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Editorial

IN this issue we publish a major article on the subject of fortifications. Although popular demand recently has called for short, not too technical, articles in the *Journal*, we would be failing in our duty if we kept Captain Glyn Taylor's "The General Design and use of Hardened Defences in Twentieth Century Warfare" to ourselves.

The author's aim was to produce a Professional Engineer training course paper on the design and construction of rapidly constructed hardened defences but his early research into the subject showed that a historical analysis was called for as a background to the paper proper. It is this earlier work which we now publish. Captain Taylor's introduction to his second paper states:

"Most modern military tacticians believe the hardened defence to be outmoded and an expensive luxury on the battlefield. This view is based on the current concept of mobile warfare and the historical failure of some hardened defence systems in World War Two, the principal example being the Maginot Line. Only the USSR and Israel are believed to maintain military hardened defence systems and recent British involvement has been limited to small-scale defences in Northern Ireland.

"The continuing Soviet threat against Western Europe, particularly their capabilities for aerial and artillery bombardment is forcing some NATO military analysts to reconsider the value of hardened defences on the modern battlefield. Several articles have appeared in the *Royal United Services Institute Journal* advocating some form of fortified belt in the forward defence zone in West Germany. The principal theme is a 'framework defence' of fortified villages and hardened defences paying special attention to defending natural obstacles. The proponents agree that such defences should be backed by mobile forces to form a 'Sword and Shield' defence. This was the original concept of the German West Wall (Siegfried Line) in World War Two and the current Israeli defences on the Golan Heights. The proponents feel that such a system should allay fears of a 'Maginot mentality' or a commitment to a single static defensive line.

"Their proposal may convert some of the military opposition but they do not remove the overriding political factor against hardened defences in West Germany. The construction of peace-time defences along the West German border might antagonize the Soviet Union and give overt acknowledgement to the existence of two Germanies. Internal opposition within West Germany would also be likely from the more radical elements of the political spectrum. One means of satisfying both the political and military opposition is to have a system of hardened defences that can be rapidly constructed during war. Today the construction industry provides the means to make this possible."

We would comment simply that rapidly constructed hardened defences are only one aspect of the whole theme of modern fortifications in which the Corps is taking a leading role to heighten the awareness throughout the services of the potential of engineering to deal with problems of protection across the whole military spectrum from internal security to general war. We would welcome other contributions on this theme.

The General Design and Use of Hardened Defences in Twentieth Century Warfare

CAPTAIN G TAYLOR MA C ENG MICE RE

The author was commissioned into the Corps in 1974. He took an engineering degree at Cambridge. He has served as a troop commander in BAOR and UK, Second-in-Command 60 Field Support Squadron and Adjutant 73 Engineer Regiment (V). In 1984 he attended the Long Civil Engineering Course and was attached to John Holland Group in Australia. This article was part of his military engineering paper for the course. He is currently at Camberley as a student on Army Staff Course 21.

INTRODUCTION

General

From Port Arthur to the Golan Heights hardened defences have played a major role in 20th century wars. This is not surprising as the principal hardened defence, the fortress, is a basic military concept which has evolved through changes in artillery power, developments in military techniques and advances in building methods and materials. In modern terms a hardened defence may be defined as a military works which protects its occupants by use of concrete and steel. The most renowned examples are the Maginot Line and the Atlantic Wall but the paper aims to cover a wider selection of hardened defences.

The medieval castle was the principal forerunner of the modern hardened defence. However, their design and construction were advanced when Louis XIV's engineer, Marshal Sebastian de Vauban, developed fortress design and systematic methods of attacking them. Vauban's principles of design remained the basic philosophy behind 20th century defences. As recently as 1985 Major Steven H Myer, assistant professor of mathematics at the US Military Academy, wrote a paper for the *Engineer* magazine harnessing Vauban's principles for the design of obstacles and protective works on the modern battlefield.

Aim

The aim of this paper is to describe the general design and use of hardened defences in 20th century warfare.

Background

The author first became interested in modern hardened defences following his second visit in 1982, to the First World War battlefields. This retraced the steps of an earlier visit in 1972 when he had written a paper on the First World War Battlefields for the Zellidja International Travel Scholarship Organisation, a European concern based in Paris. The second visit proved worthwhile due to the renovations carried out since 1972 at Verdun and Ypres. Due to his military training he also had a better appreciation of the siting and general design of hardened defences. He visited the Atlantic Wall in 1984 and has personal experience of hardened defence construction for internal security in Northern Ireland.

The original idea for this paper was to combine a historical analysis with designs for the modern battlefield. Few current military engineers have studied hardened

Captain G Taylor MA C Eng MICE RE

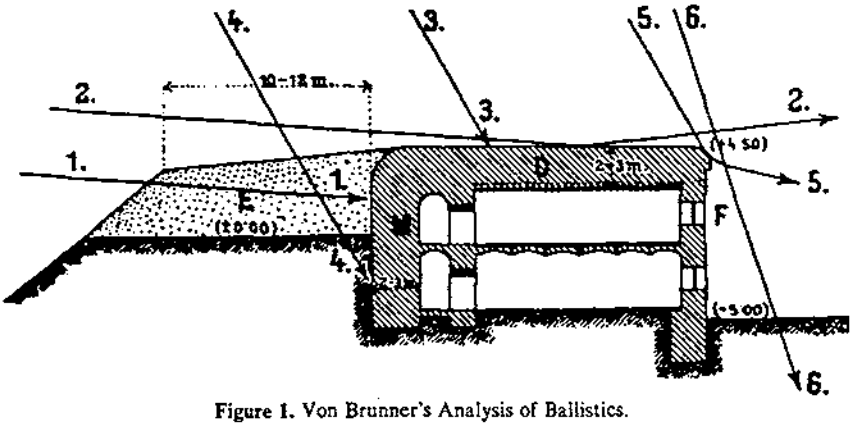


Figure 1. Von Brunner's Analysis of Ballistics.

defences and a historical analysis is essential before considering design. However, early research indicated that the subject was too wide and this historical paper will be followed by a second paper detailing the design of hardened defences using the most modern construction techniques. The scope of this paper has therefore been limited to the general design and use of hardened defences as the detailed design would not be relevant to today's materials and construction standards. This in turn has made the paper equally readable for both civil engineers and military analysts. Comments on the success or failure of a particular hardened defence will dwell on both the design and military reasons.

