno in 1943 the mobility of 'Priest' proved valuable on the beach-head, where it was able to clear German strong points obstructing the breakout.

<sup>(51)</sup> 'Priest' was often used to move by cross-country routes to destroy these positions, but when they were based around Tigers or Panthers the British usually called up the 17pdr anti-tank gun.

<sup>(52)</sup> An analogous experiment was adopted by the British Army in training during the 1960s and 1970s, when its infantry lacked adequate indigenous or artillery firepower to defend itself.

defensive lines; but in May 1944 the Gustav and Hitler Lines were broken by artillery firepower, and mobility was restored as the Germans withdrew northwards. Infantry operations were replaced by those of armoured mobility, and as ranges increased medium and heavy guns were more highly valued <sup>(53)</sup>.

German defences were usually based on well-sited anti-tank guns; but for the Allies defending beach- or bridge-heads there was little time for preparation against counter-attacks <sup>(54)</sup>. Increasing use was made of indirect fire to stop armour, using fire-mobility to compensate for the lack of anti-tank mobility. At Salerno on 15 September 1943, German armoured counter-attacks were halted by artillery concentrations; and on 16 September, 26th Panzer Division was defeated by artillery fire alone, when it attacked without artillery support.

### Massing artillery and C3

Italian terrain obstructed movement and offered opportunities to impose counter-mobility through obstacles covered by fire. As in the First World War, the task of breaching these barriers fell to artillery. They became more formidable, and as industrial production increased, the mass of equipment and weight of fire deployed against them continued to grow, supplemented by naval gunfire and air support <sup>(55)</sup>.

The appetite for ammunition grew, as is usual in wartime, to an extent not provided for in peace, despite ample experience. In effect, demand for ammunition became unlimited. As in the First World War, the scale and structure of attack came to be determined by the limits of artillery logistics, which sometimes proved hard to predict <sup>(56)</sup>.

The saturation of assembly areas for enemy counter-attacks proved decisive, as it had in the First World War. At Anzio in January 1944 violent counter-attacks by eight German divisions against the beach-head were defeated, primarily by massive artillery concentrations on possible assembly areas throughout the night preceding the expected offensive.

The neutralizing effect of concentrated artillery, which had been repeatedly

<sup>(53)</sup> As in the British advance of 1917, these were seen to be more mobile than had been assumed, and with a good tractor they could move quickly by road.

<sup>(54)</sup> For example, the bridge-head over the Trigno was lost (22-23 October 1943) through failure to deploy sufficient anti-tank guns across the river in support of the infantry.

<sup>(55)</sup> The crossing of the Straits of Messina was preceded by heavy tri-service fire-support, which left only 50 out of 114 enemy pieces in action at the time of the crossing to face 400 of the British. On 2-3 September the latter fired 29,000 rounds, to which only 5 enemy guns were able to reply.

In the assault on prepared positions on the Sangro Ridge in November 1943, 25pdrs fired over 600 rpg, 200 more than at El Alamein, and the mediums fired over 300 rpg in three days. One month later, at Monte Cassino, artillery expenditure rates were often as high as 800 rpg when 167 Infantry Brigade attacked, supported by the fire of the British X Corps and the US II Corps, delivering 1,329 tons of ammunition on four areas, each only 500 metres square, in 75 minutes.

<sup>(56)</sup> For example, before the crossing of the Garigliano in January 1944, large quantities of ammunition were stockpiled and a proportion allocated for contingency counter-preparation missions. In the event, on 22 January logistic planning was thrown into confusion when 56 Infantry Division's artillery fired twenty DF missions on 75 divisional targets in just twelve hours, holding off enemy counter-attacks only by firing without regard to ammunition consumption.

demonstrated in the First World War, was re-invented under the name ‘**Terror Concentration**’. Four hundred guns would fire on a single target, lift and strike again, repeating this demoralizing form of attack until the defenders were incapable of resisting an infantry assault <sup>(57)</sup>.

By 1944 the Germans were painfully aware that their own artillery had been neglected. The need for mass was recognized, but resources were lacking. On the Eastern front the Germans based their defence around prepared ‘islands’ of firepower. Similarly, in Italy in the summer of 1944 they concentrated resources in major defensive positions to maximize the effect of what little they had. The Gustav Line contained 400 guns in prepared emplacements, of which 150 were at Monte Cassino. Mobile armoured warfare had become a luxury of the past. It had been effective against the unwary or ill-equipped, but by 1944 battles were won by firepower, not manoeuvre. On all fronts the Germans invested heavily in the physical protection of fortified positions, which protected guns, and so in effect increased their firepower. Although lacking mobility, these often proved more effective than the protection of mobility or armour on vehicles.

The British commander-in-chief, General Sir Harold Alexander, understood that only artillery could break the German defensive lines: "The location of the enemy's positions will be difficult, his troops will be well posted and skilfully concealed. Only by a lavish expenditure of ammunition shall we be able to overrun them without suffering heavy casualties.... The troops with which we are now fighting are not as experienced and well trained as those with which we started.... The effect of this is that attacks against stiff resistance must be helped forward by artillery" <sup>(58)</sup>.

It was suitability for artillery that determined the Liri valley as the sector for attack. There was little hope of deception or achievement of surprise, and the British opted for a frontal assault by infantry supported by a weight of fire of First World War proportions <sup>(59)</sup>.

The tactics used to apply the firepower may have been questionable, but there was little chance that the Gustav Line would have fallen without it. Despite criticism that excessive destruction at Cassino hampered Allied troops <sup>(60)</sup>, if anything Allied casualties encouraged the view that yet more firepower would be needed to break the Hitler Line. For this I Canadian Corps was supported by 810 guns, and centralized C3 ensured that up to 30 regiments of artillery could engage

<sup>(57)</sup> A similar effect could be achieved with naval gunfire and close air support. In June 1943 the enemy occupying Pantelleria surrendered after 4,656 tons of bombs had been dropped on them in five days. Physical destruction was surprisingly small. Only 16 out of 109 guns were found to be damaged, but the neutralizing effect on morale and C2 was complete. Compare with the re-capture of South Georgia in 1982.

<sup>(58)</sup> Quoted in Pemberton (1950), pp.212-213.

<sup>(59)</sup> They had 4,000 aircraft available against just 400 German, in addition to 1,000 guns which would fire up to 1,100 rpg, reinforced by mortars and flame-throwers. In addition to HE, 800 tons of smoke was available to screen advancing troops. The bombing was judged accurate with 50% hitting the target, and German guns countered only after the infantry attack had become bogged down; but unfortunately Allied shelling "had little effect since German strongpoints were shell-proofed": Walters (1947).

<sup>(60)</sup> Boucher (1944).

a single target at once. Thirty-three minutes after a divisional CRA requested fire, 668 guns responded, firing 3,500 rounds at a given target<sup>(61)</sup>.

The US Army experienced a comparable appreciation of the benefits of centralized C2. Its doctrine before the Second World War had neglected both the need for corps artillery and the command of artillery by the corps headquarters<sup>(62)</sup>. This neglect was exposed in Tunisia in 1943, where corps assets were usually shared out among divisions, with the result that each received only a proportion of the support available, rather than the larger number which would have been possible had assets been controlled centrally by corps. The policy of decentralization usually wasted assets, but was popular with divisions which disliked the idea of artillery under corps command being deployed in their areas. Methods of concentrating divisional fire were well-established, and any FOO could expect to fire all the guns in the division in under five minutes<sup>(63)</sup>, but the importance of corps artillery was only slowly appreciated in the US Army over three campaigns and from the study of foreign techniques<sup>(64)</sup>.

The benefits of centralized C2 applied equally to defence and were clearly demonstrated at Anzio on 17 February 1944. The US VI Corps artillery was surveyed on a common grid and was able to concentrate fire on pre-arranged targets anywhere within range on receipt of a single code word<sup>(65)</sup>.

In 1939 artillery planning had generally been conducted at brigade level. In the early years of the war divisions accepted this responsibility, but by 1943 they had given way to corps - a progression similar to that in the First World War. Corps had previously concentrated on the deep battle<sup>(66)</sup>; but amongst the Allies it now became the most important formation in all aspects of C2.

It became the task of artillery at army level to isolate the battlefield while corps headquarters directed the close battle. Hence at Anzio the US corps artillery commander actually included the divisional artilleries in his fireplan.

Centralized C2 was not restricted to artillery but encompassed tri-service fire support. This had improved in North Africa, but became particularly important

<sup>(61)</sup> Such concentrations required detailed technical co-ordination. By the end of 1943 data were available from divisional meteorological sections, and the problem of calibrating masses of guns was solved by calibrating a pool of guns which were then distributed and from which comparative adjustments could be made.

<sup>(62)</sup> Even in May 1943 teaching at Fort Sill still urged that corps artillery be attached to divisions: See "The employment of corps artillery" *Military Review* Vol.23 No.2 (May 1943) pp.56-57 and "Reinforcing artillery employed in mass" *Military Review* Vol.23 No.3 (June 1943) pp.59-60.

<sup>(63)</sup> Pyle (1942) and Gjølseten (1943).

<sup>(64)</sup> In Sicily, 13th Artillery Brigade supporting the US IV Corps was the only US armoured field artillery group in Europe. It was commanded by a two-star general, to establish its status among divisional commanders, and eventually comprised 13 battalions, sometimes with divisional artillery attached as well. The concept of this formation was enthusiastically supported by General George Patton, and reflected similar trends in the Soviet, German and British armies. All had come to realize that "when an army has been stopped by enemy defences, it relies upon artillery to get started again": Crane (1945a), p.354.

<sup>(65)</sup> On one occasion 2,500 German infantrymen moving along a road were observed by an air OP of 45 Infantry Division's artillery. In 12 minutes all the guns of VI Corps had fired and went on to engage four other targets in the next 50 minutes: *ibid*, p.355.

<sup>(66)</sup> Lewis (1943).

in the amphibious assaults on Sicily and Italy. Co-ordination of fire support ensured that naval and air forces engaged deep targets beyond the reach of guns<sup>(67)</sup>.

Allied air superiority allowed aircraft to take the place of heavy artillery, and air support became as integral a part of ground operations as heavy artillery had been in the First World War.

Bombers delivered the greater part of the preliminary bombardment and were followed during the assault phase by fighter ground-attack aircraft, waiting on a 'cab rank' system controlled by an air OP, which had been pioneered by the US Fifth Army<sup>(68)</sup>.

Air superiority also favoured the air OP. In the pursuit north from the Hitler Line there had been criticism that aircraft took too long to respond in fluid operations, and the RAF air OP came into its own. With little enemy air defence, the air OP was able to operate over enemy lines from forward airstrips especially cleared by bulldozers; but in set piece operations aircraft themselves usually proved more effective than artillery.

It is tempting to argue that in Italy, where ground movement was relatively restricted, fire support found mobility through 'aerial artillery'; but the shell, not the equipment, is the real determinant of artillery mobility. Air support had the edge in range and in delivering a massive weight of fire at a single stroke. The dominance of the air arm in the deep battle enabled artillery to concentrate its efforts on the close battle, where it remained the most reliable, accurate and flexible source of firepower. This also held true in the campaign in North West Europe, where combined service operations developed on an even larger scale than in Italy.

## Tactics

Provision of fire support in mobile operations and the prevention of enemy mobility was not the dominant consideration in Italy. Instead, argument centred around how fire support was best applied in set piece operations, and, as in the First World War, on the length of the preliminary bombardment, the type of barrage, and the possibility that excessive firepower could prove counter-productive.

The importance of deep attack, and the execution of this task primarily by naval and air forces, have been described above, but artillery retained the major responsibility for close bombardment, although this was not always successfully

<sup>(67)</sup> A naval bombardment in 1941 took 24 hours to arrange, and it was realized that Royal Naval liaison officers would have to be attached to divisional headquarters as well as corps, if this response was to be bettered. By the time Sicily was invaded, many improvements had been made: each ship carried an artillery liaison officer, a senior liaison officer was attached to the assaulting forces to advise the naval commander; and each assaulting FOO had communications on a separate frequency to his supporting ship. By the time of the Salerno landings in September 1942 this network had expanded so that even air OPs could communicate with ships.

<sup>(68)</sup> These techniques were demonstrated on 9 April 1945 when defences on the River Senio were attacked by 700 heavy bombers guided by artillery firing coloured smoke flares and airbursts. This bombardment was followed by four hours of fighter ground attack and fire from 1,200 guns using up to 100 rpg.

exploited <sup>(69)</sup>.

In an attempt to avoid the problems of timed fireplans, concentrations were planned in advance to be 'on call' to OPs, but even so these were seldom used, because of the difficulty of identifying the location of friendly forces. On the other hand counter-preparation fire beyond the limit of friendly exploitation was commonly used, and to great effect on the Garigliano and at Anzio.

The advantages of concentrated firepower favoured the choice of narrow frontages for attack on, for example, the 2,000 metres chosen for I Canadian Corps to breach the Hitler Line. The disadvantage was that the enemy was able to concentrate his limited assets on a smaller target, but it was a battle which superior firepower was bound to win.

#### 4. North West Europe 1944-45

Artillery support available in North West Europe in the summer of 1944 was very different from that of 1940. The supported arms were less often separated in mobile operations from their artillery, for both sides recognized the need for all-arms co-operation, and were able to achieve it in practice as well as in theory, with the proliferation of anti-tank and field SP guns. Victories gained by movement of armoured formations alone were not anticipated, because the power of the gun to counter the mobility of the tank was well established. Anti-tank artillery was no longer content to play merely a passive role in static defence, but was prepared for operations in 'active defence' and offence. The re-establishment of a decisive role for anti-tank and field artillery in forward areas increased the need for protection; and guns were frequently armoured, or heavily protected in field defences.

The condition of the battlefield encouraged the conduct of deliberate operations in which the generation of firepower was of primary importance, thus reversing the balance of advantage between mobility and firepower after four years. By 1944 the Allies held air superiority, and were alone able to ensure close support of ground forces.

The Allies were also best able to mass artillery equipment and to maximize its effect through centralized C2 and improved communications, while the Germans sought the means of providing close support with relatively diminishing assets.

<sup>(69)</sup> For example, at Cassino the Polish Corps attacked after the effect of the bombardment had largely worn off, and had to be withdrawn after heavy loss. When XIII Corps attacked, it found that much of the obstacle line of wire and pillboxes, and many of the mortars and machine guns which covered them, remained intact. The infantry lost its protective barrage and the assault made little progress. As in the First World War, a more effective technique was then adopted, firing short concentrations of 40 minutes' duration, with infantry following so closely behind that enemy fire fell behind them. Attempts were also made to deceive the enemy in set-piece operations by unexpected variations in artillery fire. For example, at Conano Ridge the Canadians successfully fired four feints before their infantry assaulted.

These lessons had constantly to be re-learned. It had been observed during the invasion of Sicily that "unless the assaulting troops are sufficiently close behind the barrage to close with the enemy within two minutes of the barrage lifting, the barrage is wasted": quoted in Pemberton (1950), p. 186.



## Mobility and counter-mobility

In 1944 field artillery was able to support mobile armoured operations with a variety of SP equipment <sup>(70)</sup>. The SP concept was already well developed in the Wehrmacht, and was adopted whole-heartedly by the US Army, which had a complete range of SP equipment from 105mm to 240mm by 1945.

While field artillery was better able to support mobile operations, there was controversy over how that support should be provided. Some believed that armour could advance under the fire of its own artillery. This was seen as the best way to combine the armoured mobility of the tank with the suppression or neutralization of enemy anti-tank defences; but in practice tank commanders preferred to go without artillery support in the last minutes of an assault rather than to close down and lose visibility. The US Army judged light artillery ineffective against armour, and so was prepared to let tanks advance under friendly field artillery airbursts <sup>(71)</sup>; but as the war in North West Europe progressed, and the number of US tanks grew, the firepower of US armour became so great that the tank relied increasingly on its own armament, with field artillery required only in set-piece operations.

The US had adopted the 6pdr, renamed the 57mm MI, but in the eyes of many it was too light and arrived too late. Many were abandoned by the roadside as tanks advanced alone. Their loss was sometimes regretted later when German counter-attacks penetrated infantry areas; but the tank remained the prime US anti-tank system. As early as July 1941 this doctrine had its critics. General McNair, commander of the US Army ground forces, had said "it is poor economy to use a \$35,000 tank to destroy another tank when the job can be done by a gun costing a fraction as much" <sup>(72)</sup>, and this was essentially the justification for the US tank destroyer concept which he fashioned.

The British placed greater emphasis on co-ordinated operations. In the bocage of Normandy in June and July 1944, liaison developed to the stage where infantry and armour often took responsibility for calling for fire support <sup>(73)</sup>.

In the confusion of armoured operations, tanks often became lost and artillery was called upon to re-orient them with shell-fire. Fixing the location of the guns themselves during periods of rapid movement proved difficult, but the problem was solved by the device, pioneered in North Africa, of advancing with a pistol gun from the leading regiment, used as the reference for a control director <sup>(74)</sup>. The

<sup>(70)</sup> The SP Priest was widely used in the British Army, and became standard in US armoured divisions.

<sup>(71)</sup> Crane (1945a).

<sup>(72)</sup> Quoted in Weeks (1975), p.104 and Gabel (1985), p.19. On the other hand, in 1941 the US had plenty of tanks and not many guns. Large numbers of tanks would continue to be needed for offensive operations, and if they could also provide fire support this was itself an economy.

<sup>(73)</sup> If the infantry brigade led the advance of an armoured division, HQRA would be positioned with the brigade headquarters; but if an armoured brigade led, field artillery was often left behind to operate in captured territory being cleared by the infantry. One consequence of this was the increased importance of longer-range equipment, not to engage enemy targets, but to maintain close support from positions of depth.

<sup>(74)</sup> A pistol gun is one which deploys and fires alone, either to harass the enemy with less chance of detection, to mislead or confuse the enemy as to the location of other guns, or as in this case to obtain firing data for the main body before their arrival.

technical race between gun and armour intensified in the summer of 1944. The British proposed a 32pdr anti-tank SP (the A39 Tortoise), but abandoned the idea on the grounds of excessive weight. Instead, they favoured the 'smallhole' policy, and supported a higher velocity 17pdr, introducing the discarding sabot round with tungsten carbide core <sup>(75)</sup>.

Allied anti-tank guns were used to penetrate and disrupt enemy defences for tanks to exploit, and could best achieve this if they were SP. The US Army was the last to enter the technical race, and developed anti-tank SPs such as the M10 and M18 tank destroyers, following the German pattern from the Eastern front <sup>(76)</sup>. Unlike Soviet assault guns, which were used in the van of an attack, US SPs usually followed assaulting tanks or took enemy armour from a flank.

The British used their anti-tank SP forces rather differently, more like light fieldguns in the First World War. They occupied objectives as quickly as possible after capture, and deployed to block inevitable counter-attacks. They were also often tasked by air OPs to intercept enemy armour flushed out of defensive positions by field artillery <sup>(77)</sup>.

The Germans had pioneered the offensive use of SP anti-tank guns on the Eastern front, and often used these in small groups in the West <sup>(78)</sup>; but the terrain of Normandy gave them greatest advantage when anti-tank pieces were deployed in static prepared defences. Close country ('bocage') restricted movement and favoured engagements at short range, encouraging the development on both sides of novel infantry anti-tank weapons (such as the Bazooka, Panzerfaust and Piat) to compensate for a shortage of artillery. But such weapons were in their infancy, only realizing their potential as ATGW 30 years later; and in Normandy in 1944 armour-piercing projectiles from guns destroyed ten times as many enemy tanks as did these infantry weapons. The backbone of defence and counter-mobility remained the gun <sup>(79)</sup>, as British casualty statistics show (see Figure 7).

Fig. 7 Causes of casualties to British tanks in the Second World War

	Number of Tanks in Sample	Percentage of Casualties Caused by			
		Mines	Anti-Tank Guns	Tanks	Indirect Fire and Aircraft
North West Europe	1305	22.1	22.7	14.5	} Approximately 20%
Italy	671	30.0	16	12	
North Africa	1734	19.5	40.3	38.4	
Mean		22.3	29.8	25.3	

<sup>(75)</sup> A variety of 17pdr SP anti-tank guns were produced — the Archer, Challenger and Achilles (mounted on the US M10 carriage).

<sup>(76)</sup> Bruce (1943), Ogorkiewicz (1951) and Gabel (1985).

<sup>(77)</sup> These tactics proved so successful that in September 1944 21st Army Group considered the use of radar-controlled air OPs operating 24 hours a day, and even helicopters.

<sup>(78)</sup> A description of German SPs and anti-tank guns defending a French village in December 1944 is given in Ganz (1985).

<sup>(79)</sup> This fact demonstrated in August 1944 during Operation TOTALIZE, when First Canadian Army was halted by 60 German tanks and SP guns which had dug in, and were well-supported by ninety 8.8cm FLAK guns, despite a preliminary bombardment by Flying Fortresses.

## Massing artillery and C3

*Mass*: The application of heavy firepower had traditionally been the responsibility of artillery, but by 1944 this was being shared with air forces, and by 1945 other arms had also acquired greater capabilities. Preliminary bombardment by aircraft became routine for operations after D Day, but did not over-ride the need for massed artillery. The relative merits of the two systems were sometimes disputed; but their interdependence, and the reliance of supported arms on them, was not.

The D-Day landings could be made only with the help of air support and naval gunfire, in operations which put field artillery at a natural disadvantage. Field guns were fired from vessels standing off the beaches, but success depended upon major defensive positions being put out of action, and close support weapons could not produce sufficient weight of fire. The preliminary bombardment was by naval guns, while aircraft engaged close targets covering the beaches, and the chain of strong points 1,000 metres apart, 200 metres behind them. During the assault phase aircraft attacked the deep targets, while every available gun engaged the close ones<sup>(80)</sup>.

German artillery made relatively little impact on Allied operations in June 1944, but by July had built up a substantial force, obliging the Allies to pay greater attention to CB operations. In Normandy it was usual for the British to allocate targets up to 6,000 metres from the 'forward line of own troops' (FLOT) to artillery, and beyond that to aircraft. One US official described aircraft as constituting a fast-moving, far-ranging aerial artillery<sup>(81)</sup>. Since most positions were held in depth, aircraft had to assume the greatest responsibility for CB fire<sup>(82)</sup>. By 1944 the bomber was already better suited to the task than artillery, which was used in the SEAD role for the protection of the bomber streams. However, in the operations at Caen and others which followed, the effectiveness of air support was questioned, just as that of artillery had been in the First World War: was it too 'destructive' and was it hitting deep enough?

The need for well-directed firepower was not in doubt; the problem was that even with air superiority and the reconnaissance it allowed, enemy positions could not be adequately identified. Artillery did not have the resources to engage in saturation missions, and aircraft were available for what was in effect predicted unobserved fire. Because it was uncontrolled there were inevitable examples of

<sup>(80)</sup> These included the guns of 93 destroyers and 147 close support naval vessels, Royal Marine guns and army SPs. Ten regiments of SPs fired 18,000 rounds in 30 minutes as they stood in the surf.

<sup>(81)</sup> Quoted in Barnett et al (1986), p.7.

<sup>(82)</sup> This factor was recognized in planning Operation GOODWOOD, which took place on 18 July 1944, preceded by an air bombardment from 2,000 bombers, and supported by 776 guns on a corridor just two miles wide. US forces made even closer use of firepower, when on 25 July 1944 their VII Corps broke out, using air bombardment just 1,200 metres forward of the FLOT. It was also a classic case of amicide, for it caused the death of General Lesley McNair and many others. Air attacks like that on Caen on 7 July 1944 amounted to the saturation of a defensive area, which in the First World War would have been undertaken by artillery. The aim in both cases was to destroy or neutralize unlocated enemy positions by sheer weight of fire, and by definition required little accuracy.

overkill. Where urban areas such as St. Lo and Caen were devastated, advancing troops were often held up by the destruction caused by bombardment, and arguments were made for shorter sharper attacks which in the First World War would have been called neutralization. The Germans countered massed firepower by defending in greater depth, as they had done in the First World War <sup>(83)</sup>.

On 7 August 1944 First Canadian Army launched Operation TOTALIZE (Caen) with just a 30-minute concentration by heavy bombers followed by a creeping artillery barrage. This was partially successful, but was held up by prepared anti-tank positions. The Germans put increasing faith in these as Allied firepower increased. The British 25pdr was judged ineffective against a dug-in enemy unless timed fuzes were used; and as a result, in Operation BLUECOAT (Caumont) on 25 July 1944, the British Second Army was allocated 75% time-fuzed ammunition. But TOTALIZE illustrated the old problem posed in the First World War: how to neutralize major defensive positions if a major bombardment is foregone in an attempt to achieve surprise and reduce destruction.

Operation TOTALIZE also permitted comparison of the effects of artillery fire and air bombardment. One objective was taken with artillery support more easily than others with air support; but bombing certainly delivered a far greater weight of fire at greater range more suddenly. The lessons of the First World War were remembered insofar as neither was judged solely on its physical effect, but also took into account effect on morale. In the case of airborne bombardment, this was judged to be greater, lasting for one hour, after which the enemy would probably have recovered and taken advantage of positions in rubble and craters. In the case of artillery, the morale effect was judged to last just two minutes. Artillery was clearly less suited to deep attack than aircraft, but the inflexibility of the latter made them less suited to sustained and accurate support during assault phases <sup>(84)</sup>.

In 1944, as in the First World War, some wondered if artillery was being sufficiently discriminating, and it was criticized for being unduly destructive. The relative abundance of guns and ammunition after years of shortage encouraged an addiction to firepower <sup>(85)</sup>. British officers spoke of large concentrations being squandered on troop targets <sup>(86)</sup>. It was noted that significant casualties were caused by observed fire, while predicted concentrations, which represented 98% of all

<sup>(83)</sup> During GOODWOOD, for example, it was discovered that after an initial breakthrough of 400 metres, main anti-tank positions stretched for another 3,000 metres. Such deployments increased the size of the area to be attacked and so reduced the concentration of fire against defended positions. They also allowed the defence time to react and mount counter-attacks, reducing the element of surprise which should have lain with an attacker.

<sup>(84)</sup> German officers noted that for this reason artillery had been more effective than bombing at Monte Cassino: Tauson (1948).

<sup>(85)</sup> Even in 1942 officers on the US Command and General Staff Course were urged, "don't let the unit fire as defined in your text book limit you. The more ammunition you fire, the more help your fire is going to be in any attack", and the speaker went on to note that one battery in the First World War had fired 4,000 rounds per day: Bacon (1942), p.55. US policy during and since the Second World War has consistently emphasized the use of firepower rather than manpower. The provision of that firepower by artillery has been described as the decisive factor in US operations in the Second World War: Morelock (1985).

<sup>(86)</sup> Pemberton (1950), p.229.

British artillery fire at that time, did only slight damage.

The situation in 1944-45 was analogous to that in 1917-18. Manpower was in relatively short supply, and given large quantities of equipment, it was tempting and desirable to maximize firepower to save lives, even if this sometimes appeared wasteful. The Allied use of firepower against the Westwall and defences on the Rhine repeated that against the Hindenburg Line in the First World War. The difference lay in the advances made in artillery accuracy, and the greater strength of the defences.

The Germans constructed massive fortifications throughout Europe which could be reduced only by massive firepower. The chance of neutralizing a heavily protected defence with a short, sharp fireplan or *coup de main* in the style of the German Eben Emael operation were minimal<sup>(87)</sup>. These fortifications ultimately fell, but only at great cost to their attackers.

Le Havre was assaulted on 10 September 1944 with massive artillery support following heavy naval and air bombardment, and fell in 48 hours, but the battle for Boulogne lasted six days<sup>(88)</sup>. By building massive protection the Germans had balanced their enemy's numerical advantage, demonstrating the importance of survivability as an equivalent to mass<sup>(89)</sup>.

The Allied response to tougher defences was to increase firepower still further, to save casualties. On 18 November 1944 the bombardment of German defences at Bauchem near Geilenkirchen reached 1.8 tons per 100 metres square<sup>(90)</sup>. The results were dramatic. Even though the Germans suffered only 10-15% casualties, they surrendered without resistance. British troops suffered only seven casualties, four from their own shellfire. Subsequent attacks achieved similar results, even when the infantry assault was made 30 minutes after the end of the bombardment. These operations demonstrated that even if the destructive effects of artillery were reduced by prepared defensive positions, the morale effects of artillery could be decisive, and for considerably longer than the two minutes recommended after Operation TOTALIZE. The ability to produce such effects was reduced only when the defence was protected by massive fortifications; or ammunition was wanting.

Allied forces rarely suffered such heavy fire because the Germans lacked the guns, and on the few occasions when concentrations were achieved, ammunition

<sup>(87)</sup> On 10 May 1940, 11 gliders containing 85 Germans landed on the Belgian fort of Eben Emael and overcame 1,200 surprised defenders.

<sup>(88)</sup> The concrete positions at Boulogne proved so strong that 100,000 rounds fired by 344 guns and 3,000 tons of bombs were ineffectual. The fireplan was the most detailed of its kind, covering 400 strong points, but enemy guns were not silenced, and positions had to be assaulted one by one, with the majority of the attackers' casualties being inflicted by German artillery.

<sup>(89)</sup> The same lesson was repeated against the British at Walcheren, in October and November 1944, where heavily protected German defenders were equipped with casemated guns. These were attacked by medium, heavy and super-heavy guns, by rocket-firing aircraft and a squadron of special naval rocket craft; but they were not silenced until they sustained direct hits from 15-inch naval shells.

<sup>(90)</sup> The same as at Valenciennes in November 1918, which had been regarded as the optimum weight, and half as much again as the heaviest fire in North Africa on 19 April 1943: Military Operational Research Unit Report 3 "The effects of bombardment" (UK Department of the Scientific Adviser to the Army Council, 1st March 1946).

was severely restricted <sup>(91)</sup>. US Army doctrine forbade the keeping of guns in reserve, regarding ammunition as **artillery's true reserve** <sup>(92)</sup>, but even it sometimes found such reserves wanting where plans for ammunition supply failed <sup>(93)</sup>.

By early 1945, the line of battle on both the Eastern and Western fronts was marked by fortifications. In the West, the Westwall constituted a fortified zone 400 miles long and 8-10 miles deep, with thousands of strong points <sup>(94)</sup>. The Allies responded with yet greater firepower <sup>(95)</sup>. The bombardment for Operation VERITABLE (Reichswald) was delivered partly by aircraft, but artillery was by that time so powerful that the decision was taken to proceed without air support, if the weather should make the latter impossible. In the event, aircraft did support the operation, with targets marked by coloured flares and smoke from 25pdrs; but mobile radar control posts were also deployed, enabling some aircraft to hit targets without artillery guidance.

The strength of artillery firepower was supplemented not only by air power, but also by the fire of other systems, often manned by other arms. For example, with little artillery, and little chance of producing it in greater quantities, the Wehrmacht placed increasing reliance on mortars for close support. These weapons accounted for 70% of British casualties in Normandy <sup>(96)</sup>. The mortar enjoyed inherent advantages over its opponents, being able, like German howitzers in 1914, to hide in positions which weapons with flatter trajectories were

<sup>(91)</sup> General Graf Ralph von Oriola, who commanded the German VI Corps on the Eastern Front in 1945, claimed, for example, that during the Ardennes offensive German guns were **allowed** only 4-32 rounds each per day: Cole (1948). The Germans actually massed the same number of guns as the US forces opposing them, but were supplied with only one-tenth of the ammunition: Thoholte (1945). After firing an opening bombardment of two and a half hours, ammunition was soon expended: Reeves (1946). As Lieutenant General von Rohne noted in 1908, it may actually be an advantage to possess fewer guns, provided each has a greater supply of ammunition: Rohne (1908).

<sup>(92)</sup> Bacon (1942), p. 53.

<sup>(93)</sup> An example of this, in November 1944, resulted in a serious reverse for the 28 Infantry Division of the US First Army, opposite the town of Schmidt. Ammunition was known to be short, and V Corps **allocated** most of its field ammunition to the division, forbidding others to fire except in "dire emergency" and with written justification: Wothe (1982), p.22. But road communications were poor, re-supply routes had not been reconnoitred, and the 'Kall Trail' on which most ammunition travelled proved insecure. Ammunition distribution was poor, and enemy guns which were not silenced were largely responsible for stopping and pinning down the division, with the loss of over 60% of its tanks and tank destroyers.

<sup>(94)</sup> Landis (1945).

<sup>(95)</sup> In February 1945 the British 21st Army Group, with 1,000 guns, attacked a sector of the Westwall **defended** by the German 84th Infantry Division with just 114 guns. Surprise was abandoned to exploit this advantage in **firepower**; and the commander of XXX Corps which conducted the opening bombardment of Operation VERITABLE described his task as "to blast my way through": quoted in Pemberton (1950), p.263. Although the enemy suffered only 3% casualties, the morale of 84th Division was shattered. The bombardment achieved its aim, but again fears were raised by operational research that bombardments were becoming so heavy that they were in danger of defeating their own ends.

<sup>(96)</sup> Each German infantry division was equipped with 57 8.1cm and twelve 12.1cm mortars, with ranges between 2,600 and 6,500 metres. Their destruction (with the assistance of the new British GL III radar) became a more important task for artillery than CB fire. These mortars were usually deployed 750 metres and 1,000 metres respectively from the FLOT, drawing opposing indirect fire into the close battle, and increasing the responsibility of aircraft to fight the deep battle.

unable to reach. The mortar remained essentially an infantry weapon, even though its tasks and techniques resembled those of close support **artillery**. The British also made greater use of mortars, frequently using their 4.2-inch mortars in CRA's fireplans. They were commonly used in close support to reinforce field artillery, but as a substitute only when field artillery itself was wanting.

Artillery firepower was increased by the introduction of rocket systems. The Germans used a variety of equipment on the Eastern Front, but the *Nebelwerfer* was most preferred in the West. The US developed similar systems, and the British the multiple rocket launcher named '**Land Mattress**' <sup>(97)</sup>.

Close fire support could also be increased by firing all available weapons, rather as both sides had enhanced the fire of their artillery with massed machine-gun barrages in the First World War. The equivalent to this in the Second World War was the use of tank guns, most commonly by the Americans and Soviets <sup>(98)</sup>. In effect, the tank regained something of its First World War role, providing close support for other arms.

The anti-tank SP was not created to carry out field artillery tasks, but just as field artillery was required to carry out direct fire anti-tank tasks when necessary, so US SP anti-tank guns were called upon to thicken up field artillery close support when available <sup>(99)</sup>. If other arms proved useful sources of additional fire support, they sometimes also invited criticism. For example, in October 1944 US infantry 'cannon companies' were accused of concentrating efforts on indirect fire, instead of covering affiliated units with direct fire. This criticism formed part of a broader awareness that the US Army lacked the firepower of 'accompanying artillery' enjoyed by its Soviet ally <sup>(100)</sup>.

Another way of increasing firepower, or its equivalent effect, was to improve the munition. The introduction of the radar proximity fuze, first developed for the anti-aircraft role, was one of the most important technical developments of the war, and was a great improvement on the time fuze. The proximity fuze played an important part in stopping the German Ardennes offensive of December 1944, and proved equally successful when introduced by the British in January 1945 <sup>(101)</sup>.

<sup>(97)</sup> This was first used in an amphibious role at **Walcheren** and later at Breda and **Venlo**. A battery of '**Land Mattress**' could cover an area of 800 x 800 metres, but was less accurate than a gun battery, and took ten minutes to reload. Nevertheless, these early experiments proved effective - after the operations at Venlo on 3 December 1944, XII Corps recorded that its **firepower** was out of all proportion to the size of the unit, and that there was a requirement for each corps to have a battery in close support: quoted in Pemberton (1950), p.248.

<sup>(98)</sup> In January 1944 the US Armoured School began a course instructing tank companies to fire **with field** artillery, using the latter's FDC: Monzani (1945); and throughout the campaign in North West Europe US tanks were required to perform this secondary role.

<sup>(99)</sup> The US Field Manual 18-5 of 16 June 1942 stated that they should be used in this secondary role against **defensive** positions, and by 18 July 1944 this direction included their **employment** in the indirect fire role: Hatfield (1945).

<sup>(100)</sup> Pyle (1944).

<sup>(101)</sup> The development of the VT fuze (also known as the proximity fuze) is described in Zupa (1947), Reeves (1946) and Vattisuum (1985). It was first used by the 12th US Artillery Group on 18 December 1944 near **St Vith**. Poor visibility made the adjustment of mechanical time fuzes impossible, and VT was used in its place with great effect. A 1st US Army Field Artillery report of 23 December 1944 said:

Firepower was thus increased by massing equipment and ammunition, and by supplementing it with all available weapons on land and in the air. In the process, the responsibility of artillery to provide close fire support was not questioned; but the proven importance of aircraft, mortars, tanks and rockets influenced the perception of what tasks field artillery could, or should, perform in succeeding decades, just as the development of infantry missiles would affect the status of artillery as the arm responsible for anti-tank operations.

*Command, control and communications:* The most effective way to maximize artillery firepower was either to centralize assets in a separate force at high level or to concentrate the fire of decentralized equipment through a centralized system of C3. By 1945 the Soviets tended to the first extreme and the British to the second. The Germans and the Americans adopted a mixture of the two.

Artillery operations in North West Europe saw the evolution of increasingly centralized C2, but matched by greater flexibility of control at low level. The transformation was most marked in the US Army, not because it went to greater lengths but because it happened in so short a time. In North Africa and Italy, US divisions had grown accustomed to having battalions attached, and under their command, from corps to thicken up their own close support, and to engage deep targets on divisional intelligence. By the end of the Italian campaign, US corps were generally reluctant to hand over their assets. They preferred to centralize assets, and only to decentralize them in rapidly changing operations, when communications became over-stretched. When decentralization did occur, assets were reorganized into 'Groups', preferably of three or five battalions, to operate in divisional areas. The intention was to increase corps command of all artillery assets in the corps, including those of the divisions. Increased corps control suited operations in France in 1944, where most US operations were planned at corps level, as were arrangements for meteorology and survey; but problems arose when some 'Groups' were under-loaded, while others could comprise perhaps ten different battalions over a period of a month, hampering liaison. It was also found that 'Groups' were often too rigidly controlled by corps, and fired only on orders from the corps fire direction center (FDC), failing to respond properly to divisional requirements. In effect, command and control were both vested in the highest

"It is hard to believe, but cumulative figures indicate 2,000 enemy dead, which could be observed and counted... VT ammunition is most deadly". General Patton wrote to General Campbell: "The new shell with the funny fuze is devastating. The other night we caught a German battalion, which was trying to get across the Sauer River, with a battalion concentration and killed by actual count 702. I think that when all armies get this, we will have to devise some new method of warfare. I am glad that you all thought of it first, it is really a wonderful achievement": quoted in Vattisuum (1985), pp.311-312.

In Korea and Vietnam less than 5% of US artillery ammunition fired was fuzed with VT, although surveys of targets showed that it should have been used more often. It was also the preferred fuze in the Falklands war. The high cost of VT has discouraged widespread use, but solid state electronics can now reduce this cost by providing one fuze for all shells. The Israeli DM-137 electronic fuze is described in Watson (1986). Most major armies are now developing such fuzes.



level, when it was more desirable that control be delegated, as in the British system<sup>(102)</sup>.

Some senior US artillery officers called for the creation of Soviet-style 'artillery divisions' for all non-divisional artillery<sup>(103)</sup>, which would act as separate formations in their own right. In September 1945 Brigadier General C.E. Hart also urged that more attention be paid to the organization of non-divisional artillery, the decisive source of firepower<sup>(104)</sup>.

The Germans were aware of the advantages of centralized C2, and would have liked to create independent artillery formations at army group level in the West, as they had tried on the Eastern Front in 1943. But as in 1943 ambitious concepts made little progress in the face of material shortage<sup>(105)</sup>.

Throughout 1944-45 the British Army continued to focus its artillery command at corps level, but with the philosophy that artillery should be controlled at the lowest, linking the two by means of an extensive network of communications. The increasing strength of British medium and heavy artillery after 1942 called for new ideas for their C3. In autumn 1942 these assets were designated as army troops, but were divided into groups (Army Groups, Royal Artillery — AGRA) under a group headquarters, and each allocated to a corps. The commander of the AGRA (CAGRA) became answerable to the corps commander Royal Artillery (CCRA) for all CB operations in the corps area, and his guns were also used to thicken up concentrations. Unlike the Soviets and the Germans, there was no attempt to create artillery formations which could be committed to operations independently. The British used their highly flexible organization and communications to maximize the concentration of fire on targets, one at a time, in contrast to Soviet tactics, which called for all targets to be hit heavily at once. The British believed that with fewer resources, superior C3 could multiply the effect of their

<sup>(102)</sup> On the other hand, it seems that centralized C2 was often not achieved by the US Army. The German artillery commander for the Ardennes offensive, General Karl Thoholte, noted that US divisional artillery concentrations were accurate, but that there "appears to be no unity of action with the contiguous divisions"; indeed, US artillery was so strictly tied to divisions that its fire compromised the layout of divisional boundaries: Thoholte (1945). This contrasted with Soviet artillery deployments which at formation level paid no heed to the boundaries of supported arms. In one extraordinary example, however, the medium and heavy artillery of the US XIII Corps was used to lead the offensive into Germany in February 1945. It had its own reconnaissance battalion and at one time had advanced ten miles forward of leading armour: Murphy (1986), pp.46-47.