Until 1914 the fortress (land or coastal) remained the only hardened defence. This early period will therefore be used to set the scene for the advances that were made in the First World War. From 1914 the paper groups the examples under types of defence so their development may be analysed more closely. Hence, the main body will consist of sections on fortresses, field defences, coastal defences and air-raid protection. Finally there will be a brief resumé of today's hardened defences and the conclusions will highlight the most important points for a military engineer to consider for future designs.

Hardened Defences in Twentieth Century Warfare

PRE-1914

The Russo-Japanese war and the siege of Port Arthur in 1905 provided the only example of the use of hardened defences before the First World War. The forts of Port Arthur were primarily coastal defences and their protection was not to the same standard as those being built in Europe. However, their capture was more attributable to military tactics rather than poor construction and the Japanese simply ground the forts down by land assault and clever use of modern artillery. Indeed it was the significant artillery developments in the latter half of the 19th century that forced a rethink of fortress design.

The vertical shell, the explosive shell and the increased accuracy of rifled barrels saw the change from masonry structures to first concrete and then reinforced concrete (RC) fortresses. Open casemates were closed and guns were mounted in armoured cupolas, the most advanced being retractable. This latter development was assisted by technological advances in hydraulics. Fortresses now consisted of detached forts giving mutual support, the so-called 'girdle fortress', where hostile fire could not reach the inner ring without penetrating the outer ring first. However, the size and expense of such systems confined them to the major strategic points.

Some of the most important theorists since Vauban also published their ideas on fortress design. Major Moritz Ritter von Brunner, an engineer in the Austro-Hungarian army, applied the theory of ballistics to detailed design (*Figure 1*). A most important

statement appeared in his training manual in 1910, "The type and amount of hostile fire to be expected were the principal criteria in fortress design". As we shall see the Belgians had not applied this most fundamental principle. The theorists fell into three schools but all of them agreed that dispersion was a most important factor in modern fortress design. The first school favoured numerous detached forts, small but well armed. The second felt that a large fort with dispersed components would better satisfy the morale requirements of the defenders. The third school formed the most interesting theory; a number of dispersed armoured guns with mobility provided by railway tracks. Unfortunately, fort construction was so slow that little had been done to introduce the new theories by 1914. The reader however may recognise respectively the brainchild of the West Wall, the Maginot Line and perhaps even the tank. Despite these advances detailed design still depended on field trials and experience rather than theoretical calculations. This remained the case to the end of World War Two.

FORTRESSES

Belgian Defeat 1914

Belgium pursued a policy in the late 19th century of fortifying key towns with girdle fortresses. The individual forts were designed on either a triangular or pentagonal trace according to the terrain. A concrete central redoubt was surrounded by an earth bank with a moat covered by fire from flanking galleries. Main armament included 150 and 120mm guns housed in cupolas. These were supplemented by 210mm howitzers and 55mm quick-firing (QF) guns. A typical triangular fort is shown in *Figure 2.* They were designed by General Brialmont, a military engineer, and the towns of Antwerp, Namur and Liege had been fortified in such a manner. The latter two fortresses were to cover the Meuse Valley but both the siting and range of their guns meant this requirement was not fulfilled.

Unfortunately the designs did not encompass many of the suggestions being made by the pre-war theorists. They had not been updated since completion in 1890. Tactical siting was poor and the spacing around the girdle was equidistant rather than a function of the ground. Individual forts rarely gave mutual support and prior to the invasion, gaps had not been filled by field defences for fear of provoking the Germans. However, the main drawback was their construction; the protection was obsolete and vulnerable to modern artillery. Cupolas were made of 200mm cast iron and simply shattered when struck by shells. Only those containing the smaller guns

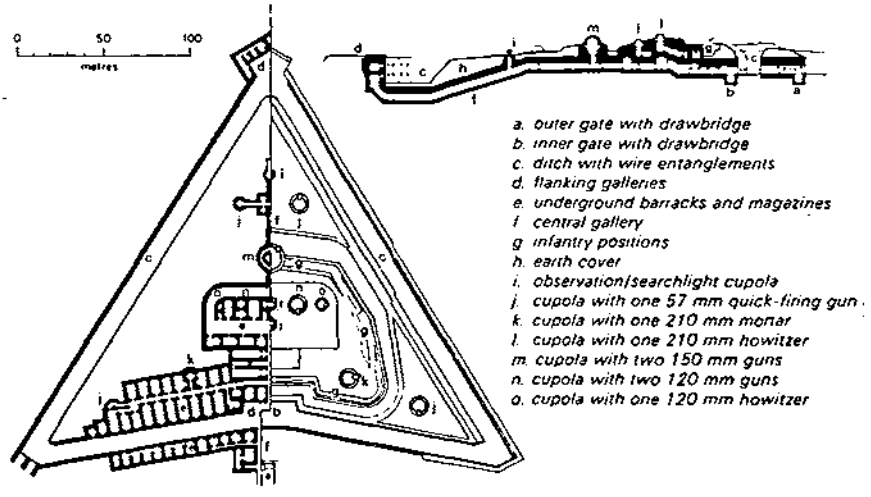


Figure 2. Typical Brialmont Fort.

could retract for added protection. Concrete was unreinforced and total protection consisted of 1.5m concrete laid on 0.4m sand and 2m of stone. Furthermore the concrete was not monolithic and laid in two layers giving a line of weakness.

Liege fell in eleven days, Namur in four and the most powerful fortress at Antwerp in ten days. Individual forts fell to 210mm high explosive shells but the real technical surprise was the Krupp 420mm howitzer. When this was used forts rarely lasted more than twenty-four hours. In many cases the cupolas were jammed and without their firepower the garrisons surrendered quickly. The living conditions under fire were dreadful as little consideration had been given to the design of ventilation and facilities. These shortcomings were summed up by General Leman the Commander of Liege, "Brialmont's military genius had an academic bent, and he forgot that his works were made for human beings. He left out of account a natural function of mankind which does not cease during bombardment: quite the reverse". The Germans held detailed designs for the forts and their quick collapse was expected. The French drew rather the wrong conclusions and decided that the fortress was obsolete. Verdun was declassified and where guns could be removed they were transferred to the field army. Eighteen months later this almost had disastrous consequences but Verdun was to enhance the image of the fortress.

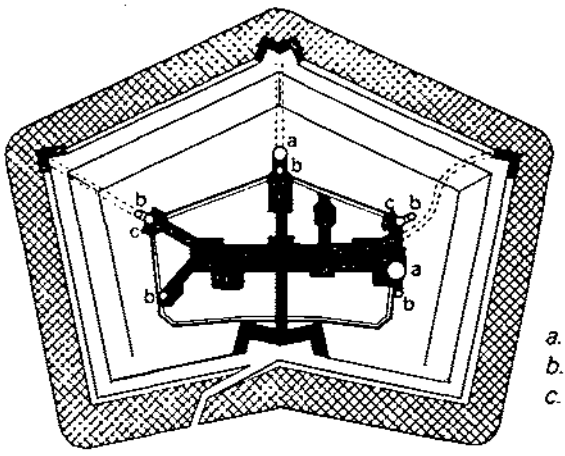
Verdun

The French fortress strategy was modelled following their defeat in the Franco-Prussian War in 1870. France applied the girdle principle, not only to the fortress towns, but to the entire system, with a border ring, an inner ring and finally the defences around Paris. However, only the border ring had been brought up to date, the most modern being Verdun. The fortresses were placed to channel a German invasion through two gaps and allow a flanking counter-attack. The Schlieffen Plan bypassed the main fortresses and its formulation had taken note of the threat the fortresses would have placed on lines of communication had their main thrust been made directly over the Franco-German border. In general the French forts were far superior to Belgian and indeed the few German forts. All steel was armoured, at least twice as thick and the concrete was reinforced and of superior quality.

Verdun had served an excellent purpose during the Battle of the Marne in 1914. Undefeated it formed the hinge of the allied counter-attack which threw the German invaders back to the Aisne. Despite this success, the collapse of the Belgian forts and an equally poor performance from Maubeuge persuaded the French Chiefs of Staff that the guns should be removed from fixed casemates. Thus in 1916 when Verdun was attacked its defences were well protected but lacked the firepower.

Fort Douaumont was perhaps the most famous of the Verdun forts and certainly the most modern. The French considered it to be impregnable. The main shell was composed of a 2.6m RC and sand sandwich covered with 5.5m of earth. Cupolas were of 300mm laminated toughened steel and most were retractable. The moat surrounding the fort was 8m deep and the sides lined by concrete. This was covered by flanking galleries. A diagrammatic layout of Fort Douaumont is at *Figure 3*.

The German Chief of Staff Von Falkenhayn had selected Verdun for his 1916 offensive as this national symbol might provide a chance to "bleed the French army white". When the offensive opened in February the defences were not based on the fortress system and the Germans made rapid progress capturing the 'impregnable' Fort Douaumont. General Petain revised the defensive system and based it on the forts. This was a sound policy as the individual installations had been cleverly sited on crests to offer mutual support and cover dead ground. Forty *ouvrages* (small installations) were interspersed with the twenty major forts. These reinforced concrete positions equated to the field defences so badly missed by the Belgians. Apart from their ability to cover the area with fire the forts provided protection for men. This was probably their most important aspect in the stalemate that ensued. Reserves were kept close to the front line in total protection with a fair degree of comfort. All but the smallest *ouvrages* withstood the 420mm shells and only one armoured cupola was destroyed. The only other fort to be captured was Fort Vaux and this after a desperate



a. artillery cupolas
b. observation cupolas
c. machine gun cupolas

Figure 3. Fort Douaumont.

struggle. However, by December Forts Vaux and Douaumont had been recaptured with much of the ground lost in the initial stages of the battle.

Verdun was a success because it was designed to meet the requirements of the First World War battlefield. With French faith restored in the fortress the Maginot Line was born.

Fort Eben Emael

The capture of Fort Eben Emael in 1940 is often cited alongside the Maginot Line to illustrate the failure of fortresses in World War Two. The fort was built in 1932 on the Dutch-Belgian border near Maastricht. It was deemed impregnable and supposedly dominated the Albert Canal and the River Meuse. Its capture formed the crux of Hitler's plans for the invasion of the Low Countries in May 1940. Constructed along similar lines to the Maginot forts the design featured RC and earth protection with firepower provided by the fixed casemates and retractable cupolas. The 750 man garrison was provided with services and every other comfort for a long siege, yet on 10 May it was neutralised in a few hours by eighty-five men.

The fort was assaulted by highly trained engineers who landed on the glacis in gliders. Their weapons were explosives, in particular the first ever hollow charge. These were used to great effect to blast into casemates, cupolas and the ventilation system thus preventing any defensive fire against the crossing of the Meuse and the Albert Canal. The fort had not surrendered immediately but its defenders seemed powerless to relieve the situation and on 11 May it capitulated. The German operation was brilliantly conceived but without three major flaws in the defences it may not have succeeded. Firstly, the designers had not considered an airborne assault and the anti-aircraft defences consisted of only eight machine guns. Secondly, the siting of fire positions was poor. The fort could not sweep itself with its own fire and there were no neighbouring defences to provide such protection. The principle of mutual support had been neglected. Lastly, the defenders were typical fortress troops. Fortress Divisions were often second rate troops with no transport or heavy mobile weapons. A determined sally by the defenders may have retrieved the situation but they stayed inside. Whilst the Belgian defenders had forgotten such historical concepts, the Germans had not and their modern petard carried the day. The loss of Fort Eben Emael was a pyschological blow from which the Belgians never recovered.

The Maginot Line

The original purpose of the Maginot Line was to eliminate the Franco-German border as a suitable area of German attack, thus economizing on manpower and equipment which could then be reserved for a planned offensive or to counter-attack

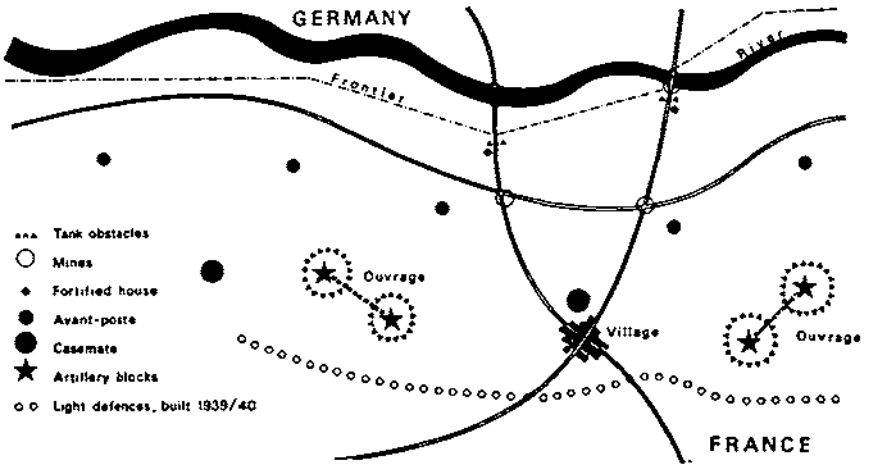


Figure 4. General layout of Maginot Defences.