<sup>(103)</sup> Crane (1945).

<sup>(104)</sup> Hart (1945) us artillery ratios within divisions and corps seldom varied. Concentrations were achieved by moving divisions and corps across a front, rather than artillery, as the Soviets did: Gay (1986a).

<sup>(105)</sup> The closest the Germans came to achieving their ideal was in the organization of artillery for the Ardennes offensive in December 1944. Artillery at army group level included armoured FOOs with an ample supply of radios, controlled by an FDC to co-ordinate the fire of an artillery brigade or more. Despite the priority awarded to the operation, ammunition and fuel were still wanting. As a result, three out of seven *VolksartillerieKorps* were not committed, and the other four could not advance more than 50km, at which point those artillery battalions with supplies remaining were sent on to be attached to divisional artilleries. The principle of centralization of C2 at army group level was thus reluctantly surrendered once again, and not recovered: Thoholte (1945), p.714.

fire with an equivalent result<sup>(106)</sup>. Examples of the need for co-ordination at high level were matched by others which demonstrated the need for control at low level<sup>(107)</sup>.

By 1945 all the belligerents in Europe had recognized the desirability of centralized artillery C2, and if resources were available some sought to achieve it by creating artillery formations in their own right under high-level command. But such organizations needed to be balanced by other assets deployed with the supported arm to respond to their immediate needs. The alternative was to command at the highest level and control at the lowest by means of radio, maximizing the firepower of all available assets. This created fire-mobility but made it harder to move and mass equipment so rapidly at points of decision.

## Tactics

By 1944 the basic components of artillery support devised in the First World War had been re-adopted. In attack, artillery would fire a preliminary bombardment, cover the assault, and carry out missions to consolidate captured objectives. In defence, artillery fired counter-preparation missions or DFs.

While aircraft were often employed for destructive effect, Allied field artillery pursued a policy of neutralization, achieving an effect similar to that of the First World War, but with less ammunition, thanks to superior target acquisition and analysis. Even so, controversy over the merits of surprise achieved by predicted fire versus the accuracy of adjusted fire persisted.

In July 1944 the British maintained that divisional and regimental concentrations were only to be fired without 'ranging' if time were short, although this policy was criticized by others who felt that accuracy was less important than surprise, which ranging compromised. These were well-trodden arguments from the First World War, and in practice a compromise was struck. Meteorological data and maps were still relatively unreliable, and observation was the best guarantee of accuracy; but this was often difficult in bocage country; and corrections of airburst ranging fire proved unsatisfactory, because of the unreliability of powder-filled fuzes. In Normandy the British therefore preferred predicted fire and led the way in its techniques. The Germans and Soviets, in contrast, did little prediction, preferring observation.

The effectiveness of preliminary bombardments was also questioned. On 18 July 1944 massive air and artillery firepower broke German defences to a depth

<sup>(106)</sup> This technique was demonstrated in the crossing of the Rhine in Operation VARSITY on 24 March 1945, when the British XII Corps deployed 706 guns and concentrated all of them on targets one at a time. The crossing was preceded by an airborne assault for which artillery fired the largest SEAD programme in history, albeit with little success. The programme had to be synchronized with the flight of the aircraft, and to achieve this control, CCRA appointed two representatives, installed on high ground, to give executive orders to fire. See Chapter 10.

<sup>(107)</sup> During the eastward pursuit after crossing the Seine in the summer of 1944, the British Second Army covered 250 miles in six days. Targets were selected from air photographs and fired on when FOOs called for fire by radio, rather than in formal timed fireplans, although these were used when communications failed.

of 4,000 metres, but, as so often in the First World War, this proved inadequate, since German defences were deployed in even greater depth. In contrast, by 1945 preliminary bombardments were better directed, and more discriminating <sup>(108)</sup>.

Smoke was widely used to cover infantry advances in Italy, and it was also used extensively in France, for example, to support First Canadian Army's advance towards Falaise on 14 August 1944 and to cross the Seine. The use of smoke was not a matter of controversy, but the use of the HE barrage continued to be disputed. Some felt that the rolling barrage was obsolete, and should be replaced by selective concentrations, which had become normal for preliminary bombardments. Barrages were expensive in ammunition, and difficult to synchronize with the assault, which seldom progressed as expected <sup>(109)</sup>.

Opponents of the barrage held that it took too long to plan, and advocated 'The Stonk', a standard fireplan covering a front of 525 metres, which could be produced on order of its origin, axis, lift intervals and speed. Short, heavy concentrations achieved greater surprise, and could also be used to deceive an enemy; but when a large concentration was fired simultaneously, using TOT (time on target) procedure, fire fell on an area 400 metres square, and kept the infantry away from their objective, making them vulnerable to fire from the surviving defenders. The area of fall of shot aside, the argument amounted to the relative merits of the 'prolongation' of fire and the 'concentration' of fire, both of which were the subject of extensive operational research <sup>(110)</sup>; the question is still unresolved <sup>(111)</sup>.

(108) When the US Ninth Army's XVI Corps crossed the Rhine on 24 March 1945, German prisoners reported the terrifying effects of artillery on their communications. XVI Corps selected 867 targets, which were carefully graded, and concentrated fire on these with thirty-five battalions of guns on a 22km front: O'Steen (1945).

The British were also more selective by the time of their Operation VERITABLE in February 1945. The fireplan anticipated a penetration of 12km, and the massive firepower available was directed precisely at the enemy's C3 and strong-points for each of its five phases. Even so, the commanding officer of 1st Battalion the Gordon Highlanders complained on 26 February 1945 that the artillery fire was excessive, creating too much mud and destruction, and that it gave notice to the enemy of impending assault. He called for shorter fireplans with the infantry closer behind: Pemberton (1950), p.267. Such views could have come straight from the First World War and reflected continuing controversy over artillery support during the assault phase.

<sup>(109)</sup> In Italy, barrages of 100 metres in 15 minutes at the Garigliano and 100 metres in six minutes at Cassino had proved too fast, but at Overloon in October 1944 the infantry complained that 100 metres in five minutes was too slow, and held them back — although German prisoners testified to the good effect of infantry's being positioned so close behind their barrage. In spring 1945 2nd New Zealand Division reported that provided troops kept right up with it, a barrage seldom failed. For Operations GOODWOOD and TOTALIZE, 150 metres in one minute proved satisfactory for tanks and mechanized infantry.

<sup>(110)</sup> Military Operational Research Unit Report 3 "The effects of bombardment" (UK Department of the Scientific Adviser to the Army Council, 1st March 1946).

<sup>(111)</sup> A compromise was achieved for Operation VERITABLE, where the XXX Corps barrage of 1,000 guns stood on the enemy line for 70 minutes and then advanced, lifting by 300 metres every 12 minutes, firing to a depth of 500 metres. This enabled guns to concentrate heavier fire on successive targets than more frequent lifts would have allowed. It was hoped that the effect of this would outweigh the disadvantage to the supported arms, which would be unable to keep close behind it. Assaulting troops were further assisted by the flexibility of centralized C3, which enabled them to direct fire at particular targets when held up. On occasions 1,000 guns fired on single targets in answering such calls.

The rolling barrage became less common, as it had in the later battles of the First World War <sup>(112)</sup>; but even the US Army, which had considered it just a relic of that war, found need for it on occasion <sup>(113)</sup>. US artillery tactics grew to favour heavier preliminary bombardments than the British, but with less covering artillery fire in the assault. Instead the US Army used tanks to provide close support during the assault, in a manner similar to that of 1917-18, with the tank combining the roles of Soviet tank and assault gun.

German doctrine for defence placed great importance on rapid and violent counter-attack, which made Allied artillery fire in counter-preparation equally important. It became routine to plan such missions as part of the consolidation phase after an assault, and on many occasions they proved as decisive as they had in the First World War, when they were first devised <sup>(114)</sup>.

Artillery tactics in North West Europe 1944-45 saw few innovations, rather confirmation that the principal components of fire support developed in the First World War had become orthodoxy, and that in mobile operations the gun could master the tank. The firepower generated was often less than in the First World War, but its effect was enhanced by better target acquisition, centralized C2, greater control at low level, and greater accuracy. These improvements confirmed the Allied view that artillery was best used to neutralize the enemy, and that destruction, if required, was best provided by air power.

## 5. Conclusion

The war in the West began with the triumph of superior German technique in the operations of combined arms, and the apparent avoidance of a crippling war of attrition through mobility of armour. It ended with the victory of superior Allied firepower, which was achieved by massing artillery according to traditional principles, and enhancing it by advances in technology and organization. It resulted in fundamental changes in the relationship between different arms and their responsibility for providing fire support.

<sup>(112)</sup> Donnelly (1943), p.39.

<sup>(113)</sup> The advantage of the rolling barrage and the reason for its development was that it swept the ground, seeking out concealed positions. On 11 July 1944 the US 2nd Infantry Division assaulted Hill 192 in Normandy on which the German defence had created a maze of dugouts and firing positions, including towed and SP guns: Little (1948). It was decided that concentrations fired by FOOs on targets as they revealed themselves would be insufficient, and a rolling barrage controlled from one of the infantry regimental command posts was devised, made up of 100-metre lifts. Eight artillery battalions fired up to 300 rpg for the attack, and German prisoners spoke of the devastating effects of what they called "automatic artillery". But this was probably the last US rolling barrage in Europe.

<sup>(114)</sup> For example, on 13-14 June 1944, German counter-attacks on the British beach-head were broken up; and on 17 July British artillery fire drove off five German divisions, of which only one even reached British positions. The importance of counter-preparation was also demonstrated by the Americans on 17 December 1944 when a field artillery battalion at Monschau delayed the German advance in the Ardennes for more than four hours and caused the Germans to alter their plan: Reeves (1946), p.141

In 1940 the Wehrmacht paralyzed its opponents by the shock of armoured mobility and close air support. German mobility created concentrations of force, which the Allies were unable to meet with concentrations of firepower. Victory was as much political and moral as military, and artillery played a useful but minor part in it.

In North Africa the dominance of armoured mobility proved short-lived as the gun asserted its superiority, so much so that from 1940-42 anti-tank fire became the primary role of anti-tank and field artillery alike. The Germans were the first to appreciate the tactical revolution which was taking place, and used their armoured mobility to exploit superior artillery firepower.

The re-equipment of the British Army after its losses in 1940 enabled it to master attacking German armour with anti-tank guns, releasing the growing strength of field artillery to its traditional role.

Just as artillery had shown its ability to counter mobility, so it seemed the best means of regaining mobility once the Allies went on to the offensive. To achieve this they reverted to the precedent of the First World War organizations and tactics, after a period of disastrous experiment with mobility and decentralization. It was recognized that infantry could not assault without thorough-going artillery support, and that armour could not act successfully on its own.

The fireplanning techniques adopted in the desert were even more apposite to the Italian theatre, where terrain handicapped armoured manoeuvre, favouring static defence. As German fortified lines became ever more formidable, the firepower originally developed to counter the mobility of *Blitzkrieg* was redirected to blasting a way through these positions, re-creating opportunities for mobility. The massed indirect fire which thus became indispensable could be generated by massing artillery and multiplying its effect through centralized C2, made responsive to low-level requirements through comprehensive communications. Its effect was further improved by developments in target acquisition and technical accuracy.

The advantages the Allies enjoyed through reviving and expanding the role of artillery were appreciated by the Germans; but by 1944 as Allied strength swelled, their material inadequacy left them unable to compete effectively, or to take full advantage of the benefits of the centralized C2 which had been demonstrated by others since 1942. They were instead forced to adopt lesser tactical expedients, rather as the British had had to do in North Africa in 1940-42, and to seek an equivalent to mass by enhancing survivability with massive fortifications.

The decisive role of firepower on the battlefield which had been neglected in the 1930s was re-asserted in the Second World War, changing the relationship between arms in the process, and in some cases the perception of which arm was responsible for its provision.

Theorists in the 1930s had assigned to aircraft responsibility for the deep battle, even though little provision was made for it outside Germany. The shortage of medium and heavy artillery and growing availability of aircraft and naval gunfire brought such ideas to fruition for the Allies by 1943. Field artillery was thus able to devote its energy almost entirely to the close battle, or at least to targets which,

on a battlefield of greater depth than in the First World War, were of greater relative proximity. Targets, which on the scale of the First World War battlefield would have been given to artillery, were now given to aircraft, whose lack of accuracy made them suitable to carry out tasks analogous to the predicted, unobserved area saturation missions of artillery's preliminary bombardments in the First World War.

The dominance of firepower in the First World War spurred the supported arm to seek autonomous sources of close support in the form of the 'infantry gun', and arguably the tank. Between the wars, the proliferation of 'infantry guns' and tanks was too often an excuse to reduce artillery strength and inter-arm liaison, rather than a means for one to complement the other. 'Infantry guns' were widely used in the Second World War except in the British Army; but the closest substitutes for field artillery proved to be the mortar and the assault gun, sometimes manned by armoured troops, infantry, or even gunners. The infantry also acquired a substitute at short range for the artillery anti-tank gun in the form of the anti-tank rocket or projectile. As these became more plentiful and sophisticated, the infantry was at least able to defend itself against armour, and was no longer obliged to deploy around the close protection of artillery anti-tank guns.

Tanks also increased their firepower with heavier guns and wider varieties of ammunition. It remained dangerous for tanks to operate without artillery support, but against the depleted firepower of the Wehrmacht in 1944-45, US tanks frequently provided their own close support in assault, following an artillery bombardment. Tanks were also used in a secondary role to reinforce bombardments with indirect fire of their own.

The distinction between the role of the tank and the anti-tank SP also became blurred. By 1945 both were deployed in massed units to create shock, in small independent tank hunting groups, and as individual equipments to bolster infantry defence.

By 1942, artillery had demonstrated the value of firepower; and by 1945 other arms and services had found ways of producing it themselves, albeit in lesser quantities at short range, but massively in depth from the air. What they could not produce was a heavy weight and variety of accurate fire, at short notice, at any range up to about 15km. This was artillery's unchallenged preserve. Artillery's historic role has always been to provide fire of a weight or range beyond that of other arms, and it was this which had emerged again by 1945, after the confusion and mistakes of the 1930s.

The means by which artillery rediscovered its role was not so much improved ordnance, as C3. The introduction of the radio was in its own way as important as that of the petrol engine. It permitted a centralized system of C2, which synthesized the authority and priorities of high command with the fresh intelligence and immediate requirements of the smallest sub-unit. Together these could create the swift concentrations of fire which artillery has always striven to produce.

Innovations in C3, combined with the massing of materiel and a reversion to tactics forged in the First World War, gave artillery an unmatched power on the battlefield, which few had foreseen in the 1930s and many would soon resent.

## B: THE EASTERN FRONT

On 22 June 1941 the Wehrmacht launched Operation BARBAROSSA, the invasion of the USSR. The war on the Eastern Front was a struggle between two antipathetic ideologies, fought by armies with different tactical precepts and logistic resources. By May 1945 these had been put to the test and subjected to a process of evolution. The fundamental issue was the inter-relationship between firepower and mobility. Many of the lessons learned were similar to those experienced in the West; but others were peculiar to the Eastern Front.

Germany invaded the USSR with 3 million men, 600,000 vehicles, 3,580 panzers, 7,184 guns and 1,830 aircraft. However impressive these figures may sound, they were comparable to those engaged in earlier campaigns in much smaller theatres. This force was not intended nor equipped to fight a long war, which *Blitzkrieg* was designed essentially to avoid. Operation BARBAROSSA sought a quick victory through political and military shock before the USSR and the other major powers could mobilize their potentially much greater materiel resources.

The Wehrmacht could not contemplate a slow, deliberate advance across the steppe. It had therefore to rely on armoured mobility to penetrate and paralyze the opposition, and through mobility to concentrate available firepower at selected points in a vast terrain. It was not so much that the Wehrmacht discounted the value of firepower, as that it recognized Germany's inability to win a war fought on terms of comparative mass. Enhanced mobility seemed to offer the only means of circumventing this unacceptable conclusion.

This concept of operations would have found support in German historical thought, which tended to disparage the value of artillery. Clausewitz had written: "An excess of guns will impose a more passive and defensive character on operations. Greater reliance will be placed on strong positions, major natural obstacles, and even on positions in mountainous areas. The idea will be to let terrain difficulties take care of the defence and protection of the guns and to let the enemy court his own destruction. The whole war will proceed at the solemn, formal tempo of a minuet. Shortage of artillery will have the opposite effect. It will bring back attack to the fore—the active principle of movement. Marching, exertion and continuous effort will become arms in themselves, and war will be a brisker, rougher and more variegated business. Great events will be broken down into small change."<sup>(115)</sup> BARBAROSSA reflected that spirit. By contrast the USSR was eager to seek salvation in 'strong positions', 'major natural obstacles', and 'an excess of guns'.

It was in the Soviet interest to create a *Materialschlacht*, given their resources of men and materiel. Whereas Germany had learned from the First World War that it must avoid a war of attrition, and so developed alternative tactics which favoured the tank and relied less on artillery, the USSR championed the decisive power of

<sup>(115)</sup> Carl von Clausewitz *On War* (Book Five, Chapter Four: "Relationship between the Branches of the Service"), edited and translated by Michael Howard and Peter Paret (Princeton University Press, New Jersey, 1976), pp287-288; this passage is also quoted in Balck (1914), p.241.

the gun. In 1945 Lieutenant General I.S. Prochko, describing these developments, wrote: "Military doctrine fought against theories which tried to belittle the importance of the role of artillery in modern warfare. Neither tanks nor aviation, no matter how great their importance may be, can replace artillery. Artillery was and still is the most powerful weapon of the Red Army"<sup>(116)</sup>.

In Germany and Britain in the 1930s, it was judged that tanks supported by aircraft could operate independently of artillery, while the Soviets saw tanks and aircraft primarily as enhancing the role of artillery<sup>(117)</sup>. The Soviets believed that, given the strength of field defences combined with artillery, the balance of advantage lay still with defence. Yet they accepted that a war could only be won through offensive action. The belief that the gun was supreme in defence led to the conclusion that the gun and fire superiority over enemy guns would also be supreme in the attack. The essential problem was to provide mobile offensive forces with that firepower, and to give them protection in the absence of field defences. The belief that tanks and infantry should not attack until the enemy in their path had been destroyed by artillery created a greater, not lesser, need for field artillery support, as well as for anti-tank artillery in defence.

The Germans, unlike the British, actually provided armour with the air support that the theorists of the 1930s had advocated. The Soviets, though eager to exploit air-power whenever possible, regarded this weapon as a supplement to, not a substitute for, artillery, if only because of meteorological uncertainties.

War on the Eastern Front was therefore characterized by the Wehrmacht's demonstration of how mobility could concentrate firepower at the decisive time and place; by the realization on both sides that the tank could be mastered by the gun; by the demonstration that massed artillery, handled in the manner developed in the First World War, was still decisive in defence and offence; and the acknowledgement that unless *Blitzkrieg* achieved an immediate knock-out blow, an army which necessarily relied upon mobility rather than firepower could not prevail in a war of attrition, against one with opposite priorities.

## Mobility

The Wehrmacht contained surprising contrasts. Doctrine required high armoured mobility, but armoured forces constituted only a relatively small part of the total force. In 1939 the British Army was the only completely motorized army in the world. In the Wehrmacht, 80% of motive power was provided by the horse. Of the 153 German divisions taking part in BARBAROSSA, 119 were horse-drawn. Even a panzer army had deceptively few tanks. In 1941 Guderian's 2nd Panzer Group had 930 tanks but 148,544 men. An army moves at the speed of its slowest formation, and it took the Wehrmacht as long to reach Moscow as it had taken Napoleon in 1812, both travelling at the speed of the horse.

The Wehrmacht's problem lay in the speed differential between its highly mobile panzer forces and the slow-moving infantry and artillery which supported

<sup>(116)</sup> Prochko (1945), p.20.

<sup>(117)</sup> Smimov (1943).



them. It was thought in some quarters that reliance could be placed on air power as a sufficient substitute for artillery, where this could not be brought into action, but the idea was to prove fallacious. Official doctrine still acknowledged the need for artillery in armoured warfare; and in the planning for BARBAROSSA, 2nd Panzer Group was required to hold its artillery so far forward as to be able to break enemy resistance from the line of march, rather as Prussian artillery had been directed by von Moltke after 1866. The theory that field artillery could keep up proved justified in France in 1940, and sceptics were silenced.

While good roads were available, towed artillery was at least as mobile as slower tracked vehicles, although even in July 1941 German heavy artillery sometimes had difficulty keeping up <sup>(118)</sup>. But despite the problems, German artillery in the summer of 1941 was widely praised <sup>(119)</sup>.