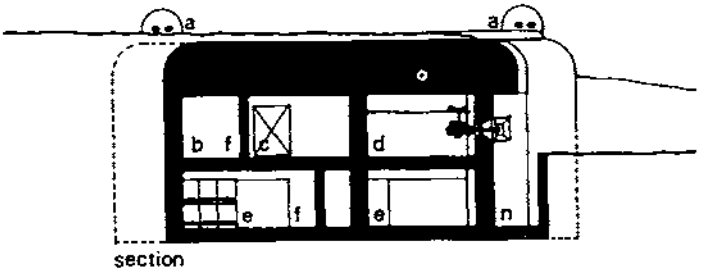
enemy penetration. Although it fulfilled the role of stopping a direct German invasion of Alsace-Lorraine it was to be blamed for France's defeat in May 1940.

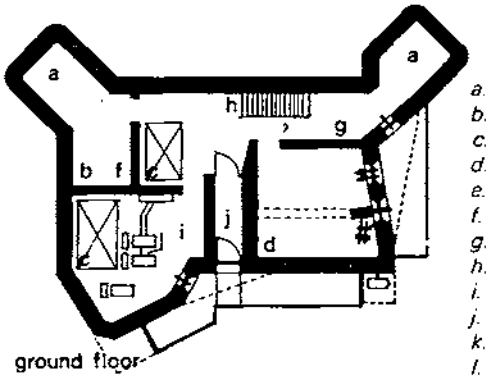
The line of defences were named after the Minister of War, André Maginot. Whilst he strongly supported the construction of fixed defences to counter the growing German menace he was not the only driving force behind the project. Both military and civilian leaders had recognised the 'Verdun Spirit' as their saviour in the First World War. A military study group, The Frontier Defence Commission, proposed two solutions to deter German aggression; either a discontinuous line of forts to be used as troop bases for counter-attacks or a continuous, impregnable line. Petain, the victor of Verdun, supported the latter theory and a linear system was adopted. When tenders were let in 1928 Maginot was not even the War Minister but it was his unqualified support that saw construction begin in 1930.

The lessons of Verdun were used as a basis for the general design. Hence, retractable turrets, heavy casemates and a sandwich construction were also a feature of the Maginot Line. One weakness at Verdun was the lack of hardened protection connecting the defences. This and the increasing threat of the aerial bomb persuaded the French to use massive subterranean works 20–90m below ground level to protect accommodation, nerve-centres and communications. Exposed concrete was limited to the combat blocks. Thicknesses of RC were determined by field tests using howitzers. The tests were successful but led to a tripling of concrete thickness. The final thickness of 3.5m RC was known as 'Method of Protection No 3' as three direct hits could be withstood at the same point of impact. This was important as the individual blockhouses were expected to sweep each other with fire to guarantee mutual support (a factor the Belgians had forgotten with Fort Eben Emael). Roofs were designed to withstand a direct hit by 420mm howitzer or 1000kg bomb. Additional protection was provided by using curved profiles and constructing the blockhouses as far into the earth as possible. Some savings were made by reducing thicknesses on the rear of installations to 1.5m RC. A similar principle was used on tank armour and although sound in theory the Maginot Line was attacked from the rear by the Germans in 1940.

The general layout is explained by *Figure 4*. The final linear system was not continuous but consisted of mutually supporting positions 12km deep. The first line lay close to the border and was known as *maisons fortes* (fortified houses), little more than armed police posts, which also held equipment to block roads. Their role was to delay the enemy and give advance warning to the main defences. One to two kilometres behind lay the *avant postes* (advance posts). These had a similar role to the *maisons*

fortes but were manned by garrisons of thirty to fifty men and were more heavily armed with machine guns and anti-tank guns. Six to eight kilometres further behind lay the main defensive line, the *position de resistance*. This was normally sited on low hills giving a commanding view of the border. Defences consisted of either *ouvrages* (forts) or smaller interval casemates. As these were the principal defences they bear closer examination. The actual siting of all defences depended on topographical and





a. observation cupolas
b. periscope room
c. water tank
d. gunroom
e. dormitories
f. telephone exchange
g. cooking area
h. stairs
i. engine room
j. entrance
k. toilets
l. wireless room
m. ventilation chamber and stores
n. moat

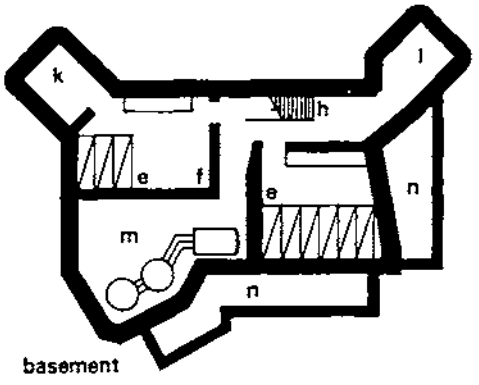


Figure 5. Interval Casemate.

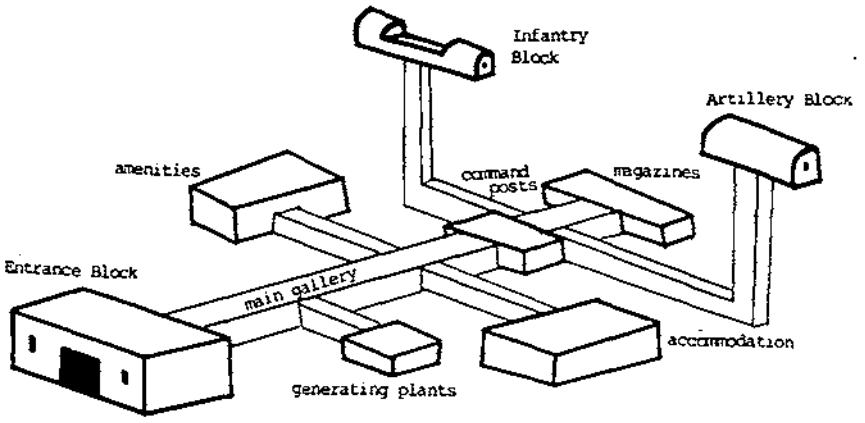


Figure 6. Schematic layout of *ouvrage*.

tactical factors. Obstacles were used to protect all defences and these included wire, mines and anti-tank ditches. The entire system was to be supported by interval troops who would construct light defences behind the main line in war. They would provide additional artillery and a mobile reserve to counter any penetrations of the *position de resistance*.

The interval casemates were placed between the *ouvrages* to provide flanking fire along the main obstacle line. They were two-storey structures with a basement and a ground floor. The basement provided the amenities and the ground floor was the fighting compartment. Armament included 50mm mortars, 47mm anti-tank guns and machine guns. One feature of the weapon mountings was the ability to swing either a machine-gun or anti-tank gun into the embrasure. Garrisons were twelve to thirty men and they were sited alone or in pairs with a connecting tunnel. *Figure 5* illustrates a typical interval casemate.

The *ouvrages* were to establish many of the myths of the Maginot Line. Sited approximately 5km apart they contained the tunnels and galleries that were the outstanding feature of the defences. Garrisons were 200 to 1200 men and although the *ouvrages* were not identical they did contain the same basic elements or blocks. Infantry, Artillery and Entrance blocks were connected by a vast infrastructure of tunnels, command posts, underground barracks, magazines and generating plants. The Entrance Block was 2–3km behind the combat blocks and was protected by machine-guns, anti-tank guns and obstacles. A gas-tight, armoured door led into the main gallery. This was serviced by a light railway and led from the Entrance block to the nerve-centre of the fort. Internal protection was provided by machine-gun posts along the gallery. The nerve-centre with the accommodation, magazines and command posts branched off the main gallery and sometimes covered several floors. Lifts connected the floors and provided access to the combat blocks at ground level. The magazines had one special feature, a 17 ton armoured door that closed automatically in the event of an explosion. *Figure 6* is a schematic layout of an *ouvrage*.

The combat blocks were composed of individual blockhouses. Infantry blockhouses were similar to the interval casemates. Armament was 50mm mortars, 47mm, 37mm or 25mm anti-tank guns and machine-guns. Artillery blocks were either a group of retractable turrets or a group of blockhouses (*Figure 7*). Armament was 75mm guns, 135mm howitzers and 81mm mortars. The total number of guns was surprisingly low, only 344, spread between 152 retractable turrets and 192 blockhouses. The retractable turrets generally contained short 75mm guns. This was due to weight restrictions imposed by the hydraulics. The maximum diameter of turret was 4m and with 0.3m of armoured steel it weighed 280 tons. Artillery blocks were supported by observation

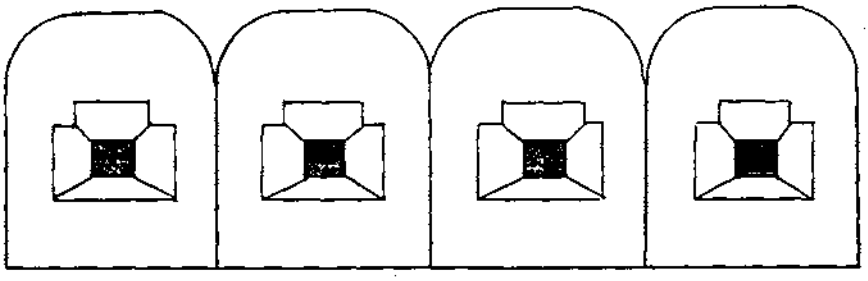


Figure 7. Artillery block with blockhouses.

and machine-guns turrets. These were fixed turrets of 0.25m armoured steel and eventually proved vulnerable to 88mm anti-tank fire.

The secrecy and spy-mania surrounding the construction of Maginot Line fuelled the various myths published in the 1930s. Even Liddell Hart wrote in 1937 that the Maginot Line "extended to Dunkirk in the north and to the Jura in the south". In 1939 James Eastwood wrote a book *The Maginot Line and Siegfried Lines. Walls of Death*. He was equally inaccurate on the opposing defences but his descriptions of the barbers' shops, white-coated attendants and colonial decoration in the Maginot Line was perhaps his worst exaggeration. The reality was rather different. The defences only covered the border from Luxembourg to Switzerland. The damp, cavelike atmosphere of the defences caused pyschological problems and forced troops to live outside in tented camps when the threat-level was low. Only the Germans were not fooled by the veiled publicity. They had ample intelligence from the construction works. Only 50% of the workforce was French, the rest came from Germany and Eastern Europe. Firms were under such pressure to meet completion dates that sub-contracts had even been let to German firms! Germany had also occupied the Czech fortifications in Sudetenland and as these had been based on the Maginot Line, Hitler had the perfect training ground for an assault. Despite these advantages Hitler considered a direct assault as impossible and he vowed to "manoeuvre France right out of her Maginot Line without losing a single soldier".

Hitler achieved this aim in May 1940 and few of the Maginot defences fought a serious battle. The engineers had done their best within the constraints that the military and politicians had set. This unique feat of engineering is best illustrated by the construction statistics. The works involved 100km of tunnels, 12 million m³ of earthworks, 1.5 millon m³ of concrete and 150,000 tons of steel. At 1940 prices a large fort cost 70 million francs and an interval casemate 2.5 million francs. The total cost of the Maginot Line was 6 billion francs. The real blame for the fall of France lay in the moral and political degeneration of the country and the failure of the military authorities to recognise the development of warfare after 1918. The tragedy of the Maginot Line is that it could have been used twice to gain a victory. During the Phoney War of 1939 and in the initial stages of the German invasion it could have been used as a firm base for counter-attacks. Unfortunately the interval troops (the "sword") were held as stationary as the "shield".

FIELD DEFENCES

German Field Defences 1914–1918

For over four years the German army developed ideas of defence and fortification which were to be the basis of European defence construction for the next three decades. The backbone of German defensive theory was protection of troops, therefore maintaining morale. This philosophy is best summed up by a quote from a Prussian War Ministry document of 1916 "Splinter-proof constructions have proved actually harmful. They not only fail to give protection, but block the trenches with their debris. Every means must be used to provide shell-proof shelters".

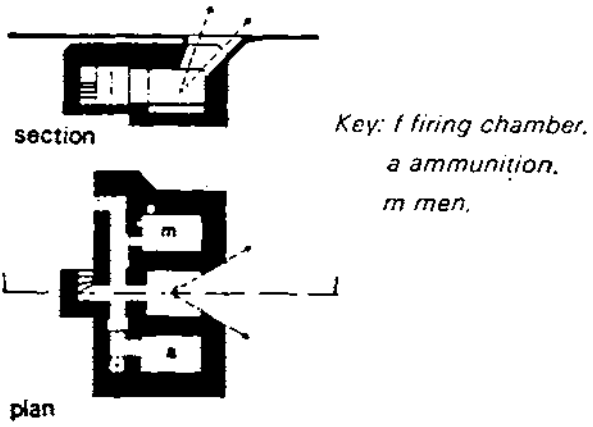


Figure 8. Mortar emplacement with aperture.