The advance and early victories were dazzling; but Germany had underestimated the penalties that Soviet terrain and weather would impose on tactics dependent on mobility. In June 1941 a serious delay was imposed by Fifth Red Army in the defence of the Rokitno marsh, creating gaps and strains between, for example, 1st Panzer Group and the infantry divisions of the Sixth Army. The advance slowed to 11 km per day, absorbing the impetus of the drive East. Caught by mud and snow in October 1941, tanks found that their artillery had often been left stranded <sup>(120)</sup>.

The 'le Fh 18' (*leichte Feldhaubitze* 18) 10.5 cm gun, the mainstay of German field artillery, proved too heavy and many were abandoned in the mud. In an attempt to keep up, the Germans often commandeered powerful Soviet tractors to replace their horses; but it was often found that in heavy frost the guns were frozen and cemented to the ground in a solid block of ice. Towed artillery virtually disappeared from the battlefield.

By December 1941 any hope that *Blitzkrieg* could achieve an instant victory had passed. The effect of rapid movement on a grand scale was spent, and although the Wehrmacht was able to launch major offensives during the next four years, it found itself increasingly reliant on weaving tactical schemes around static fortified positions, in an increasingly defensive campaign.

The mobility of Soviet artillery was no better than that of the German. Soviet guns were not designed for quick engagements or movement, and large numbers were captured as panzers encircled or over-ran them. Both sides sought urgent remedies and looked to SP equipment for this.

<sup>(118)</sup> See Kreppele (1944) and also "Forward on roads off the main route of the army" *Military Review* Vol. 22 No. 87 (January 1943) pp. 97-98.

<sup>(119)</sup> Steiger (1975), p. 72. The advantage of close support artillery advancing well forward was illustrated by the capture of Ostrow on the Soviet/Latvian border on 4-5 July 1941, where it was estimated that half the Soviet tank casualties were caused by field artillery. The policy of pushing artillery forward exposed the guns to enemy fire, but in the spirit of the 1870s they were deployed "regardless of cost": Duic (1943a), p. 73.

<sup>(120)</sup> The attack of XXIV Panzer Corps, due for 1 November 1941, had to be postponed for several days while its artillery caught up; and on 1 December 1941 4th Panzer Division had only 38% of its supply vehicles, reporting that "the artillery tractors are falling out more and more and so too are the urgently needed guns": Sleigher (1975), p. 73. At the battle of Tula one mechanized division had just four light guns and three heavy howitzers in support.

The need for SP artillery in the Wehrmacht had been recognized before the war by Guderian. In 1935 von Manstein considered the use of assault artillery on a tracked chassis<sup>(121)</sup>; but these officers were opposed by others who feared that SPs would divert resources from tank production. Trials had shown in 1937 that an SP could engage targets more quickly than a tank, but still little was done to develop it. In 1940 only four batteries of SPs were deployed in France, but the concept proved itself, and Guderian insisted: "The SP gun carriage for the light artillery unit is an absolute necessity"<sup>(122)</sup>. The SP went into full production, but even so only 11 battalions of SPs were available for BARBAROSSA in June 1941.

The first German SPs were 75mm guns mounted on PzKwIII or IV chassis and were designed to shoot forwards with limited traverse left or right. The Germans soon developed a full range of SP howitzers, assault guns, anti-tank guns and tank destroyers<sup>(123)</sup>. The Soviets quickly developed their own range of SPs, and by the end of 1943 had regiments equipped with SU-76, SU-122 and SU-152. These were replaced by the more sophisticated ISU-122, ISU-152, SU-85 and SU-100 SP guns<sup>(124)</sup>.

As new models were produced to meet new tactical requirements and old models were misemployed to meet contingencies, the distinction between SP indirect fire weapons, SP assault guns, and SP anti-tank guns became blurred; but there remained a clear difference in their employment by the Soviets and by the Germans.

The original idea of the SP, which started in the First World War and led to the British Birch Gun of 1925, was that it should accompany armour to provide additional firepower. If this idea appealed to some senior German officers of the 1930s, it was certainly not practised in the early years on the Eastern Front, where the SP was essentially a mobile artillery reserve for infantry formations<sup>(125)</sup>.

The SP gun had been seen since 1940 as an ideal 'shock' weapon. It could undertake lengthy night marches, and its mobility enabled the Germans to drive hundreds of kilometres in 1941-42 to block Soviet offensives. The SP was also self-sufficient to the extent that, for example, the Stu GIII assault gun could carry

<sup>(121)</sup> Kurowski & Tornau (1978), pp.7-8.

<sup>(122)</sup> Steiger (1975), p.74.

<sup>(123)</sup> The mainstays of German field artillery were *Wespe*, a *le Fh* 10.5cm howitzer mounted on the PzKwIII chassis, and *Hummel*, a 15cm howitzer. The Stu GIII equipped with the 7.5cm and later 10.5cm gun was the primary means of close support to armour between 1940 and 1945. The first tank hunter was the *Panzerjäger I*, a 4.7cm PAK mounted on a PzKwI chassis. It was succeeded by heavier vehicles such as the 8.8cm *Ferdinand* *Elefant* (see Andreev (1943) and Vysckoostrovski (1943a)) and the more successful *Jagdpanther* and *Hetzers* of 1944-45.

<sup>(124)</sup> A measure of the mobility achieved by Soviet artillery may be seen in the ability of the 2nd Belorussian Front to cover 600km in one month during the summer of 1944: Smimov (1945a), p.104.

<sup>(125)</sup> 'Leadership and Employment of Assault Artillery', issued by OKH in 1945, described them as "the decisive means by which a commander can control the changing circumstances of an engagement", providing support at times of crisis when towed artillery was unable to respond: quoted in Lucas (1980), p. 122. SPs were said to be "decisive when formed in a compact group and put in at the point of main thrust. This effect is reduced or lost completely if the unit is split up": quoted *ibid.*, p. 123. Each SP assault brigade of 31 guns was allotted to a division with the intention that it be used as a single unit, in accordance with OKH policy.

44 rounds of ammunition or up to 120 with rounds laid on its floor, a logistic convenience which enhanced mobility.

Infantry originally moved on foot, but later it was found expedient for them to ride on the vehicle itself. In battle, the guns were usually positioned behind the infantry. As the infantry assaulted, the assault guns passed through them to engage the enemy; but in close country, such as maize or sunflower crops, they would take the lead, firing the infantry on to their objective — this was artillery used in the manner of Napoleon at Friedland and Wagram, or the *Schlachtkörper* of the 1860s and 1870s. In defence, SPs usually formed part of the anti-tank barrier, or acted as a mobile reserve.

The relationship between infantry and the SP was gradually transformed, until it was the infantry which de facto operated in support of the gun. The SP became more vulnerable as Soviet anti-tank guns proliferated, and therefore required close infantry protection <sup>(126)</sup>.

SPs relied increasingly on their own command structure. They were well equipped with radios, and usually had a Luftwaffe liaison officer available at their brigade headquarters, through whom they could be directed by air OPs.

By 1944 the German SP, whether designed originally as an anti-tank, field or anti-aircraft gun, had become not so much a means of armoured fire support for infantry as a force of mobile hunters supported by infantry. The natural reaction to a shortage of resources is to spread them out. As the strain on the Wehrmacht grew, the use of SP tank hunters in large formations became impossible; and, in contravention of OKH policy, SPs were often deployed in troops, using their mobility to compensate for inferior numbers <sup>(127)</sup>.

Despite a doctrine that SPs were best employed *en masse*, they nevertheless proved equally effective tank-killers, when employed in small groups. It is estimated that by May 1944 they had destroyed 20,000 Soviet armoured vehicles, and 30,000 by the end of the war. Soviet tanks were often instructed to avoid combat with SPs, which gun for gun destroyed more equipment than did German tanks <sup>(128)</sup>.

The SP concept was originally to provide fire support for tanks, but for some years this was judged unnecessary. The ironic experience of the Wehrmacht on the Eastern front was that the tank could no longer operate alone for fear of the SP. In 1944 Lieutenant Colonel von Kugelgen wrote that "the artillery must keep up to the speed of an armoured advance. Only then is armour safe against any surprise" <sup>(129)</sup>.

The Soviets employed their SPs in an orthodox manner from the start <sup>(130)</sup>. Lieutenant General I.S. Prochko pronounced that "the main object of the SP artillery is the closest possible co-operation with tanks" to destroy enemy anti-tank

<sup>(126)</sup> Each sp artillery brigade was assigned 200 grenadiers, permitted no other task than the close protection of the guns.

<sup>(127)</sup> Rather as British 'Jock Columns' did in North Africa in 1942.

<sup>(128)</sup> Kurowski & Tosnau (1978), p.17, and Lucas (1980), pp. 122-123.

<sup>(129)</sup> von Kugelgen (1945), p.434.

(T0) Bykov (1944).

defences and to destroy enemy counter-attacks<sup>(131)</sup>. Without such support Soviet armour was not free to manoeuvre. "Tanks used in a large number in an offensive against a defending enemy are capable of carrying out important tasks, but they do not replace artillery. On the contrary, tanks themselves constantly require artillery support"<sup>(132)</sup>.

The firepower and armour of AFVs came to be valued more than their mobility. By the end of the war armoured formations did not so much seek to out-manoeuvre as to out-shoot one another, which explains the use of SPs in Soviet tank formations. As the calibre of SPs increased, so their mobility was reduced, but tank units were prepared to restrict their own mobility in return for this enhanced firepower<sup>(133)</sup>.

### Counter-mobility

In 1914 artillery was directed primarily against infantry, but by 1917 enemy artillery achieved equal importance as a target, and in 1918 the German General Staff went beyond that by declaring the destruction of enemy tanks to be artillery's priority. During the 1930s this wisdom was generally neglected, and all belligerents entered the Second World War with inadequate anti-tank ordnance, characterized by 37mm and 2pdr weapons. Inadequate anti-tank defence was as evident on the Eastern front in 1941 as it had been in France in 1940,

Count Kutusov's order of the day at Borodino in 1812 was: "Let it be known to the commanders and officers that only by standing our ground courageously shall we succeed in not yielding a single step to the enemy. The artillery must sacrifice itself. Even at the risk of being captured altogether with your ordnance, fire your last shot at the enemy. A battery which acts thus, even if captured, will more than compensate for its loss". Similar exhortations were made to Soviet gunners facing German tanks in 1941-43.

The Soviets tried desperately to form anti-tank barriers in the path of German offensives<sup>(134)</sup>. Lieutenant Colonel V. Smirnov maintained that "artillery proved to be the basic weapon of fighting tanks" and that "the creation of reliable anti-

<sup>(131)</sup> Prochko (1945), p.27. In July 1943 Major General Nozdrunov described the importance of the SP in attacking complicated German fortifications, since only the SP with its armour could approach close enough to these positions to destroy them with direct fire: Nozdrunov (1944).

<sup>(132)</sup> Prochko (1945), p.23.

<sup>(133)</sup> Lieutenant Colonel G. Khainatskii maintained that within armoured formations Soviet tanks should be concerned with the destruction of enemy manpower rather than duelling with other tanks. Instead, Soviet SPs were the primary means of destroying enemy armour, and were to "immobilize enemy tanks and prevent them from disengaging from battle, thereby accomplishing their main mission, which is securing liberty of movement of our tanks": Khainatskii (1946), p.25. Colonel P.S. Afanasyev also asserted, in his description of artillery planning for armoured operations, that the aim of artillery was to suppress anti-tank defences in order to secure freedom of manoeuvre for mobile groups: Afanasyev (1944), p. 128. The firepower of artillery was thus to give the tank mobility, as Alanbrooke had predicted in 1926: Brooke (1927), p.482.

<sup>(134)</sup> All Soviet armies possessed anti-tank regiments, each capable of covering a front of 2-3km to a depth of 1km. These were in constant demand outside Moscow in 1941, at Voronezh and Stalingrad in 1942, at Kursk in 1943, and Yassy in 1944.

tank defence has become the main task of artillery during this war”<sup>(135)</sup>. Lieutenant General Prochko held that “no tank attack is to be feared if there are sufficient numbers of anti-tank guns”<sup>(136)</sup>.

In 1941 the gun had far from mastered the tank. The Wehrmacht was still generally equipped with the PAK 36, a 3.7cm weapon criticized in 1940 as being ineffective against British armour, and derisively known as ‘door knocker’<sup>(137)</sup>. The 5cm PAK 38 began to arrive in 1941; but the Germans were horrified to find that the Soviet KVI and T34 were apparently impervious to all but the 8.8cm flak gun, and direct fire from the 10.5cm field gun<sup>(138)</sup>. Rather as the British were compelled to misuse their 25pdr field guns in North Africa as direct fire anti-tank pieces, so the Germans misused their field guns in desperate attempts to protect their under-gunned and under-protected armour from Soviet assaults<sup>(139)</sup>.

From 1942-45, the war became a race between the designers of guns and tanks, in which tanks never led. A partial remedy for the German predicament came in 1942 with the introduction of the PAK 40, a 7.5cm piece originally ordered in 1939. It was a powerful weapon able to penetrate 94mm of armour at 1,000metres, while the T34 had only 60mm of armour; but it was extremely heavy, and in Russia many were abandoned in the mud. The mainstay of the Wehrmacht in 1942 was, in a double irony, not the PAK 40 but the Soviet (formerly German) 76.2mm Field Gun, Models 1936 and 1939, which were among the estimated 15,000 guns captured by the Wehrmacht in 1941<sup>(140)</sup>.

The Soviet answer to the problem of anti-tank defence in 1941-42 was not to design series of new weapons but to adopt the German tactic of 1917 and designate all artillery weapons as anti-tank; they discovered too that direct fire from howitzers could be very effective<sup>(141)</sup>. Unlike the Germans, the Soviets were able to produce artillery in vast quantities, and by 1943-44 the balance had tipped in their favour, with the number of German guns in relative decline.

Artillery had been designated the primary tank killer, but by 1944-45 the Wehrmacht was unable to cope with the scale of the task. Just as in the First World War the infantry had demanded an ‘infantry gun’ to restore a measure of battlefield independence, so technology was developed to meet the requirement for an infantry anti-tank weapon<sup>(142)</sup>. The Germans developed the Teller mine, and, using US research into recoil-less rifles, produced the Panzerschreck and Panzerfaust. These short-range weapons were never as effective as the anti-tank gun, but

<sup>(135)</sup> Smimov (1945a) p. 104.

<sup>(136)</sup> This feat was first achieved by the Soviets outside Moscow, where they claimed that between 16 November and 10 December 1941, 1,434 German tanks were destroyed: Prochko (1945). p.24.

<sup>(137)</sup> The Germans wanted to use a tungsten armour-piercing shot, which had up to 50% better penetration than other rounds, but none were produced after 1941, because of a shortage of the raw materials: Weeks (1975) p.63.

<sup>(138)</sup> Duic (1943).

<sup>(139)</sup> On the other hand, they could take comfort from duels with lighter Soviet tanks, which “resulted without exception in our favour”: *ibid*, p.78. Provided that the gun were powerful enough, the tank as a system proved the more vulnerable.

<sup>(140)</sup> Mellano (1951) and Gabriel (1943).

<sup>(141)</sup> See “Point-blank fire” *Military Review* Vol.23 No.9 (December 1943) pp. 85-86.

<sup>(142)</sup> Kamarck (1943).

could be produced and deployed in great numbers. These developments, which were comparable to the US Bazooka and the British PIAT, were significant in that they sowed the seed for a type of weapon, the ATGW, which in time would prove more useful than the anti-tank gun, and remove from artillery the prime responsibility for anti-tank warfare which it enjoyed in the Second World War.

## Massing artillery

The fate of German armour in 1941 taught the Soviets that before they could deploy their own armour in attack successfully, they would have to master the enemy's anti-tank defences, and that only artillery could be relied upon for this task. The firepower required could be generated by massing equipment and ammunition, by its efficient command and control, and by its sound tactical application.

(i) *Mass*: Russian artillery tradition had always favoured mass, but in the First World War the techniques of applying massed artillery fire were developed on the Western rather than the Eastern Front. Consensus in the West after the First World War was that destructive fire carried severe penalties and that future tactics would be characterized by fast-moving operations with short sharp concentrations, fired by decentralized artillery units, neutralizing the enemy. Opinion in the USSR disagreed, and in the 1930s Soviet artillery under Marshal Voronov developed on the principles which the West had discarded. His objective was the centralized control of artillery, and its massed employment at all levels to destroy the enemy. Any critic of these principles was silenced by the Soviet experience in 1941. From that time Soviet artillery demonstrated the lessons learned in the West in the First World War, lessons which her allies were forced to re-learn<sup>(143)</sup>.

In December 1941 the Stavka authorized organizational reforms and the allocation of massive resources to artillery production. On 10 January 1942 the Stavka decreed that artillery be used in concentrations, and massed on the axis of advance<sup>(144)</sup>. By mid-1943 Soviet artillery strength had doubled and by mid-1945 had multiplied fivefold<sup>(145)</sup>. The Wehrmacht became painfully aware of Soviet firepower and reckoned that where the Soviets were successful, it was usually because they had achieved artillery superiority of at least two to one. When the Soviets massed medium artillery formations with MBRLs "the combined firepower was almost unbearable"<sup>(146)</sup>. There was nothing new in the principle of concentrating artillery; the Soviet innovation was to concentrate artillery on all parts of the chosen sector at once, and to give all guns a direct fire role<sup>(147)</sup>.

<sup>(143)</sup> Stalin himself was a keen advocate of massed artillery, influenced perhaps by his witnessing the destruction of the White General Mamontov's forces at Tsaritsin on 17 October 1918. He had been impressed by the power of General Tikonov's artillery in Soviet victories over the Japanese in Manchuria in 1938, and by Marshal Voronov's breaking of the Finnish Mannerheim Line in 1940.

<sup>(144)</sup> Bellamy (1983), p.270.

<sup>(145)</sup> Hofmann (1978).

<sup>(146)</sup> Thoholte (1945), p.713.

<sup>(147)</sup> Smirnov (1945a), p. 105, where it is also noted that at Sapun, for example, the Soviets employed 256 guns in the direct fire role on a 6km front.

The number of Soviet guns gradually wore away German resources. On 19 November 1942 the Soviets fielded 5,000 pieces and fired 700,000 rounds to start their encirclement of Stalingrad, and in July 1943 finally established materiel superiority over the Wehrmacht at Kursk, in a battle of attrition from which the latter never recovered. See Figure 8 for a comparison of Soviet and German gun production.

Fig. 8 Comparison of German and Soviet gun production, 1942-44

<i>Gun Production (over 75 mm)</i>	<i>Field Artillery</i>	<i>Anti- Tank Artillery</i>
German 1942	12,000	2,400
German 1944	40,600	15,300
Soviet 1944	56,000	29,000

*Source: Seaton (1982).*

The use of massed artillery was to some extent an alternative to the creation of fire-mobility by technical means favoured by the Western allies; but massing artillery in forward and often exposed positions also caused the Soviets to accept fearful casualties which the allies could not, for political reasons, have sustained<sup>(148)</sup>. Soviet artillery continued to grow. It was not uncommon to find Soviet artillery massed with 200 guns per kilometre, and on occasions this could rise to 500 guns per kilometre<sup>(149)</sup>.

The Wehrmacht did not oppose the principle of massed artillery; rather, it had made scant provision for it, having designed its forces and tactics in such a way as to avoid a war in which such masses would be necessary. By 1942 it was clear that Germany had embarked on just such a war; it scoured the arsenals of occupied Europe in search of equipment, and endeavoured to create the organization to match Soviet firepower.

In 1948 Lieutenant General Kurt Dittmar, General Graf Ralph von Oriola and Major General W. Viebig, all former artillery commanders, were asked to analyze

<sup>(148)</sup> Their approach to casualties was exemplified by the sanguinary exposure of the artillery of Fourth Ukrainian Artillery Group on the Perekop Isthmus and around Sevastopol in the spring of 1944,

<sup>(149)</sup> In Flanders and at Verdun in the First World War, concentrations had rarely been greater than 160 pieces per kilometre. On 23 June 1944 the Soviets launched their assault on 38 German divisions in Belorussia with 166 divisions supported by 31,000 pieces of over 76mm, and 5,200 tanks and SP guns. These were sustained by a total of 150,000 railcars and 3 million tons of ammunition in 50 trains per day. The effect of such firepower could be dramatic. For example, at Jassy-Kishinev on 20 August 1944 six lines of Gennan defences were over-run in five and a half hours — a breakthrough of a kind never seen in the First World War: de Watteville (1947), p. 139. On 12 January 1945 the First Ukrainian Army under Koniev secretly massed thousands of guns on the Sandomierz front, and after a violent two-hour bombardment burst through German defences, in an advance that was to capture ground from the Vistula to the Oder.

The Battle for Berlin provides an interesting illustration of how by 1945 firepower had come to dominate warfare. In 1760 Berlin fell to General Tchemyshev after the firing of just 12,000 rounds by his forces. In 1945, by contrast, the Soviets attacked the city with fire from 22,000 guns: Prochko (1945), p. 31. At one time 500 pieces were lined up on less than one kilometre of Unter den Linden.

the causes of German defeat<sup>(150)</sup>. They were at pains to point out that the concept of concentrated fire (*Feuerzusammenfassung*) developed in the First World War, was indeed the principle of the Wehrmacht's tactical and technical doctrine. Before 1939 there had been annual training, which included shooting by concentrations of up to 30 batteries, presided over by the Inspector of Artillery, with great emphasis laid on the provision of radios, maps and the perfection of target indication to create fire mobility<sup>(151)</sup>. But such relatively small demonstrations of fire control were no compensation for mass in the generation of firepower. The real failure was one of resources that could be made available. Germany's inability to match the fire concentrations of her enemies was not the result of a judgement that these were unnecessary, but rather occurred because "where there is no ammunition there is no fire concentration"<sup>(152)</sup>. General Karl Thoholte also attributed defeat to logistic failure<sup>(153)</sup>. The Wehrmacht was able to concentrate masses of artillery at, for example, the siege of Leningrad, where in 1942 it amassed 220,000 tons of artillery ammunition and was able to fire 4,000 tons per day on a single corps front of 20km; it was claimed that at Lake Ladoga there were no gun positions left for any more<sup>(154)</sup>. Large concentrations of artillery were also achieved at the sieges of Stalingrad and Sevastopol, but the Wehrmacht was not designed or able to create these without imposing an intolerable strain on resources elsewhere; and "German armoured forces were not in sufficient strength to equalize (Soviet) firepower"<sup>(155)</sup>. The Allied strategic bombing campaign against Germany was largely responsible for this. Not only was industrial capacity damaged, but also large numbers of guns were diverted to air defence. In September 1939 the Germans had 9,000 guns deployed in the defence of the home front, but by June 1944 this had risen to 45,000, with 33,000 of them in the West.

The continual pressure to disperse forces to cover vast distances with inadequate, though mobile, assets militated against effective concentration. Rather than spread their forces thinly, the Germans created heavily fortified 'Hedgehogs', to act as bulwarks against the Soviet tide<sup>(156)</sup>. But 'Hedgehogs' invited encirclement, and although they often imposed serious delay and heavy casualties, they were usually isolated and doomed. They were reduced one at a time by Soviet forces, which were able to mass in even greater strength with little interference<sup>(157)</sup>.

<sup>(150)</sup> Cole (1948). Lieutenant General Dittmar commanded the 169th Infantry Division in 1941. General Graf von Oriola commanded the VI Corps on the Eastern Front in 1945. General Viebig commanded the 277th Infantry Division in 1945.

<sup>(151)</sup> The concentration of the fire of 10 *Abteilungen* on a 800-metre front during the offensive against Voronezh in 1942 was given as an example of how such training paid off in war.

<sup>(152)</sup> Cole (1948), p. 196.

<sup>(153)</sup> Thoholte (1945).

<sup>(154)</sup> A problem reminiscent of complaints made in the battles of 1870-71. Such masses also strained the resupply system, as the French had discovered in the Verdun Salient in 1916, where the concentration of yet more guns was counter-productive, given that those already deployed had insufficient ammunition.

<sup>(155)</sup> *Ibid.*, p.709.

<sup>(156)</sup> In a similar position, on a much smaller scale, in North Africa in 1942 the British resorted to the 'Tobruk Box'.

<sup>(157)</sup> For a description of the development of German defensive positions between 1943 and 1944, and the Soviet concentrations massed to defeat them, see Donnelly (1984a), p.10.



Some theorists held that the Luftwaffe could provide decisive fire support; but General Thoholte said that even against weak Soviet air forces, the Luftwaffe was never able to influence the ground battle to such an extent that the importance of artillery could be neglected. Once Germany had been thrown on to the defensive, the burden of combat shifted away from aircraft and tanks to the infantry and artillery. This was not because the former were not needed; on the contrary, demands on their services became even more severe. Rather, their short supply forced reliance on the latter, against earlier German doctrine. In time, infantry strength weakened, and 60-80% of combat was undertaken by the German gunners — a burden out of all proportion to pre-war planning <sup>(158)</sup>. The shortage of artillery therefore carried severe penalties. These were bad enough in the close battle, but in a war dominated by artillery on both sides, CB fire in the deep battle was especially significant. The Soviets were sensitive to effective CB fire. Where it was achieved, their operations were badly disrupted, and in consequence they were wont to attack sectors weak in artillery. The inability to conduct effective large-scale CB operations, as well as the loss of air superiority, was a primary cause of German failure in both the West and the East. The pattern was similar to that of the First World War. The early hopes of victory through mobility were replaced by an insatiable demand for the firepower of artillery; but with the trials of strength occurring in encirclements and annihilations reminiscent of Cannae, rather than in the linear trench systems of 1914-18.

(ii) *Command and control*: The Soviets succeeded in creating overwhelming firepower through the massing of equipment, and were masters at operations above divisional level. The Western Allies generated firepower by multiplying the effect of their substantial assets by fire mobility. In the case of the British, this required a centralized ‘vertical’ command structure, but also a highly developed ‘lateral’ control by radio communication. Whereas the British might rely on calls for fire to neighbouring units, the Soviet style was to provide larger quantities of equipment on all sectors in the first place; and if this proved insufficient, to commit reserves of independent artillery formations. This may have appeared an inefficient use of resources in Western eyes, but it suited Soviet circumstances and proved a reliable and resilient means of generating firepower. In 1941, 8% of Soviet artillery was usually allocated as a reserve, but by August 1945 35% was a more common figure. General Thoholte believed command and control to be “the strongest point in Russian artillery” <sup>(159)</sup>.

A Soviet artillery officer was not answerable primarily to the commander of the formation which he supported, but to his next superior artillery officer. The effect was to create a uniform and powerful chain of artillery command with far greater freedom of tactical responsibility than in other armies. Artillery sectors seldom corresponded to those of the supported formation, conforming instead to the design of higher command; and in operations with a major artillery involvement the artillery officer had a greater say in its tactical execution than either the

<sup>(158)</sup> Thoholte (1945), p.709.

<sup>(159)</sup> *Ibid*, p.713.

infantry or armour commanders, and in many large formations the second in command was himself also a gunner.

The Soviets believed that every infantry or armoured unit should have close support from its own affiliated artillery; but such limited artillery could not alone deliver the blows required for decisive results on a given sector. Extra artillery was required, often outnumbering supported units in the process <sup>(160)</sup>. Such an excess of artillery required a special system of C2.

The method of centralizing Soviet artillery C2 was laid down in the 'Battle Regulations for Artillery' of 1937. These directed that close support artillery be co-ordinated at divisional headquarters even though no assets were actually grouped at that level. Artillery for deep tasks were grouped and commanded at corps level. If a division required additional close support, the corps commander would allot assets from another division rather than use those held at corps.

This system was reorganized in 1941 with deep attack responsibilities being passed on to artillery formations created at army level; and shortly afterwards corps regained its own artillery, enabling it to reinforce one division without removing support from another. At the same time a divisional artillery group was formed to ensure that supported units within the division could be reinforced, again without cost to others <sup>(161)</sup>. By the time the Germans invaded the USSR, Soviet artillery had adopted a system in which no unit or formation was without its own artillery support and at all levels a further force of guns was available if necessary. Because supported units were thus largely self-sufficient, formation commanders were usually able to deploy their own artillery as a cohesive body, the artillery division, committed to the battlefield as a unit in its own right, without commitments to other arms. Artillery achieved a measure of independence through these units which had not been seen since the 19th century <sup>(162)</sup>.

The Germans undertook a major reorganization of their artillery shortly before the invasion of the USSR to shape it for the operations to come. Corps artillery was disbanded, with heavy guns dispersed to divisions; and within the divisions guns were distributed to lower levels <sup>(163)</sup>. All levels of command from company to regiment possessed their own fire support, but assets at division were small, and there was none at corps. The intention of such decentralization was to give units self-sufficiency in a theatre which demanded rapid offensive action, and to encourage junior commanders to use their own initiative rather than appeal up the chain of command for help. The Germans also feared that if artillery were held

<sup>(160)</sup> In June 1944 the Second Belorussian Front contained 36 rifle regiments, but had 41 artillery regiments; and in March 1945 one army within the Second Ukrainian Front had 18 rifle regiments but 39 artillery regiments.

<sup>(161)</sup> Samsonov (1946).

<sup>(162)</sup> The Soviet model won many admirers in the US Army, who believed the complete lack of close support artillery at the lowest level to be a serious flaw in their own organization; but the US Army persisted in the belief that tanks could produce sufficient firepower of their own: Pyle (1944).

<sup>(163)</sup> Instead of four 10.5cm guns and eight 15cm howitzers, divisions were given twelve 15cm howitzers and four 10.5cm infantry guns. Within the panzer division, 25% of heavy guns were given as organic artillery to the infantry, which formerly had none.

at higher level to the rear it would miss the battle<sup>(164)</sup>. Time and speed of response were judged more important than weight of fire and co-ordination. The problem was, how would this low-level artillery keep up, and if thrown on to the defence, how would it be co-ordinated? In the event, war on the Eastern Front did not go according to plan; and in coming to grips with a powerful adversary co-ordinated artillery operations at a higher level became essential.

The early success of *Blitzkrieg* made it hard for the Wehrmacht to alter its concept of the way artillery should be employed<sup>(165)</sup>. The Germans found that a division with just three light battalions and one medium battalion could not operate effectively on the wide fronts in the East, and so a pool of artillery battalions at divisional, corps and army levels was created where large operations were envisaged<sup>(166)</sup>.

The Germans and Soviets both recognized that centralized command and control multiplied the effectiveness of artillery fire, but only the Soviets had the resources to exploit this fully. The Germans were particularly impressed by Soviet independent artillery formations, and tried to create their own. This was Artillerie Division 18, the brain-child of Field Marshal Erich von Manstein, formed in October 1943 but disbanded in August 1944 on the order of Field Marshal Model. It was a well-equipped, innovative formation, which might have become a model for many others. It proved instead to be the only artillery division deployed by the Wehrmacht in the Second World War, not because it failed, or because of battle losses, but because of the continual dissipation of its strength to other units. Its role and organization offer an interesting hindsight into the lessons learned by German artillery on the Eastern front and how it could have organized itself, given the means<sup>(167)</sup>.

<sup>(164)</sup> A philosophy in keeping with that of the 1860s and 1870s, which preferred to place artillery well forward in the line of march.

<sup>(165)</sup> 'Esen' (1944).

<sup>(166)</sup> This attempt at centralization contained many weaknesses. Firstly at divisional level these battalions lacked an *Artillerie Kommandeur* (ARKO), the next senior artillery commander being at corps; and secondly, pooled assets were primarily for deep attack, and were seldom used to reinforce the close support of other arms. Nevertheless these groupings proved valuable in a role not fully understood before 1939: Thoholte (1945).

<sup>(167)</sup> Artillerie Division 18 played a major part in the destruction of the Soviet 1st Tank Army south of Cherkassy in early 1944. It was created to provide concentrated firepower in attack and defence. It consequently had high cross-country mobility and sufficient armour, infantry and anti-aircraft assets for self-defence. Advanced techniques of fire-mobility were developed to generate maximum firepower. It possessed as many radars as an infantry corps, each FOO was armoured, and had communications to each of the division's nine battalions as well as to divisional headquarters. To ensure sound tactical decision-making the FOO was not a lieutenant but usually an experienced field officer; and to improve targetting the division possessed its own intelligence cell. The divisional commander himself rode in a tank, and could authorize a FOO to fire on a single divisional target with 148 guns in a drill taking just four minutes. The key to fire-mobility was the *Feuerleitbatterie*, whose modern equivalent is the Fire Direction Center (FDC). Artillerie Division 18 was the first German formation to use such a system and also the first to use the automatic reckoning equipment *Koppelungsgerät*: see Thoholte (1945), p. 712.

The division had its own supply organization to sustain its firepower, including seven trains, and could travel 100 km in 24 hours with full logistic support. It would have had further enhancements, such

When that division was formed, the Soviets already had many independent artillery formations. The German experiment took the principle and created the most potent force of its kind, combining armoured mobility, exceptional firepower and sophisticated C3. But by 1944 the forces of decentralization were overwhelming, and subsequent attempts to recreate it during the campaign in Normandy failed; and such an organization has not been seen in the West since.

### Tactics in defence

Soviet artillery was founded on the lessons of the First World War. Experience in the Second World War confirmed these principles, which remained the foundation for the tactics which developed. The Soviets' first challenge was to establish an effective defence, and by the time of their victory at Stalingrad this had been well-proven. The German attack on Stalingrad was a rapid operation executed primarily by tanks supported by aircraft, with artillery in a relatively minor auxiliary role.

For the Soviets, Stalingrad was essentially a test of artillery in defence, with two major considerations: the siting and the security of anti-tank guns. They deployed four anti-tank belts 10km deep, able to fire out to 20km from the final positions. Field guns were tasked to fire indirectly until presented with direct fire targets, and SPs were held as a direct fire, mobile reserve. From this battle the Soviets concluded that, in defence, artillery not aircraft was the superior source of fire support; that the anti-armour plan should determine the general deployment; that all guns should be capable of direct fire; that an artillery reserve was essential; that tanks should counter-attack only after a tank attack had been halted by artillery; that artillery must be sited in depth in prepared positions; and that indirect fire was only efficient if massed and commanded centrally <sup>(168)</sup>. Similar lessons could have been listed in 1918.

In July 1943 the Germans massed their forces to the north and south of the 200km-wide Kursk Salient in an attempt to regain the initiative. The long build-up was known to the Soviets well in advance, and the battles which followed re-taught the 25-year-old lessons that surprise and counter-preparation fire can be decisive <sup>(169)</sup>.

as a Nebelwerfer battalion, which was diverted elsewhere, and helicopters, which failed to arrive. It was also supposed to be equipped with 15cm and 21 cm howitzers, but the 10.5cm was issued as a substitute for the former, as a result of bomb damage to factories in Germany.

<sup>(168)</sup> 'Esen' (1943).

<sup>(169)</sup> In the north, General Rokossovskiy forbade his Thirteenth Army to interfere with the German build-up until just hours before the offensive was due to be launched. On 5 July German assembly areas were devastated by pre-emptive fire; and so much German artillery was destroyed, that those units which did attack were left to assault with inadequate support. Even during the counter-preparation phase the Soviet anti-tank defence lines were forbidden to fire, lest their positions be compromised. The Soviet Seventh and Sixth Armies adopted similar policies; and the German 19th Panzer Division was so badly mauled by the latter that it was unable to advance. Counter-preparation on the First World War model played an important part in Soviet artillery tactics, and was all the more effective when, as at Kursk, it was planned at army level, and executed through a system of centralized command and control: Levit (1944). Its importance was acknowledged by German commanders (such as Major General Ulrich Vassol, who

German tactics in defence were similar in many respects to those of the Soviets, but in execution lacked the resources of firepower. *Blitzkrieg* had proved stunningly successful in 1941, but although the *Wehrmacht* retained the ability to mount major offensives, it was thrown progressively on to the defensive. Its doctrine had prepared it for 'active defence' or the 'delaying battle' (*das hinhaltende Gefecht*). This had its origins in General *Lossberg's* idea of 1917 which gave up linear defence in favour of a system of strong points, positioned well forward but supported by forces in great depth <sup>(170)</sup>.

The difficulty of applying this in the USSR soon became apparent, where the scale of operations made it impossible to construct a comprehensive system of strongpoints supported in depth. By 1943 the Germans had accepted that the Soviets would not only penetrate their positions as 'active defence' expected, but would also encircle vast numbers of troops. These encirclements were usually the consequence of political direction that forbade withdrawal. German defence was therefore generally not characterized by co-ordinated mobile operations around a deep framework, but by isolated fortified 'hedgehogs', and the occasional desperate attempt at their relief. On the other hand, these positions, which were usually based on transport junctions such as Orel, *Kharkhov* and *Belgorod*, were often so large that they themselves could operate a system of 'active defence', and, as at *Velikie Luki*, featured checkerboard systems of dugouts and gun emplacements reminiscent of 1917. Many had defensive zones up to 20km deep, consisting of barriers which channelled attackers on to protected gun positions, exposing the former to subsequent armoured counter-attack.

The Germans were well aware of the value of heavy fortifications, and had for example been held up themselves by Soviet positions on the 'Stalin Line' in 1941 <sup>(171)</sup>. Many German positions such as *Staraya* proved very successful; but most succeeded only in delaying the Soviets, who found that such fortifications could eventually be defeated by monstrous firepower, such as the 3,000 barrels per mile deployed at Orel in July 1943 <sup>(172)</sup>.

## Tactics in offence

Having proved their tactics in defence, the Soviets turned their attention to offence. Looking to the experience of the First World War, they opted not for neutralization but for destruction. "The enemy's fire weapons were so effectively protected that

observed that "if our infantry does not advance, it is because of your artillery": *Prochko* (1945), p.58), who frequently used it themselves with success, though never on the scale of the Soviets. General *Vassol* commanded *Artillerie-Kommandos* 144 and 153 in 1941.

<sup>(170)</sup> This had been taken up by the French generals *Loizeau* and *Allehaut*, who championed the role of mobile armoured forces operating around fortified pivots, as an alternative to mere firepower. The German General von *Nehring* pursued *Lossberg's* ideas of pivots, and *Loizeau* and *Allehaut's* ideas of 'active defence', contributing to a major study of the subject in 1938 by General von *Leeb*. This adapted the principles of *Blitzkrieg's* defence — the concentration of limited forces, creating a disproportionate effect through shock. *Kovacs* (1943). In *Pabst* (1986) a member of a German OP party describes his experiences in Russia 1941-43.

<sup>(171)</sup> *Kreppel* (1944).

<sup>(172)</sup> *Kovacs* (1943).

it was not enough to silence him. They had to be smashed to atoms" wrote Major General F. Samsonov <sup>(173)</sup>.

German hedgehog fortifications constituted such formidable barriers to movement that destructive tactics alone seemed likely to create opportunities for rapid armoured exploitation. The Soviet innovation was to generate destructive firepower in so short a time that the advantages of surprise associated with the tactic of neutralization were not lost; but otherwise they stuck to the formula of 1915-18: the preliminary bombardment, the assault, the barrage and the exploitation.

The Soviet preliminary bombardment depended on the massing of equipment and ammunition. They studied and admired the effect of artillery in offensives such as that on the Aisne in April 1917, where 5,597 guns had been massed <sup>(174)</sup>; but mass alone was not responsible for Soviet success. The key lay in the shock of high rates of fire and surprise. The Germans noted the great skill with which the Soviets prepared and concealed their operations <sup>(175)</sup>; and whereas similar preliminary bombardments in 1916-17 might have lasted seven days, surrendering surprise, the Soviets often achieved destructive effects in just one to three hours. "The enemy's infantry in the area of the direct breakthrough has as a rule been completely annihilated by the concentrated fire of Soviet artillery" <sup>(176)</sup>.

The search for a weapon that would deliver massive shock led to the proliferation of MBRLs on both sides, the most famous being the Soviet Kostikov BM13 introduced in July 1944, which the Germans soon copied. The Germans also produced the smaller Nebelwerfer, a six-barrel rocket launcher <sup>(177)</sup>. Both sides used rockets to great effect, adding surprise and weight of fire to their bombardments <sup>(178)</sup>. More sophisticated models were developed during and after the war, establishing a role in close support above and beyond that of the gun. Dr. Dornberger, who developed the Nebelwerfer, noted that "for decades to come the powder-propelled rocket will maintain its importance as a weapon" <sup>(179)</sup>.

The success of Soviet bombardments can be attributed partly to the use of careful targetting <sup>(180)</sup> and partly to the use of all available assets, often in the direct fire role. "Practice has shown that artillery preparation is most effective when a section of guns of all calibres up to 203mm are brought forward to fire over open sights". This precise Napoleonic firing was more cost-effective than carpetting an area with ill-directed fire, as had often occurred in the First World War.

<sup>(173)</sup> Young (1945), p. 118.

<sup>(174)</sup> Nadisov (1945).

<sup>(175)</sup> Thoholte (1945), p. 713.

<sup>(176)</sup> Quoted in Young (1945).

<sup>(177)</sup> Rocket launchers produced a conspicuous firing signature, had a relatively short range, and tended to be inaccurate; but they were cheap, mobile and effective. The Nebelwerfer, for example, could deliver six tons of explosive on to a target in five seconds, while traditional artillery would have needed 81 batteries to achieve the same: Lucas (1980), p. 165.