Initially deep dugouts with natural protection provided the means of defence against heavy bombardment. The advent of the creeping barrage caught many Germans still underground and thereafter the emphasis was on smaller dispersed RC dugouts close to the surface. The Germans had first used concrete in 1915 but by 1916 RC was more common. This can be explained by the German design depths for various materials. Equivalents were as follows; 11m of clay, 8m of chalk, 1.5m of concrete and 0.8m of RC. Work was carried out by trained fortress engineers and pioneers plus civil engineers selected for their peace-time experience. The RC was initially made with poor quality concrete and scrap steel for reinforcement. Surviving examples of German pill-boxes on Kemmel Hill near Ypres show the use of iron gates for reinforcement! This unsatisfactory situation was soon superseded by production of quality concrete and standard reinforcement with tied joists and beams. The Germans even imported Rhine gravels as this improved the quality and strength of the concrete. Formwork was timber or corrugated iron (CGI). CGI was found to be particularly suitable for the inner revetment of concrete walls and structures. The use of permanent formwork increased the strength of structures considerably. The construction of positions in the front line posed several problems. Curved corners were desirable but difficult to form under battlefield conditions. Silence was maintained by maximising off-site work, for example concrete was dry-mixed and transported forward. Lastly, large quantities of material were difficult to bring forward so designs utilised minimum

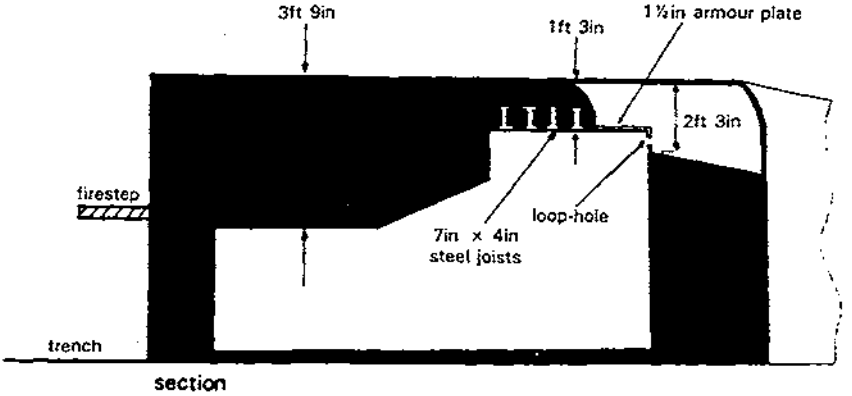


Figure 9. Trench shelter for two machine-guns.

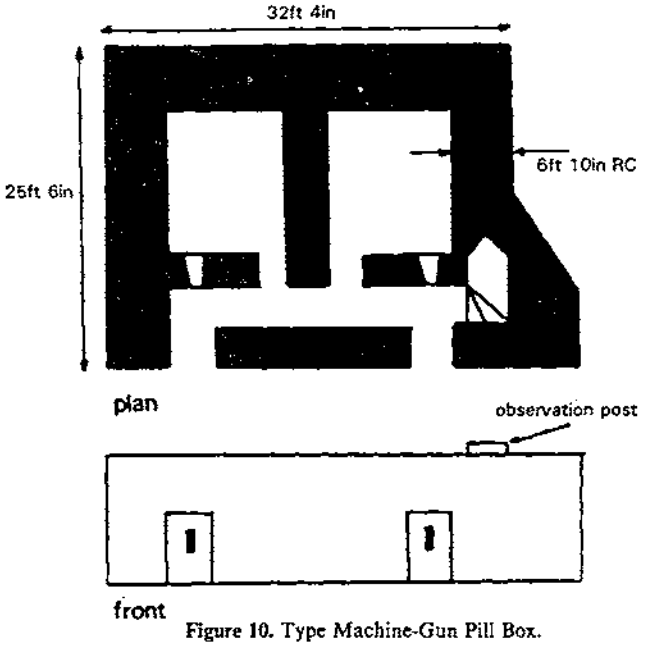


Figure 10. Type Machine-Gun Pill Box.

thicknesses. It is therefore not surprising that the Germans constructed the Hindenburg Line in 1916 and then withdrew sections of their line to it.

Following the German failure at Verdun the Germans decided to spend 1917 on the defensive whilst they concentrated on the Eastern front. Apart from the withdrawal to the Hindenberg Line the Germans also restructured their defensive strategy. This abandoned the continuous line of trenches and heavily defended front line and relied on defence in depth. The front line was a series of isolated outposts with two main defensive lines behind, the deepest being the most formidable. RC defences were scattered amongst all three lines and siting was dependent on concealment and the ability to offer mutual support.

Camouflage and concealment were primarily achieved by constructing positions in the ground. Shelters, aid posts, mortar emplacements and searchlight positions were placed completely below ground. The latter two had apertures to utilise their equipment. *Figure 8* illustrates a typical mortar emplacement.

Machine-gun, gun and observation posts were placed as far into the ground as possible trying to achieve a maximum above-ground profile of 0.9m. This proved difficult with a minimum of 0.8m RC for overhead protection. However, the profile could be reduced further to 0.7m with steel joists or 0.4m with an armour plate cupola. The example in *Figure 9* utilises both joists and armour plate. It is a typical trench shelter for two machine-gun crews. The weapons were intended to be fired from the firestep behind the emplacement but one machine-gun could be permanently mounted to fire out of the loop-hole.

Little has been mentioned about ground conditions but they were to have a major effect on designs in the Ypres area where much of the land was reclaimed polder. The phrase 'pill-box' emerged at Ypres due to the appearance of RC defences standing proud amidst a devastated landscape. Most of the structure was above ground and excellent examples can still be seen today at Langemarck and Tyne-Cot cemeteries. The Type Machine-gun Pill Box is a typical example of standard designs used in 1917 and 1918 (see *Figure 10*). The only method to overcome the pill-box was to drop a grenade through a loop-hole. The recessed loop holes in this design made this task even more difficult.