<sup>(178)</sup> Kamarck (143). The development of Soviet rocketry 1920-1945 is described in Halbert (1987).

<sup>(179)</sup> While the anti-tank rocket would give infantry the ability to deal with close targets previously dealt with by artillery, the MBRL would become artillery's most potent conventional system, shifting its attention from the close battle to deeper targets which other systems could not reach.

<sup>(180)</sup> Rostovtsev (1945).

Clausewitz would have called Soviet tactics the "simultaneous application of forces"; but whereas Clausewitz envisaged successive concentrations of force against parts of an enemy force, the Soviets aimed to engage and destroy **all** at once.

For the assault phase, Soviet barrages followed the pattern of the First World War. Chief Marshal of the Artillery Voronov, referring to the campaigns of 1943-44, described how "the infantry offensive was preceded by a creeping barrage" <sup>(181)</sup>; and Major General von Mellenthin noted that "Russian infantry in solid serried ranks attacked **behind** a barrage on an abroad front.... and one wave following another" <sup>(182)</sup>.

Colonel E. Idelson stressed the importance of maintaining the momentum of an assault by commencing the barrage as promptly as possible after the bombardment had ended <sup>(183)</sup>. The Soviets also tried to form up assaulting troops at equal distances to the enemy line, so that the assault and barrage would hit the enemy simultaneously along its whole length. The British solution in the First World War had been to complicate the fireplan and tailor it to the assault. The Soviets in the Second World War, characteristically, kept the fireplan simple and rearranged the assault. Start lines and timings, for instance, were generally chosen for the convenience of the artillery rather than of the supported arms, whose units were expected to move distances unequal to those moved by fellow units at irregular times if necessary. The assault usually lasted less than five minutes, for anything more than that was said to allow the enemy time to recover from the shock of the preliminary bombardment.

The official Soviet safety distance for infantry was 150-200 metres behind the barrage, considerably further than that practised in the First World War; but General Chuikov urged that troops "try to keep as close as possible behind the explosions of your own shells"; and the maxim, as in the First World War, was "to attain success in attack, press close to artillery fire" <sup>(184)</sup>. The force of a Soviet assault was usually augmented by SPs, which advanced firing with the infantry, and were used to destroy enemy **strongpoints** with direct fire <sup>(185)</sup>. The SP assault gun succeeded in the task given to the infantry gun in the First World War, but which the latter had been too immobile and ill-protected to accomplish.

Having achieved a breakthrough, the Soviets tried to exploit their advantage by pushing forward as much artillery as possible; but this was unlikely to succeed without extensive preparation in depth <sup>(186)</sup>. Marshal Voronov compared tactics in the Second World War with those of the Allies in the First World War, and

<sup>(181)</sup> Quoted in Young (1945), p.121.

<sup>(182)</sup> Vernon (1980), p.44.

<sup>(183)</sup> Idelson (1945). This was more than achieved in one extreme case in June 1944, when an infantry regiment forced the River Drut at Bobruisk before the preliminary bombardment had even lifted, catching the defenders in their shelters: Young (1945), p.121.

<sup>(184)</sup> See "The important factor in infantry-artillery cooperation" *Military Review* Vol.23 No.7 (October 1943) pp.80-81.

<sup>(185)</sup> Smirnov (1945). On occasions the SPs pushed forward so fast that they led the assault, as in the battle for the Kiev-Zhitomir road in December 1943: de Watteville (1947).

<sup>(186)</sup> Maslov (1944). **Operation BAGRATION** in June 1944 witnessed artillery attacking the German first and second lines of defence simultaneously: Larionov et al (1984), pp.281-282.

attributed the success of Soviet breakthroughs in the former not merely to the quantity of close support artillery available to forward units, **but** also to the conduct of the artillery battle in greater depth. Lieutenant General Prochko described artillery's broad responsibility to "reduce the enemy firing points throughout the depth of the whole of his tactical defences, and to accompany the infantry with its fire, and advance with it on wheels". But the course of the exploitation phase was seldom predictable, and beyond the breakthrough the Soviets relied upon the initiative of armoured FOOs and SP commanders.

## Conclusion

Mobile armour with minimal artillery fire support was victorious in the West in 1940, through paralysis of the political will and military opposition with swift, concentrated and precise blows. This success obviated the need for a war of attrition and the resources it would consume. In the East the speed and concentration of the Wehrmacht's blows were blunted and weakened by the inherent character of the theatre. The early free-wheeling successes of the Germans were overtaken by catastrophe. As General Oberst Franz Haider observed, "Now for once our troops are compelled by the stubborn Russian resistance to fight according to their combat manuals"<sup>(187)</sup>.

In the war of attrition that followed, firepower not mobility proved the key to success; and the Wehrmacht had relatively little artillery to provide it. This shortcoming was soon realized, and attempts were made to enlarge the organization and role of artillery to match the Soviets; but Germany could not prevent the erosion of her assets, and the ever-rising mass of materiel set against her. As Major General Hans Wultz, artillery commander of IV Corps, observed, "the greatest losses in manpower and equipment sustained by the German encircled troops were due to Soviet artillery"<sup>(188)</sup>.

After 1941, battles on the Eastern Front were won or lost by artillery, just as they had been on the Western Front in the First World War. Whereas the belligerents in the latter had abandoned many of their hard-won lessons between the Wars, the Soviets held doggedly to them, using new equipment as a means of enhancing them with yet greater firepower, rather than as an excuse to ignore them.

The Soviets proved, as others had observed in 1918, that the primary task of artillery in defence was the destruction of armour. By 1942, it was clear on the Eastern and other fronts that the gun had mastered the tank. It followed that in attack the primary duty of artillery was to destroy anti-tank guns, allowing armoured mobility by the generation of firepower; and that if armoured mobility thus created was to achieve a decisive breakthrough, fire would have to be 'deep' as well as 'close'. It also followed that if artillery held such a dominant role on

<sup>(187)</sup> Vernon (1980), p.43.

<sup>(188)</sup> Prochko (1945), p.58. At Stalingrad 1942-43 the Germans lost 12,000 guns and mortars: Larionov et al (1984), p. 188. In the summer and autumn of 1943 they lost 26,000 guns and mortars: *ibid*, p.255; between January and April 1944 they lost 20,000 guns and mortars: *ibid*, p.262; and in summer and autumn 1944 they lost 28,000 guns and mortars: *ibid*, p.266.



the battlefield, then CB fire was a task of equal importance to close support.

By 1945 the Soviets had proved at least to their own satisfaction that artillery was indeed 'the God of War'.

## C: THE FAR EAST

Of all factors, terrain most shaped the war in the Far East. The Pacific campaign witnessed a series of battles for islands, in which ground forces were wholly dependent on naval and air forces for movement and re-supply. The South East Asian land campaign offered opportunities for tactical mobility, though under arduous conditions of terrain and climate. The difficulty of achieving equipment mobility in the mainland campaign restricted the scale of firepower concentrations, and on occasions naval and airpower became relatively more important sources of fire support. Strategic mobility made it possible to concentrate field artillery; but terrain often restricted the size of the actual battlefield, concentrating violent action in a small and isolated area.

By contrast with the Russian theatre, it was often impossible to find sufficient space in which to deploy field artillery<sup>(189)</sup>. Apart from the problem of space, the difficulty of moving masses of guns and ammunition by land was appalling. In New Guinea, British ammunition had to be carried by porters through miles of jungle where it took a porter one day to carry a single round four miles. A road-bound army could not mass without roads; and these had often to be built, or abandoned for amphibious or air transport.

The defender of an island could seldom expect relief, had little to gain from tactical manoeuvre, and in the face of a set piece attack with tri-service fire support had everything to gain by sacrificing mobility in favour of camouflage and massive physical protection. Offensive operations were therefore usually characterized by efforts to defeat such positions.

In the Pacific, where concentrations of forces were widely separated, amphibious operations were the equivalent to the encirclement operations of the Eastern front; and island defence resembled the German 'hedgehogs' of the steppe. The seizure and defence of small areas of vital ground was more important than the breaching of defences to win mobility for other arms. Artillery was therefore seldom required to neutralize the enemy, whose refusal to surrender ensured that his destruction was usually the object of operations in itself; but the need for firepower coincided with exceptional difficulties in providing it.

The physical difficulties in massing artillery were matched by those of

(189) Nothing Atoll, for example, saw possibly the roost unorthodox deployment of a 155mm howitzer battalion of the war. It went into action on a beach-head only 300-400 metres deep with two batteries trail to trail. Another battalion on the Atoll occupied an area just 200 metres square, whereas the norm in the Italian campaign was 800 by 800 metres.

achieving fire mobility through good target acquisition and accuracy. The jungle hampered observation and made flash-spotting and sound-ranging almost impossible. All artillery tended to give close support, and fired at very short range <sup>(190)</sup>. Air OPs often proved effective, but these required landing strips or aircraft carriers. Survey was as difficult as target acquisition, and accuracy was further hampered by climatic effects on munitions.

The one outstanding advantage that artillery did enjoy was the opportunity to conceal and protect itself with abundant materials for camouflage and the construction of field defences.

The effect of these factors was to encourage small-scale decentralized artillery operations, in which those who found ways to overcome environmental handicaps and strove to achieve mass and concentrations of fire were rewarded.

### Artillery in attack

The Japanese offensive in the Far East was similar in style to *Blitzkrieg*. Sudden, violent attacks, penetrating ill-prepared and often complacent defences, won startling victories over what were sometimes apparently superior forces. These were tactics in which artillery played but a minor role.

Artillery had been scarce even in the less adverse conditions of Japan's campaign in China, and early successes did not encourage the Japanese to change. The command of Japanese guns was usually decentralized. An infantry battalion might have the support of six guns of mixed calibre from 75mm to 150mm, which would deploy singly to maximize the advantages of terrain, protection and concealment. Although these guns would support one another, at any one place only two or three guns could be brought to bear.

The Japanese care for concealment extended to the adjustment of fire, which would often be conducted over long periods of time to conceal intentions, and was often mistaken by the recipients for harassing fire. A common trick was to adjust fire just as enemy artillery opened up, so that enemy troops would blame their own artillery for 'dropping short' <sup>(191)</sup>.

Sophisticated communications were often impracticable because Japanese guns fought with their infantry as far forward as possible, and consequently fire was seldom concentrated above battery level. Their support was close support and they rarely engaged in CB or harassing fire. The early success of the Japanese Army in China and Malaya taught them bad lessons. It encouraged the belief that mobility and deception could always be substitutes for mass and firepower <sup>(192)</sup>.

<sup>(190)</sup> Because an OP's view was limited, the British often found it necessary to have up to eight OPs in a battery, but were often handicapped by poor radio communications, screened as they were by the rugged terrain and jungle.

<sup>(191)</sup> The masking of Japanese guns in this way is described in Shrader (1982) p.11.

<sup>(192)</sup> The closest the Japanese came to massing artillery was at Bataan on 3 April 1942, where 150 pieces, including heavy mortars, pulverized a two-and-a-half-mile sector of the US defence for five hours: Gordon (1984). A degree of fire planning was also evident at the battle of Matanikau on 23 October 1942 at Guadalcanal: del Valle (1943); but these were relatively minor and exceptional displays of firepower. Indirect fire was seldom used, for example when Lieutenant General Kanda attacked Empress Augusta

By 1942-43 experience elsewhere had taught the British the value of massing and organizing their artillery to maximize firepower in the attack; but in the Far East they lacked the resources to effect this <sup>(193)</sup>. The consequences of attacking with insufficient fire support became evident during the **Arakan** campaign between December 1942 and May 1943. On 6 January the British met prepared bunker defences, against which the indirect fire of the **25pdr** proved ineffective. The best way of destroying bunkers was by direct fire, or dive bombing, and as the war progressed 'bunker busting' became an essential and specialist artillery task<sup>(194)</sup>.

Although direct fire came into its own, the British also made major improvements in their indirect fire, with better communications, survey and meteorology. But difficulties remained: preliminary bombardments were sometimes hard to justify, given the difficulty of locating enemy positions; and barrages were seldom used because they were so expensive in precious **ammunition**, and oftendangerous to advancing infantry because rounds burst prematurely in trees. Whatever the problems, there was sometimes no alternative to massive indirect fire. For example, in January 1944 at Arakan the enemy vantage point in defence of 'Razabil Fortress' was so strong that, like Keren Ridge in North Africa, it could be taken only by co-ordinating all available firepower <sup>(195)</sup>.

The use of all-arms fire support in a 'Pepperpot' became standard practice. Artillery would clear camouflage from enemy bunkers, while troops formed up for the assault. On firing coloured smoke, a "Pepperpot" would open up on bunkers while artillery undertook CB tasks and tanks were used as a means of close support for infantry, as they had been in the First World War <sup>(196)</sup>.

Bay on Bougainville on 8-24 March 1944, all Japanese guns were sited for direct fire: **Guenther** (1945); and without indirect fire major concentrations would not have been possible.

<sup>(193)</sup> The British Army that withdrew to Imphal in May 1942 recovered with it just ten 25pdrs, eleven 3.7-inch howitzers, and four 2pdrs. It took time to rebuild its strength, since the Far East was accorded a low priority and India could produce only twelve 3.7-inch howitzers per month.

<sup>(194)</sup> The technique preferred was to place a 25pdr or '5.5' in position for direct fire and blow away camouflage with HE rounds and 'superquick' fuzes. These would be followed by rounds with 'delay' fuzes into the embrasures; but bunkers often proved remarkably resilient despite such attack. I.V. Hogg has described an engagement in the area of Tiddin in February 1944 where 684 rounds from 3.7-inch howitzers and 670 rounds from 25pdrs were fired into an area of bunkers just 250 metres square, but "no material damage was suffered by the bunkers": Hogg (1970), p. 133. Tactics against bunkers were often reduced to those of the 18th century, with cannon pushed out in front of the infantry, who would storm the enemy position after its defences had been silenced. A classic example of such archaic tactics was seen in the siege of Fort Dufferin, a Japanese stronghold in **Mandalay**, against which tanks could make no impression. It was instead engaged by 5.5-inch guns, firing 100lb shells at point blank range and zero elevation. For further examples of these tactics, see Chapter 11, Section A (FIBUA operations).

<sup>(195)</sup> The need to be able to generate concentrated firepower from all sources was firmly established by March 1944. When the Japanese infiltrated around the British garrison at Kohima in that month, the garrison was able to hold out largely because of air support; but its relief owed much to the massed artillery fire of 2nd Division's artillery, combined with mortars, machine guns, tanks and air defence weapons.

<sup>(196)</sup> For example, at Gun Spur tanks fired at targets just 10 metres in front of advancing artillery, who wore white towels on their backs to indicate their position: **Pemberton** (1950), pp.295-296. SP guns were seldom used in this way, usually being held in army reserve instead.

The development of air/ground liaison reflected trends in other theatres, and flourished with Allied air superiority. On the Tiddim Road in August 1944, 5th Indian Division was able to call upon aircraft operating a 'cab rank' system, allowing field artillery to concentrate on 'bunkerbusting'. Thus on a smaller scale, air support had an equivalent effect to that in Western Europe, releasing artillery to take on closer targets.

Artillery also found advantage in some of the new equipment developed in the Western theatre. The US 4.4- and 7.2-inch rocket launchers proved useful in amphibious operations along the tidal inlets of Burma; and mortars proved so useful that after April 1945 many superfluous anti-tank units were re-equipped with the 3- and 4.2-inch mortars.

In addition to re-equipping in order to generate greater firepower, the British strove to achieve greater concentration at critical points by increasing equipment mobility. On one occasion 25pdrs were mounted on railway wagons towed by a jeep, with an observer on a motorcycle mounted on a railway trolley, and at other times mules and elephants provided transport. But sometimes it was just not possible to deploy artillery where it was required. For example, in December 1944 81st West African Division advanced down the Kaladan river, but found itself outnumbered and outranged by Japanese guns. It was not practicable to bring forward more artillery for a firefight, and so the enemy was instead outflanked, and his main positions attacked by a total of 453 aircraft sorties.

Despite all these efforts, artillery in South East Asia never matched that of other theatres. It was rare to find concentrations of more than 100 guns, and ammunition expenditure was small, even though the need for heavy fire was often greater than elsewhere. Stubborn Japanese defence seemed hard to neutralize, and this encouraged demands that artillery destroy the enemy, even though these could seldom be met <sup>(197)</sup>.

Shortage of ammunition made the barrage a luxury. On 31 July 1945 the CCRA of IV Corps said that a barrage could be justified only if enemy positions were not known. Selected concentrations were usually fired in place of a barrage, but their success depended on good intelligence. Inflexible timed fireplans became less popular, and fireplans for advances, such as that on Rangoon by IV Corps, were characterized by series of contingency 'on call' predicted targets.

Tactics in Western Europe emphasized neutralization, and by 1945 many favoured the development of longer-range, if lighter, guns with perhaps a 20lb shell. Far East gunners held the opposite view that the destruction of field defences was their prime task, and called for an SP that could accompany assaulting infantry, and fire a 100lb shell at defences in their path. The CCRA of XV Corps said, "Neutralization has had it. It is an outworn tactic — armour and digging-in has defeated it" <sup>(198)</sup>.

<sup>(197)</sup> In February 1945, XXXIII Indian Corps crossed the Irrawaddy supported by 80 guns; but it was not so much these guns as the assaulting tanks that silenced enemy positions. Where tanks could be employed, they offered a decisive **advantage**, since the Japanese had few anti-tank guns with which to answer accurate direct fire.

<sup>(198)</sup> Quoted in Pemberton (1950), p.320. It was ironic that under completely different conditions these views should be so akin to those of the Soviets, who also championed destruction.

The US Army in the Pacific held similar views. It encountered Japanese fortifications, which became the priority targets for all sources of firepower. As early as January 1943, on Guadalcanal, the Americans found direct fire from SP guns the most effective method of destroying bunkers<sup>(199)</sup>, and as positions became even more heavily protected, so the firepower grew to defeat them<sup>(200)</sup>.

The American solution was destructive firepower: "There was only one answer to such a position... to fire enough rounds to knock them out". The Americans feared an encounter with similar defences throughout the home islands of Japan, and saw massive destructive firepower as an alternative to a series of equally costly battles, such as had been fought in Europe in 1918 and 1945. The Pacific War ended with the indirect application of destructive firepower at Hiroshima and Nagasaki; but in the meantime artillery tactics concentrated on achieving maximum destruction on the battlefield. Brigadier General R.G. Gard, commander of the 96th Divisional artillery, put it thus: "Any half-hour, or half-way preparation for an infantry attack just won't do the business against these strongly built defences... you've got to pound and pound and pound... to crack open his pill-boxes and smear his anti-tank positions". He compared the ammunition requirement to that of the First World War, and said, "anything less than that is just a waste of ammunition"<sup>(201)</sup>.

US artillery did its best to concentrate and co-ordinate its resources; but this was usually only achieved at divisional level. Divisional headquarters became the focal point for tri-service liaison, with the support of dedicated warships and aircraft as an integral part of fireplans. Artillery could not match the weight and concentration of naval gunfire during amphibious operations; but in close country and at close quarters the accuracy and effect of direct fire from the field gun proved superior. Land operations were also supported by the B-24 bomber, but aviation's greatest contribution to fire support was the provision of the L-4-H Cub air OP<sup>(202)</sup>.

## Artillery in defence

The Japanese had few guns and took great pains to protect them when preparing defensive positions. It was common for them to spend a month preparing a single cave or bunker and movement between positions took place only in darkness.

<sup>(199)</sup> Casey (1943).

<sup>(200)</sup> Direct fire at point blank range was used to destroy Japanese blockhouses on Tarawa in November 1943: Rixey & Best (1945); and also in the battles for the Philippines in 1945, but these were often tough nuts to crack: Randall (1945) and Carlson (1945). On Okinawa, Japanese positions incorporating 198 field guns were so strong in deep tunnels and concrete shelters that on 1 April 1945, despite the largest and heaviest naval bombardment in history, combined with air and artillery support, the Japanese suffered "no more than a slight shaking up. When our artillery lifted they came up to man their guns". In one case a single Japanese position held up two US regiments for nearly two weeks: Soth (1945), p.466.

<sup>(201)</sup> *Ibid.* The role of US and Japanese artillery in the battle for Okinawa is described in Waterman (1945a).

<sup>(202)</sup> On Saipan and Tinian, 85% of all observed fire was directed by air OPs, who also became the mainstay of corps intelligence-gathering. They were also more effective and flexible than bombers. Whereas the B-24 could deliver four tons of bombs, a battalion air OP could direct the fire of five tons of shells every three minutes at any target in sight: James (1945), p.98.

Guns were sited with particular regard to terrain, and even when relatively plentiful, the Japanese preferred to spread them thinly, rather than group them to concentrate fire. Their communications were primitive, and easily disrupted by Allied fire, sometimes reducing them to firing on orders by light signal <sup>(203)</sup>. Their rate of fire was also low, because of poor ammunition supply. US I Corps reported that the Japanese opposing them fired a total of only 158 rounds per day between 21 February and 30 June 1945; and their CB fire was rare and ineffective <sup>(204)</sup>.

Defence in island fighting involved high stakes, for defeat meant total loss. An attacker could concentrate his forces at a time and place of his choosing more easily than in other theatres; and the defender had to calculate the risk of committing a major force to an island which might be by-passed or, in the case of vital ground, committing troops with no hope of evacuation in defeat. In this respect they became island 'Cannae', and analogous to the vast encirclement battles of the Eastern Front <sup>(205)</sup>.

Allied artillery practised a more sophisticated and effective defence; but in the early battles of the campaign it was frequently required to fire directly at advancing Japanese infantry <sup>(206)</sup>. The key to effective defence was the co-ordination of artillery fire and speed of response; and despite the difficulties of the theatre, the Allies frequently achieved this <sup>(207)</sup>. Superior C3 proved a significant Allied advantage, enabling them to deliver heavy counter-preparation fire and DFs which the Japanese never matched <sup>(208)</sup>.

Calls were frequently made for DFs close to friendly troops. Infantry in close combat with the enemy often lost contact with its artillery. In such a situation in

<sup>(203)</sup> In the fighting at **Kangaw** between 22 January and 18 February 1945 the British reported the heaviest Japanese defensive fire yet encountered, but this amounted to no more than the co-ordinated fire of one artillery battalion firing up to 600 rounds per day: **Pemberton** (1950), pp308-309. In the battles on Northern Luzon between 9 January and 30 June 1945, the Japanese could field fifty artillery battalions over and above guns affiliated to infantry battalions and regiments. These were mostly 75mm guns and obsolete 150mm howitzers, but the potential of this substantial force was lost through ineffective handling. On no occasion did they concentrate more than a battery, and even this was unusual. Even on Okinawa in April 1945 the Japanese were unable to co-ordinate the fire of more than a single 4-gun battery: **Waterman** (1945a), p.525.

<sup>(204)</sup> See "Jap artillery in Northern Luzon" *Field Artillery Journal* Vol.35 No.1 (January 1946) p.22.

<sup>(205)</sup> American victory on Luzon, for instance, entailed the loss of the entire Japanese defence, including at least 331 guns, and a similar catastrophe befell the defenders of Okinawa in April 1945.

<sup>(206)</sup> The British used shrapnel in this way at **Situang**: **Chaplin** (1980), p.163, as did the US/Philippine artillery on Luzon between 31 December 1941 and 3 January 1942, when it often held the line alone: **Gordon** (1984).

<sup>(207)</sup> Although eventually defeated, the US II Corps on **Bataan** managed to mass 130 guns and howitzers, controlled by a corps FDC, and proved so effective that General **McArthur** described artillery as "the best arm you have" in his final words to General **Wainwright** on 10th March 1942, on his departure for Australia: quoted in **Gordon** (1984), p.31.

<sup>(208)</sup> For example, during the battle of **Tenaru** on Guadalcanal in August 1942, Japanese attacks were halted when counter-preparation fire struck their approach routes: **del Valle** (1943), p728; this success was repeated on Tarawa on 20 November 1943: **Rixey & Best** (1945). In March 1944, on Bougainville, artillery isolated the battlefield by holding off Japanese reinforcements, allowing the destruction of their first echelon. On 24 March, US guns fired a concentration of 14,882 rounds into the assembly areas for the final Japanese attack, proving that effective C2 at corps level could produce devastating results: **Guenther** (145).

September 1942 during the battle for Bloody Ridge on Guadalcanal, artillery continued to fire on its last target, and adjusted fire by ear on to likely Japanese positions. Brigadier General P. A. del Valle maintained that “the danger of hitting our own troops was disregarded in the effort to place a wall of fire between our men and the enemy”<sup>(209)</sup>. The infantry lodged no protest at this, even though two shells hit the command post of 1st Marine Division<sup>(210)</sup>.

In February 1944 the 7th Indian Division was isolated by a Japanese counter-offensive in the so-called ‘Administrative Box’; but it was able to call for fire from the neighbouring 5th Division, bringing down fire on corps targets almost on top of British defensive positions. A similar situation arose in April 1944 on the Imphal Plain, where DFs were so close to forward trenches that it was “not unlike that of trench warfare in World War One”<sup>(211)</sup>.

## Conclusion

The disadvantageous conditions of the Far East theatre caused artillery to play but a minor role in land operations, which became uniquely dependent upon air and naval forces for strategic mobility and firepower. The primary challenges were the conduct of amphibious operations, and coming to terms with the jungle, rather than the problems of armoured mobility and anti-tank fire. It was hard to mass artillery, and where island geography created concentrations of forces, these themselves became attractive targets and concentrations of vulnerability, running the risk of isolation at the hands of superior attacking forces that commanded the sea and air.

The Japanese neglected to build up artillery materiel and an organization that could generate concentrated firepower. They were content to use artillery as mere ‘infantry guns’, and sought to maximize what advantages were available to enhance their scant resources. They placed high priority on survivability through camouflage, physical protection, and local defence. They also believed that careful siting of individual guns produced better results than the fire-mobility gained by the co-ordination of a number of guns.

The Allies strove to overcome the problems of the theatre and to create conditions where the principles of artillery tactics learned elsewhere could be practised; but field artillery's prime role in attack was the destruction of fortified enemy positions, often by direct fire, and neutralization seemed an inadequate tactic. In defence there was greater scope for the Allies to concentrate indirect fire, since the Japanese had little armour, and presented massed and vulnerable targets to artillery, if it could co-ordinate and deliver timely and accurate fire.

It was appropriate that in a theatre where artillery was so relatively weak, an aircraft should deliver the most powerful display of destruction, whose effect was so great that it ended resistance on far removed battlefields. This ultimate source of concentrated firepower was soon to be harnessed by artillery, changing the face of battlefields and tactics around the world.

<sup>(209)</sup> del Valle (1943), p. 729.

<sup>(210)</sup> For a description of similar close fire, see note 47 above.

<sup>(211)</sup> Chaplin (1980), p. 163.

## D: THE SECOND WORLD WAR — CONCLUSION

The Second World War confirmed the importance of artillery and apparently settled the debate between mobility and firepower; but it was uncertain whether firepower was best obtained by mass on the Soviet model, or by the more efficient use of resources, as favoured in the West. The seeds of doubt were being sown, and more problems posed than resolved. As in 1918, the areas of uncertainty lay around new and undeveloped weapon systems, that would transform the role of artillery and its relationship with other arms.

The rocket had been both a means by which the infantry could lessen its dependence on scarce artillery resources, and for the artillery a method of combining greater shock with a heavy weight of fire. It had the potential to reduce the role of artillery in the close anti-tank battle, which had been the former's primary role in the Second World War, and at the same time offered artillery the possibility of achieving a new and deeper role on the battlefield. As Dr. Dornberger had suggested, it would be in decades to come the vehicle for the delivery of high-technology munitions.

Aircraft had dominated the deep battle in the Second World War. Artillery's role in this after 1945 would depend upon improving its own performance relative to aircraft capabilities, and the ordering of ground attack in air force priorities.

Above all, the nuclear warhead cast many new shadows of uncertainty over the battlefield, at a time when it had seemed that tactical orthodoxy had been restored to fire support. Nuclear weapons could generate such mass destruction that it was thought by some that conventional war, let alone conventional artillery, had become obsolete. Alternatively if a conventional war were indeed out of the question, perhaps artillery would regress, and be used only in limited wars in inhospitable regions of the world, where few of the lessons of the Second World War would be considered relevant.



## Chapter 19: THE DEVELOPMENT OF FIRE SUPPORT - SUMMARY AND CONCLUSION —

Before the development of indirect fire techniques at the turn of the century, artillery provided close support by siting its guns among the supported arm. This ensured that fire would be delivered against targets of greatest importance to that arm. It was not possible to concentrate a decisive weight of fire by fire-mobility, because the guns had a limited range, and poor communications prevented their co-ordination. Concentrations of fire could be achieved only through a geographical concentration of the guns; and it was the skilful massing of artillery in the 19th century, following Napoleon's example, that enabled artillery to go beyond mere close support of others, and to fight as an arm in its own right.

Indirect fire enabled artillery to pull back from the front line, often to the consternation of other arms, giving the gunners greater survivability. It enabled artillery to switch fire to areas beyond the line of sight, achieving concentrations of fire through fire-mobility and reducing the need for the massing of the equipment. Provided that a strong link was maintained with the other arms, indirect fire techniques enhanced the quality of close support provided.

Concepts take time to be translated into training and battlefield practice. In the first months of the First World War it was still common to find guns deployed forward and in the open, firing over open sights. These were rapidly swept away, and artillery drew back from the front line. The imperative to survive stimulated the rapid development of accurate indirect fire techniques in survey, observation, computation and planning. Targets were relatively static and concentrations of fire could be achieved through fire-mobility. Equipment mobility became less important in the provision of close support. Artillery had discovered how to produce massive concentrations of fire through technical innovation; but its ability to deliver these on to targets of immediate importance came to be questioned. All sides believed that the war would eventually be won by some form of infantry attack. The problem for artillery was how best to support this, and different armies produced different answers.

In the early years of the First World War it was generally held that a heavy preliminary bombardment was essential. In time, the moving barrage was developed for the infantry assault phase. The barrage progressed in front of the advancing infantry on to a series of pre-arranged targets. If the infantry's timetable slipped, artillery fire might land well away from its preferred target. Advances in communications had not kept pace with those in accuracy and fireplanning, which became ever more complex as attempts were made to overcome the problem through changes in timing, rates of advance and distances between phases.

By 1917, a clear difference in doctrine had emerged between the British and the Germans. The British had abandoned hope of destroying defending infantry with artillery fire, and merely attempted to neutralize it with sophisticated, but inflexible, fireplans in support of broad linear infantry advances. The Germans however believed that artillery must destroy the enemy, rapidly blasting a hole in

defences, often on a narrow front, for infantry, working in flexible groups, to break through. The battle of Cambrai in 1917 indicated a change in British thinking. With the coming of the tank it was no longer necessary to stun the enemy with a massive preliminary bombardment, although the firing of the first predicted artillery attack in history by over 1000 guns was, in its way, more dramatic than the performance of the tanks. The possibility of creating shock through battlefield mobility, surprise and rapid exploitation had been dramatically demonstrated.

The First World War changed perceptions of artillery employment. After 1918, the outstanding issues were how best to support and to stop mobile armour. The British 'Armoured School' believed that the primary arm involved was no longer infantry but armour. The only way to deliver fire on to close targets would be to match the mobility of the tank, and to add armour for the gun's protection on the front line. The case for an armoured SP was quickly identified; and the infantry was issued with a 2pdr light anti-tank gun to supplement the Boys .55-inch anti-tank rifle in stopping enemy armour.

By the 1930s, British confidence in armour, and traditional aversion to all arms integration, caused artillery and armour to go separate ways. Tanks were judged to be self-sufficient in battle, the infantry's light anti-tank guns were issued to the artillery for defence, and field artillery tended to be distributed piecemeal in support of the infantry. The consensus of opinion was that colossal fire concentrations, and the complex planning they required, were out of date in modern mobile warfare. Britain thus entered the Second World War with only limited ability to concentrate decisive artillery fire on close targets, and with its artillery equipped with an infantry light anti-tank gun. The consequences of this were painfully exposed at the outset of the Second World War, before the reforms of 1942.

Between the wars the Germans held to their belief in artillery as a means of destruction on a sector of an enemy defence to allow a breakthrough, but now by tanks accompanied by infantry, rather than by infantry alone. Close support in the exploitation phase was to be provided by aircraft. The infantry was given an effective anti-tank gun, and artillery its own heavier weapons. Although German Army artillery weapons were of high quality, and produced in a well-balanced mix, the period was one of relative decline for their artillery after its heyday of the First World War, when its status had been elevated to that of the decisive arm and its success exploited by others. By the mid-1930s artillery had been eclipsed by the tank, and relegated to supporting its successes. The early success of *Blitzkrieg* masked the inadequacies of German artillery doctrine, which were soon revealed on the Eastern Front. Here, German tanks were left without proper artillery support; and for a time, because of their technological inferiority to Soviet tanks, German artillery had to take over the major defensive anti-tank role.

The Soviets, in contrast, had always regarded their artillery as the most important arm on the battlefield. Despite the stifling effects of political purges, the delayed introduction of new models, and enormous early losses, the Soviets managed to produce outstanding equipment in great numbers to match a thorough and successful concept of combined-arms operations. They had seen the need for

a close support SP gun to accompany armour, and to provide direct fire if necessary. Their equipment mobility was matched by the fire-mobility achieved through longer range; and these enhanced the quality of close support provided. The Soviets also demonstrated how mobile tactics could be supported by massive destructive fireplanning on a scale at least as great as that seen in the First World War. While the Germans might hope to break a hole in an enemy's defence with artillery fire, the Soviet approach was to 'steamroller flat' the whole area of operations. This difference was eventually not so much one of doctrine as of logistic capability.

The most profound influence on artillery close support in the Second World War was the introduction of workable battlefield radio, and its use by observers. This revolutionized fireplanning. A fireplan of First World War proportions could now be initiated, modified or stopped by the voice of a single artillery observer. Fire-mobility could once more deliver concentrated fire on to targets specified by the supported arm, achieving a measure of co-operation not seen since the development of indirect fire forty years earlier.

The advent of nuclear weapons created changes in artillery doctrine as dramatic as those provoked by the tank but above all was seen by politicians as an excuse to reduce the size of conventional forces. It seemed that concepts of mobile armoured warfare had become obsolete except in exploiting the aftermath of a nuclear exchange; but by the 1970s, a phase of conventional operations early in a war in Europe seemed a valid scenario once more. This coincided with the emergence of the infantry ATGW, which, following the success of the recoil-less rifle, effectively ended anti-tank direct fire as an artillery task, except in self-defence. The ATGW satisfied the requirement for infantry to defend itself against tanks, first set in 1917, which the infantry gun and larger artillery equipments had meanwhile tried to meet. The SP has returned to take its place in mobile warfare, but only in the Soviet Army does it retain a major direct fire role.

Field artillery today cannot match the concentrations of equipment seen forty years ago, but technical advances are improving the quality of close support it can provide. ADP can better decide the priority of targets to be engaged, and maximize the concentrations of fire on to those targets. Along with increased ranges, ADP has extended fire mobility, and the equivalent of fire concentration has been generated by the achievement of higher rates of fire, and enhanced munition lethality.

Technology will enable artillery to concentrate decisive fire on to targets of the highest priority; but will this really still be close support? The opinion if not the interests of the other arms seems to be less valued than formerly, as fireplanning decisions are taken at higher levels and targets are engaged at greater range.

Until recently depth fire was often criticized for being inefficient and wasteful. Targets were hard to acquire and hit accurately; and the effect of depth fire was often difficult to judge. Depth fire required extensive, meticulous and often inflexible fireplanning, rather as did artillery operations in the First World War. Those operations were revolutionized by advances in accuracy, radio communications, observation and mobility. Equivalent advances to these are now taking

effect in depth fire capabilities through target acquisition, ADP and precision guidance.

What has happened is that other arms have now extended their power to cover that part of the FEBA which was formerly the responsibility of field artillery. They no longer have to depend upon artillery to hit targets in the immediate contact battle, thanks primarily to the recoil-less rifle and the ATGW, provided these are supplied in sufficient quantity and maintain their technological edge. The battlefield has expanded away from the FEBA, so that the targets of greatest, if not most immediate, importance lie at longer ranges, but still within the range of field artillery. The significance of this deep battle will soon be comparable with that of the close battle of forty or seventy years ago; and artillery will be judged in future primarily by its performance in this engagement, not in close support. This will cast artillery as an offensive arm fighting in its own right, rather than merely in a supporting role. In that sense artillery will revert to the position it held under Napoleon as the primary and decisive arm.

The requirements of the European theatre drive most of the advances in conventional military technology. In Europe the stakes between East and West are at their highest. There may be a mutual interest in NATO and the WP to reduce the costs and risks of their commitment through arms negotiation; but even if a reduction is achieved, disequilibrium in Europe would probably remain the greatest threat to world peace. War in Europe may be the greatest threat, but on the evidence since 1945 it is also one of the least likely, thanks largely to the size and equilibrium of forces deployed.

The chances of limited wars or counter-insurgency operations taking place elsewhere in the world are much greater. In wars where lesser powers are evenly matched, the scale of firepower deployed will depend on the extent to which those countries have acquired the technology originally intended for deployment in Europe. In wars where a greater power intervenes against a nominally weaker enemy, firepower will not be constrained so much by its availability as by its political control. Excessive, insensitive use of firepower has frequently been more politically damaging to its perpetrator than the military effect has been to the enemy.

In conventional warfare, firepower is best used to bring about attrition and to create opportunities for movement. In COIN operations attrition by artillery is less important, and tactical mobility, allowing the provision of fire over a wide area, will usually be more significant. Attrition is best carried out by manoeuvre arms, which are a more discriminating force in politically sensitive conflicts. While in conventional war artillery has often, and would probably again, become the decisive arm on the European battlefield, this will not be so in COIN operations, where artillery will remain merely in support. The greatest difficulty will be in identifying conflicts in which the political imperative for military moderation exceeds the military requirements to apply superior force. The quality of that judgement will be as important to the success of the operation as military competence.

Appendix A: A selective historical comparison of artillery concentrations and ammunition expenditure									
Date	Nationality	Location	Frontage (km)	Number of Guns	Guns per km	Ammunition Expended	Rounds per Gun	Period of Consumption	Remarks
1526	Turkish	Mohacz	300						
1689	Russian	Crimea	700						Tartar War
1704	British & Allies	Blenheim	4	60	15				
1704	French & Bavarian	Blenheim	4	90	23				
1709	British & Imperial	Malplaquet	4	100	25				
1709	French	Malplaquet	4	60	15				
1758	Russian	Zorndorf	3	60	20				
1759	Russian	Palzig	3	186	62				
1759	Russian	Kunersdorf	5	230	46				
1805	Russian & Austrian	Austerlitz	5	278	56				
1805	French	Austerlitz	5	139	28				In 1805 the French possessed 20,000 cannon
1806	French	Auerstedt	5	44	9				
1806	Prussian	Auerstedt	5	230	46				
1806	French	Jena	5	70	14				
1806	Prussian	Jena	5	120	24				
1807	Russian & Prussian	Eylau	5	400	80				
1807	French	Eylau	5	200	40				
1807	French	Friedland	1	30	30	3,750	125	25 mins	
1809	French	Wagram	15	554	37				
1809	Austrian	Wagram	15	480	32				
1812	French	Borodino	5	200	40				Napoleon took 1,422 guns to Russia; 587 guns were available at Borodino against 640 Russian guns available
1812	Russian	Borodino	5	320	64				
1813	French	Leipzig	15	700	47				
1813	Allied	Leipzig	15	1,500	100	200,000	91		
1815	French	Ligny	10	218	22				
1815	Prussian	Ligny	10	224	22				
1815	French	Waterloo	6	246	41				
1815	Allied	Waterloo	6	156	26				
1854	Russian	Balaclava	1.5	46	31	600	13	7 mins	Against the British Light Brigade

Date	Nationality	Location	Frontage (km)	Number of Guns	Guns per km	Ammunition Expended	Rounds per Gun	Period of Consumption	Remarks
1859	<i>French</i>	<b>Solferino</b>	1	320	320				
1859	<b>Austrian</b>	<b>Solferino</b>	1	451	451	<b>9,775</b>	22		
1862	Union	<b>Malvern Hill</b>		100					
1862	Confederate	<b>Fredericksburg</b>		100					
1863	Union	Gettysburg	2	80	40	<b>32,000</b>	400		
1863	Confederate	<b>Gettysburg</b>	2	145	73	20,000	<b>138</b>		
1866	Prussian	<b>Königgrätz</b>	25	675	27	46,350	69		
1866	Austrian	<b>Königgrätz</b>	25	672	27	19,400	29		
1870	German	<b>Vionville</b>		222		20,900	94		
1870	<b>German</b>	<b>Gravelotte</b>	8				57		
1870	French	Sedan	1	564	564				
1870	German	Sedan	1	774	774	33,600	43		
1871	French	Paris		744					
1871	German	Paris		788					
1899	British	<b>Magersfontein</b>		24		3,840	160		
1904	<b>Russian</b>	<b>Liaoyang</b>		96		40,500	422	per day	Russians deployed 609 guns altogether against 170Japanese guns
1904	<b>Russian</b>	<b>Sha-ho</b>		48		8,000	167	<b>40mins</b>	
1915	<b>British</b>	Neuve Chapelle	1.2	354	295	<b>106,000</b>	300		
1915	British	<b>Festubert</b>	5	433	87	31,000	72		Preliminary bombardment of <b>101,366</b> rounds fired for assault on 15 May
1915	<b>British</b>	Loos	11	1,032	94	256,000	<b>248</b>		Preliminary bombardment only
1915	<b>French</b>	<b>Champagne/Artois</b>	35	1,100	31	935,000	850		
1916	<b>German</b>	Verdun	13	1,230	95				of which 560 were heavy guns (43 per km)
1916	French	Verdun	13	<b>1,220</b>	94				of which 542 were heavy guns (42 per km)
1916	<b>German</b>	<b>Verdun</b>	13	2,000	154	} 24,000,000	} 6,000	<b>16 weeks</b>	
1916	French	Verdun	13	2,000	154			<b>16 weeks</b>	
1916	British & French	<b>Somme</b>	22	2,029	92	<b>1,732,873</b>	854	8 days	<b>British had 20 heavy guns per km, and the French had 55 per km</b>
1916	British	Courcelette					235		<b>18-pounders</b> only
1916	British	<b>Courcelette</b>					270		<b>18-pounders</b> only
1917	British & <b>Canadian</b>	<b>Vimy Ridge</b>	7	1,130	161	1,135,700	1,005	14 days	<b>59 heavy guns per km</b>