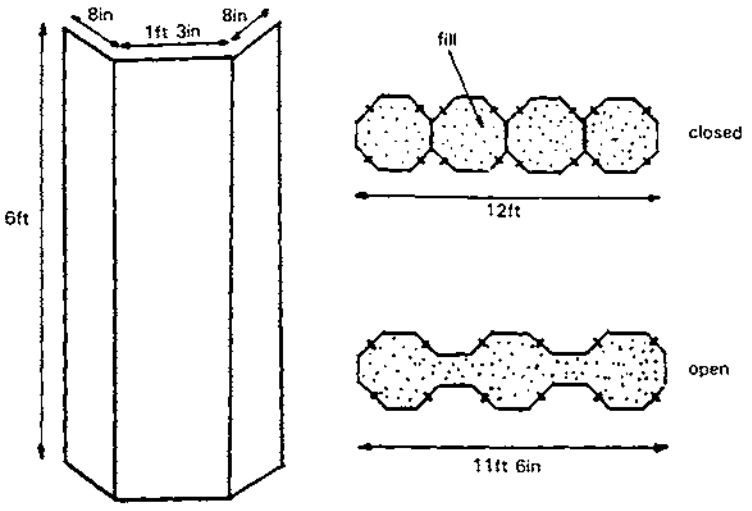


Figure 11. Ryes Plate.

The 3rd Battle of Ypres in 1917 represented the greatest success for RC defences in the First World War. Trenches were difficult to construct in the poor ground and Ypres had a higher density of RC defences than any other area of the front. Concrete was undoubtedly the most important constructional feature of the German defences built on the Western Front, and the use of RC from 1914 to 1918 by the Germans was probably the first use of the material on such a vast scale.

British Field Defences 1914–1918

The field defences constructed by the allies during the First World War were well below the standards set by the Germans. This was due to their belief in the offensive spirit or *arme blanche*, more permanent defences may have induced a defensive mentality amongst the troops. Hardened field defences were therefore non-existent amongst the French trenches and the British efforts only warrant a closer study due

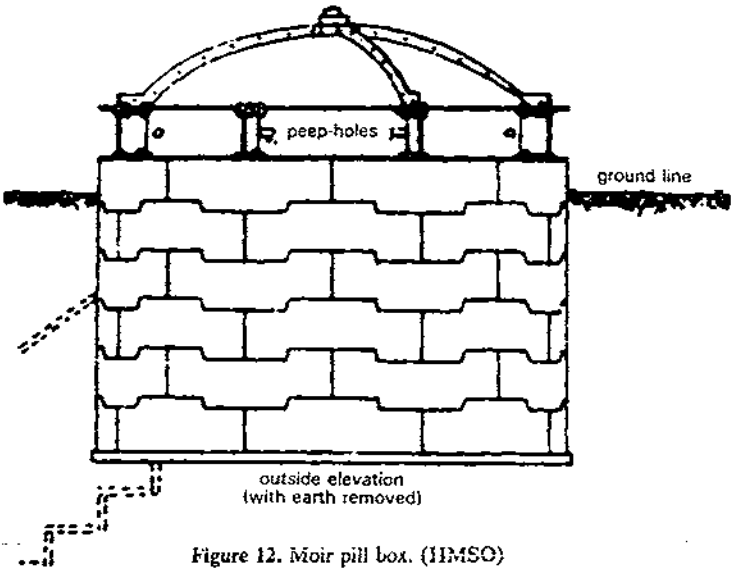


Figure 12. Moir pill box. (HMSO)

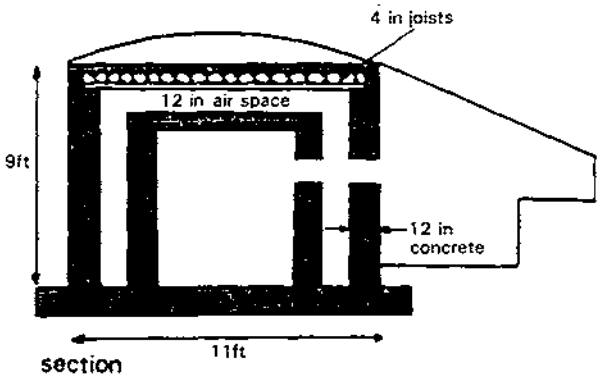


Figure 13. Concrete Pill-box designed by Air-Space Theory.

to two developments which would influence later hardened defence design. These were prefabricated defences and the use of the air-space theory.

The British made excellent use of corrugated iron (CGI) in their early defence construction. It was used for revetment of trenches and dugouts and for permanent formwork on concrete emplacements. Other emplacements were simply constructed with walls of CGI and rubble. Sheets were fastened with a suitable space and this was filled with the hardest material available. This led to a more sophisticated development, the Ryes OP plate. This was designed to meet the demands of the Royal Artillery for rapidly constructed observation posts. The Ryes plate is more easily explained by *Figure 11*. The part-hexagon shape could be bolted together to form closed or open connected hexagons. The plates came in two sizes, 6 feet long and 9 feet long, and once the hexagons were constructed the space was filled with concrete, rubble or earth.

The ultimate in prefabricated design was the Moir Pill-Box. This was developed at the end of the First World War but did not see service. Constructed from interlocking concrete blocks and prefabricated steel parts it provided a rapidly constructed pill-box for a machine-gun *Figure 12*.

The French had used a sandwich construction in the Verdun Forts as a means of reducing the shock wave of an explosion before it reached the inner layer. The air-space theory took this one stage further with a double-skin concrete construction separated by air. The outer slab was known as the burster slab which detonated the shell forcing the explosion to be dissipated through the air space. The British implemented the air-space theory on both concrete defences and standard earth and timber construction. The design in *Figure 13* is for a machine-gun post in 1916. Note that reinforcement is only used in the roof in the form of steel joists. The air-space theory was to be used in the Maginot Line and also by the Germans for their submarine pens, when they proved vulnerable to the allied blockbuster bombs.

West Wall (Siegfried Line)

The West Wall or Siegfried Line was the name given to the zone of defence constructed on Germany's western border in 1938 and 1939. It was popularly believed to be an equivalent of the Maginot Line, but this theory was the product of German propaganda. Although Hitler desired a 'Maginot Line' in reality he had a series of cleverly sited field defences. The brainchild of the West Wall lay in the diverse sources of First World War field defences and the autobahn system constructed in the 1930s. The former provided the philosophy and the latter the constructon organisation. The German autobahn system was regarded by British Engineers as the greatest inter-war development in Germany. In 1930 Dr. Fritz Todt wrote a paper *Proposals and Financial Plans for the Employment of One Million Men*. The paper proposed a concrete motorway system and his description of the "best motorway in the world" found wholehearted support from Hitler who was fascinated by grandeur. Permission was granted in 1933 to begin construction and the system was planned to provide mobility for an army rather than internal communications for the population.