Date	Nationality	Location	Frontage (km)	Number of Guns	Guns per km	Ammunition Expended	Rounds per Gun	Period of Consumption	Remarks
1917	French	<b>Aisne</b>	40	5,500	138	8,000,000	1,454	9days	<b>Preliminary</b> bombardment only; 47 heavy guns perkm
1917	British	<b>Messines</b>	16	2,266	142	3,561,530	1,572	8days	
<b>1917</b>	British	<b>Pilckem</b> Ridge	18	3,091	172	<b>4,283,550</b>	<b>1,386</b>	18days	
1917	British	Gheluvelt	4	1,295	324				
1917	German	<b>Ypres</b>	18	1,556	86				
1917	German	Riga	5.5	700	127				
1917	British	<b>Passchendaele</b>		2,300					
1917	British	<b>Cambrai</b>	8	1,003	125				
1918	German	<b>Somme</b>	80	6,473	81			Largest grouping of the First World War	
1918	Allied	<b>Marne</b>	40	2,000	50				
1918	British	<b>Hindenburg</b> Line				943,847		24 hrs	
1918	British	Valenciennes	2.5	250	100			Defended by just 1,500German infantry	
1939	German	air defence		9,000					
<b>1939-40</b>	Soviet	<b>Summa, Mannerheim</b> Line, Finland	2	440	220			On 1 Feb 1940, 300,000shells were fired in 24 hrs. On 11 Feb, 600 guns were fired	
1940	British	<b>Tummar West</b>	3	72	24	42,272	587		
1941	British	<b>Bardia</b>	1.5	122	81	360,000	2,951		
1941	British	Keren	5	220	44	110,000	500		
1942	Japanese	<b>Bataan</b>	4	150	38				
1942	British	<b>Alam</b> el Haifa	48	456	9				
1942	Soviet	Leningrad	20	1,442	72				
1942	German	Leningrad	20	6,000	300	140,000	23	per day	
1942	Soviet	Stalingrad	20	13,000	650	700,000	54		
1942	German	Stalingrad	20	10,000	500				
1942	British	<b>El Alamein</b>	32	1,000	31	>1,000,000	>1,000	12days	
1943	British	<b>Medenine</b>		18		9,990	555	600 rpg fired on the first night 3 batteries out of a total of715 guns on a 24km front	
1943	British	<b>Wadi Akarit</b>		450					
1943	British	<b>Tunisian</b> Plain	3	444	148	164,000	369	24 hrs	
1943	Soviet	Kursk	200	15,000	35-90				
1943	Soviet	Orel	150						
1943	British	<b>Sangro</b> Ridge		216			600	25-pounders	

Date	Nationality	Location	Frontage (km)	Number of Guns	Guns per km	Ammunition Expended	Rounds per Gun	Period of Consumption	Remarks
1943	US	<b>Camino</b>	2	346	173	64,000	185	<b>24 hrs</b>	} n US Corps firing on the same targets as X British Corps
1943	British	<b>Camino</b>	2	303	151	<b>89,883</b>	297	<b>24 hrs</b>	
1944	Soviet	Karelian Isthmus	40	21,000	525				
1944	German	Karelian Isthmus	40	10,070	252				
1944	Allied	<b>Anzio</b>	20	432	22	<b>25,000</b>	58	<b>per day</b>	
1944	German	<b>Gustav Line</b>	100	400	4				
1944	British	<b>Cassino</b>	7	890	127	195,969	220	<b>8 hrs</b>	<b>1,060</b> guns available across the whole front <b>3,509</b> rounds on each target in turn with 839 aircraft with 7,000 <b>aircraft</b> field guns firing <b>from</b> landing craft of which 33,000 were deployed in the West with <b>2,000</b> aircraft
1944	British & Canadian	Hitler Line	2	668	334				
1944	<b>German</b>	<b>Belorussia</b>	259	969	4				
1944	Soviet	<b>Belorussia</b>	400	31,000	78				
1944	British	Normandy coast	25	180	7	18,000	100	<b>30 mins</b>	
1944	German	air defence		45,000					
1944	British	Normandy	3	776	259				
1944	US/Canadian	Normandy	4	324	81	278,600	860		
1944	German	Ardennes	80	1,900	24				
1944	US	Ardennes	80	394	5				
1945	Soviet	Vistula/Oder	600	32,143	54	<b>3,200,000</b>	100		including mortars
1945	Allied	<b>Reichswald</b>	10	<b>1,046</b>	105	350,000	335		
1945	Soviet	East Prussia			244				<b>54 Gds Inf Div</b> 8 Gds Armoured 2nd Shock Army
1945	Soviet	<b>East Prussia</b>			268				
1945	Soviet	East Prussia			276				
1945	US	<b>Intramuros</b> (Manila)	1	200	200	<b>7,896</b>	39	<b>2 hrs</b>	
1945	Japanese	Okinawa	40	198	5				
1945	Soviet	<b>Berlin area</b>	150	22,000	147				13,000 guns around the city; 310 guns <b>per km</b> on the breakthrough sector
1945	US	Okinawa	7.5	324	43	<b>19,000</b>	59	<b>40 mins</b>	1 Apr-22Jun; <b>1,766,352</b> rounds fired <b>15 Field Arty Bn</b>
1951	US	<b>Bloody Ridge</b> , Korea		18		14,250	792	<b>24hrs</b>	
1954	<b>Viet Minh</b>	<b>Dien Bien Phu</b>	2.5	300	120	300,000	1,000	<b>54 days</b>	
1954	French	<b>Dien Bien Phu</b>	2.5	60	24			<b>54 days</b>	
<b>1954-5</b>	British	Kenya		6		<b>2,000</b>	333	per month	<b>156</b> Battery <b>J</b> Battery
1963-4	British	<b>Radfan</b>		6		1,430	238	per month	
1960s	British	<b>Dhofar</b>					125	per month	
1965	British	Borneo	1,500	36		0.025			



Date	Nationality	Location	Frontage (km)	Number of Guns	Guns per km	Ammunition Expended	Rounds per Gun	Period of Consumption	Remarks
1966	US	Op MASHER/ WHITEWING, Vietnam				141,712			
1967	US	Dak To, Vietnam		77		150,000	1,948	37 days	
1973	Egyptian	Bar Lev Line	50	2,000	40	10,500	5	53 mins	
1973	Syrian	Israeli border	75	1,200	16				
1980s	Soviet	IGB			120				Estimated for a breakthrough sector.
1984	US	IGB					300	per day	US Army TRADOC Approved Scenario, Europe I, Sequence 2A for M109 155mm cannon)

## Appendix B: ACRONYMS

This appendix lists acronyms which occur in the text.

AD	air defence
ADP	automatic data processing
AGRA	<b>Army</b> Group Royal Artillery
AKA	<b>Artillerie in Artilleriesbekämpfungsgruppen</b>
ANGLICO	<b>Air/Naval</b> Gunfire Liaison Company
AP	1. armour-piercing 2. ammunition point
APFSDS	armour-piercing fin-stabilized discarding sabot
ATGW	anti-tank guided weapon
BAI	battlefield air interdiction
BC	battery commander
BEF	British Expeditionary Force
C2	command and control
C3	command, control and communications
C3I	command, control, communications and intelligence
CAGRA	Commander <b>Army</b> Group Royal <b>Artillery</b>
CAS	close air support
CB	counter-battery (fire)
CCRA	Commander Corps Royal Artillery
CNAD	<b>Conference</b> of NATO Armaments Directors
CO	commanding <b>officer</b>
COIN	counter-insurgency
CP	command post
CRA	Commander Royal Artillery
DAER	daily ammunition expenditure rate
DASC	Direct Air Support Center
DF	1. defensive fire 2. direct fire
DS	direct support
DSWS	Divisional Support Weapon System
DZ	drop zone
ET	emerging technology
EW	electronic warfare
FASCAM	Family of <b>Scatterable</b> Mines
FB	<b>fire</b> base
FDC	fire direction center
FEBA	forward edge of battle area
FEKA	<b>Fernkampfgruppen</b>
FIBUA	fighting in built-up areas
FLOT	forward line of own troops
FOFA	Follow-on Forces <b>Attack</b>
FOO	forward observation officer
FPF	final protective fire
FSB	<b>fire</b> support base
FSCC	fire support co-ordination center
FSCL	fire support co-ordination line
FSE	fire support element
FSR	Field Service Regulations
FSSB	<b>fire</b> support surveillance base
FUP	<b>forming-up</b> place
HE	high explosive
HQ	headquarters
ICM	improved conventional munitions
IKA	<b>Infanteriebekämpfungsgruppen</b>

IS	internal security
JSTARS	Joint Surveillance and <b>Target</b> Attack Radar System
JTACMS	Joint Tactical Missile System
LS	landing site
LZ	landing zone
MAD	mutual assured destruction
MOUT	military operations on urban terrain
MBRL	multiple-barrel rocket launcher
MLRS	<b>Multiple-Launch</b> Rocket System
MRBM	medium-range ballistic missile
NATO	North Atlantic Treaty <b>Organization</b>
NGS	naval gunfire support
NORTHAG	Northern Army Group (NATO)
OMG	Operational Manoeuvre Group
OP	observation post
PGM	precision-guided munition
RAC	Royal Armoured Corps
RAP	rocket-assisted propulsion
RDF	radio direction finding
RFA	Royal Field Artillery
RGA	Royal Garrison Artillery
RHA	Royal Horse Artillery
RPG	rounds per gun
RPV	remotely-piloted vehicle
SACEUR	Supreme Allied Commander Europe
SADARM	Search and Destroy Armor
SCHWEFLA	<b>Schwerste Flachfeuergruppen</b>
SEAD	suppression of enemy air defence
SL	start line
SP	self-propelled
SRARM	short-range anti-radiation missile
TNW	tactical nuclear weapon
TOC	tactical operations center
TOT	time on target
TRADOC	Training and Doctrine Command
WP	Warsaw Pact

## Appendix C: GLOSSARY

*This glossary lists words and phrases used in the text which may require definition, either because they are somewhat specialized, or because the variety of general use has rendered them imprecise.*

**Adjust** An observer adjusts **fire** by ordering corrections of aim to the guns.

**Air interdiction** Air operations designed to destroy, isolate, neutralize or delay the enemy's military **potential**, before it **can** be brought to bear effectively against friendly forces, conducted at such a distance from friendly forces that detailed integration of each air mission with their fire and movement is not required. (Contrast *close air support*).

**Ammunition** A device charged with explosives, **propellants**, pyrotechnics, initiating compounds or **nuclear/biological/chemical** material, for use in connection with offence or defence, including demolitions.

**Assault Gun** A form of tracked self-propelled gun, with a gun of larger calibre than normally **found** on a tank. The traverse of the gun is limited to a narrow forward arc and the vehicle carries heavier frontal armour than found in a SP field gun designed **primarily** for indirect fire. The assault **gun's** role is usually to accompany tanks and infantry in the **assault** and to suppress the **enemy's** defences, usually with direct fire.

**Assembly area** An area in which a command is assembled, preparatory to further action.

**Battlefield air interdiction (BAI)** Air action against hostile surface targets, which are in a position directly to affect forces, and which requires joint planning and co-ordination. While BAI missions require co-ordination in joint **planning**, they may not require continuous co-ordination during the execution stage.

**Calibre** The diameter of the inside of a **barrel**.

**Cannon** A term used formerly to describe a gun. Now used to refer to any **barrelled** weapon other than a small arm.

**Close air support (CAS)** Air action against hostile targets which are in close proximity to **friendly** forces, and which requires detailed integration of each air mission with the fire and movement of those forces.

**Close support** The action of the supporting force, against targets or objectives, which are sufficiently near the supported force to require detailed integration or co-ordination of the supporting action, with the fire, movement, or other actions of the supported force.

**Command** Authority granted a commander to assign missions or tasks to subordinates, to deploy units, to re-assign forces, and to retain or delegate operational and/or tactical control.

**Concentration area** An area where troops are brought together, briefed, rehearsed, administered, and prepared for battle.

**Control** The detailed, and usually local, direction of the control of movement, manoeuvres or fire necessary to accomplish missions or tasks assigned.

**Counter attack** Attack by part or **all** of a defending force on an enemy attacking force, for specific purposes such as gaining lost ground or cutting off and destroying enemy advancing units, and with the general objective of denying to the enemy the attainment of his purpose in attacking.

**Counter battery fire** Fire delivered for the purpose of destroying or neutralizing indirect **fire** weapons systems.

**Counter mobility** Denying enemy mobility by obstacles or fire.

**Counter penetration** Action to counter enemy penetration of a defended area.

**Counter stroke** A counter-attack at formation level, with the specific aim of destroying enemy forces which are on the move or have temporarily halted.

**Dead ground** An area within the maximum range of a weapon, radar or observer, which cannot be covered by **fire** or observation from a particular position because of intervening obstacles, the nature of the ground, the characteristics of the trajectory, or the limitations of the pointing capability of the weapon.

**Deception** Measures designed to mislead the enemy to induce him to react in a manner prejudicial to his interests.

**Defence**

**Active defence** Similar to Mobile defence.

**Main defensive area** Area containing **firmly held positions**, obstacles and reserves designed to destroy the **enemy's** main attacking force.

**Positional defence** Strong, mainly static, **defence** where terrain can be held by well prepared and mutually supported positions, protected by obstacles and supported by **reserves**.

**Mobile defence** A means of defeating an attacking enemy as he forces his way into and through a framework of well sited and prepared positions with mobile reserves operating **between** them. First coined by the German **Army** in 1917, referring to enemy deep penetrations destroyed by **counter-attack**. More recently, emphasis has been placed on the defeat of enemy penetrations in prepared areas by mobile forces.

**Defence in depth** Siting of mutually supporting **defensive** positions designed to absorb and progressively weaken attack, to prevent initial observation of the whole position by the enemy, and to allow the commander to manoeuvre his reserve.

**Defensive fire (DF)** Fire delivered by supporting units to assist and protect a unit in a defensive action.

**Defilade** To shield **from** enemy fire or observation by use of natural or **artificial** obstacles, usually with the purpose of engaging an enemy in the flank (with enfilade fire).

**Depth fire** The engagement of targets beyond the contact zone, **for example** headquarters, artillery and follow-up forces.

**Desant** A force placed in the **enemy's** rear.

**Direct fire** Fire directed at a target which is visible to the aimer.

**Direct support (DS)** British artillery placed in direct support of a formation or unit **provides** an artillery commander, observers and communications to **that** formation or unit.

**Economy of Force** The optimum use of type and quantity of arms to achieve an objective with the minimum casualties and wasted effort.

**Electronic silence** The deliberate prohibition of electronic radiation, normally applied for a stated

period, to specific equipments or frequency bands.

*Electronic warfare (EW)* Military action involving the use of electromagnetic energy to determine, exploit, reduce or prevent hostile use of the electromagnetic spectrum; and action to retain its effective use by friendly forces.

*Encirclement* Envelopment from both flanks simultaneously.

*Enfilade fire* Fire striking the flank of the target, usually from a defiladed position.

*Exploitation* The taking of full advantage of success and following up of initial gains.

*Forward edge of the battle area (FEBA)* The foremost limits of a series of areas in which ground combat units are deployed, excluding the areas in which the covering or screening forces are operating, designed to co-ordinate fire support, the positioning of forces or the manoeuvre units.

*Fire Mobility* The flexible switching of fire from one target to another across a front and in depth.

*Forward line of own troops (FLOT)* A line which indicates the most forward position of friendly forces in any kind of military operation at a specific time.

*Final protective fire* An immediately available pre-arranged barrier of fire designed to impede enemy movement across defended lines.

*FLOT* See forward line of own troops.

*Forming-up place (FUP)* The last position occupied by the assaulting echelon before crossing the Start Line.

*Forward slope* Any slope which descends towards the enemy.

*FSCL* A line established by the ground force commander to ensure coordination of fire which is not under his control, but which may affect operations which are.

*General support artillery* British artillery controlled at divisional or corps levels.

*Gun* A weapon in which projectile and charge are loaded in one piece, and which fires at high muzzle velocity in flat trajectories. The term is now used to refer to any barrelled artillery equipment.

*Gun-howitzer* An artillery weapon in which projectile and charge can be loaded separately, as with a howitzer, but which can also fire at high muzzle velocities and with low trajectories.

*Harassing fire* Fire designed to disturb the enemy troops, to curtail movement by threat of losses, to lower morale.

*H Hour* The specific time on D-Day at which hostilities commence, or, in a planned operation, at which operations commence. In World War Two this was known as Zero Hour.

*Howitzer* An artillery weapon in which the projectile and charge are loaded separately, allowing the size of the charge to be varied according to the range and type of the target, and which can be fired in the high angle.

*Indirect fire* Fire delivered at a target which cannot be seen by the aimer.

*Limber* A wheeled carriage which can be attached to the trail of a gun and is usually used for carrying ammunition or the gun detachment.

*Mil* One mil is  $\frac{1}{6400}$ th part of a circle used for aiming and survey.

*Minimum Force* The **least** force of any type required to achieve an objective.

*Mortar* A smooth-bored weapon firing finned bombs in the high angle.

*Munitions* Explosive ordnance, such as ammunition and bombs.

*Mutual support* A condition which exists when positions are able to support each other by direct fire, thus preventing the enemy from mounting an attack against any one position without being subject to direct fire from one or more adjacent positions.

*Muzzle Brake* A device fitted to the muzzle of a barrel, which deflects the **propellant** gases **following** the projectile to develop a forward thrust, countering the recoil.

*Neutralize* To render the enemy's weapons temporarily ineffectual.

*On-call target* A planned target other than a scheduled target, on which **fire** is delivered when requested.

*Operational level* Operations at divisional level or higher.

*Ordnance* Originally a generic term for all military equipment and supplies, now usually restricted to artillery equipments.

*Piece* Any barrelled weapon; the term is being increasingly applied to any artillery firing or launching system.

*Predicted Fire* Indirect artillery fire without observation. The firing data result from computations allowing for map co-ordinates of target and guns, meteorological conditions, the ballistic variables of the guns and other factors.

*Projectile* Anything fired from a gun, howitzer or launcher.

*RAP* See rocket-assisted projectile.

*Recoilless* Producing gases on firing which escape to the rear of the gun so as to produce minimal recoil force.

*Rocket-assisted projectile* A projectile which increases its range by a rocket motor cutting in as it loses forward speed at the high point of its trajectory.

*Registration* The determination of correct Firing data by adjusting the fall of shot on to a target.

*Reverse slope* Any slope that descends away from the enemy.

*Round* (1) a projectile, or a projectile and propelling charge (2) a unit of accounting for the number of times a weapon has been fired.

*Scheduled target* A target engaged at a predetermined time.

*Shell* A projectile with a hollow interior into which HE or some other cargo can be packed, and fired by a gun or howitzer.

*Shot* A solid artillery projectile used primarily against armour.

*Start line* A line designated to co-ordinate the departure of an attack.

*Survey* The calculation of the precise co-ordinates of a firing unit so that an accurate relationship may be **established** between the positioned guns, observer and target.

*Tank destroyer* A tracked SP anti-tank gun specifically designed to destroy tanks.

*Time on Target (TOT)* In order to achieve the **maximum** shock **effect**, artillery **fire from various** sources is often synchronized to fall on a particular target at a particular time. To achieve this, firing units are given a TOT. Because of their different distances from the target, the time at which firing units open fire may vary in order to achieve a common TOT.

*Trail* That part of a towed gun which extends from the axle to the ground to provide support and to counter the recoil.



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