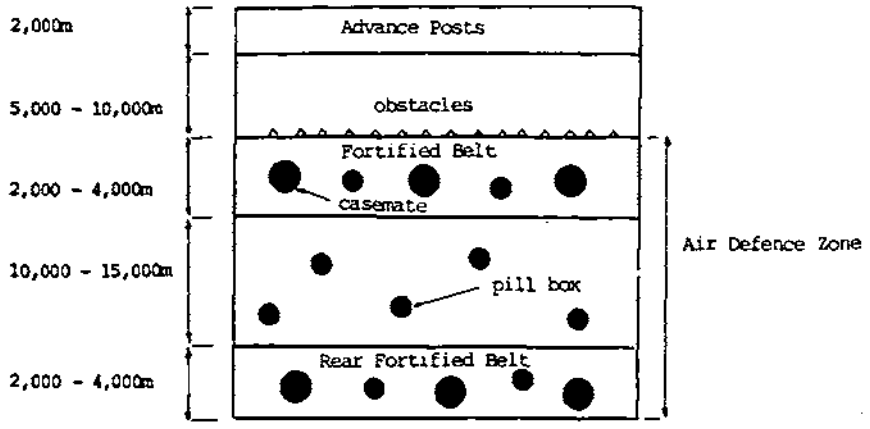


Figure 14. Schematic layout of West Wall.

Hitler regarded himself as the "greatest fortress builder of all time" and when he briefed Todt in 1938 for the construction of the West Wall he was beginning a chain of fortification programmes that far exceeded those constructed by France. Todt was to employ the same organisational methods to build giant fortifications from Switzerland to the Netherlands. It was to be deeper and longer than the Maginot Line with a 20 to 30 km Army Zone and 30 to 50 km Air Defence Zone. In contrast to the Maginot Line the construction programme was not surrounded by secrecy. This fuelled the propaganda and whilst the western allies thought they faced an impregnable wall it was only a tool to be used by a mobile German army, the classic military principle of Sword and Shield.

The West Wall has often been described as a 'milky way' compared to the 'hard skin' of the Maginot Line. The schematic diagram in *Figure 14* illustrates the resemblance to the German defence system in the latter stages of World War One. The Fortified Belt and Rear Fortified Belt were similar in that they both contained pill boxes giving mutual anti-tank and machine-gun support. The former was also protected by an anti-tank obstacle provided by natural or artificial obstacles. Artificial obstacles included dragons teeth, a well-remembered image of World War Two.

Dragon's teeth were truncated concrete pyramids laid in rows of four or five deep and increasing in height from 800mm in front to 1400 or 1750mm at the back. The teeth were cast on a grid of interlocking concrete beams projecting 600mm above the ground. When used the line was continuous crossing towns, hills, marshes and even rivers. Gaps could be left open to allow vehicles through but these were blocked with steel H-beams when required. The visual barrier added to the impression of an impregnable wall.

Todt's organisation used 350,000 men. In eighteen months they poured six million tons of concrete to construct 22,000 individual works. Despite the presence of the organisation, sections were supervised by local army commanders. There was no standardisation of design and this lack of economy was compounded by corrupt officials selling off materials. No ballistic research had been carried out, unlike the French, and the end result was numerous structures of monolithic construction but of varying quality. There had been standardisation in the thickness of concrete but the 0.4m for the 'standard positions' was too thin. 'Strengthened positions' had 1.5m of concrete and in 1939 extra thickness was added to the front of installations to withstand direct fire. Although tactical siting was clever the ground conditions were seldom considered. When the Rhine flooded many installations failed to prevent seepage. The poorest sites were improved by surrounding the concrete with sheet-pile walls and adding extra thickness below ground level to prevent soil corrosion. A typical pill box/small casemate is illustrated in *Figure 16*. Embrasures faced forward

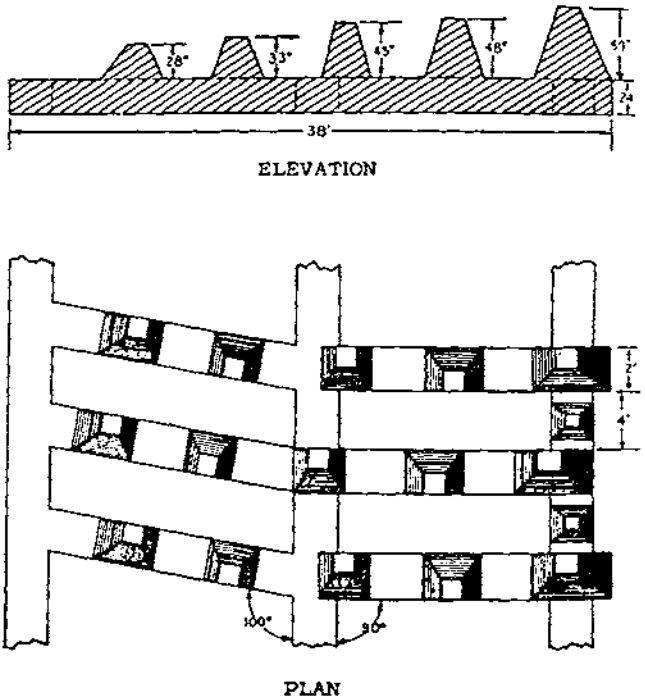


Figure 15. Dragons Teeth. (Department of Defense USA)

or to the flanks and fields of fire were given priority over cover. There were large 'decentralised works'. These consisted of casemates with support trenches and could be up to battalion size. The infantry were sheltered in concrete bunkers behind the main defences. These larger defences were thought to be equivalent of the Maginot Line but the wartime photographs to depict such works were probably taken in the Czech fortifications occupied in 1938 in Sudetenland.

In conclusion the strength of the West Wall lay in the surrounding propaganda rather than the construction. It was the cause of the Phoney War and probably caused Eisenhower to adopt his broad-front strategy in the Allies advance in 1944. Apart from the Hurtgen Forest and the Reichswald the defences were penetrated easily. However, there are two explanations for the failure. First, the installations had been designed for the weapons and tactics of 1938. Many anti-tank casemates were simply too small to take the 75 and 88mm guns required to destroy the allied tanks. Indeed no improve-

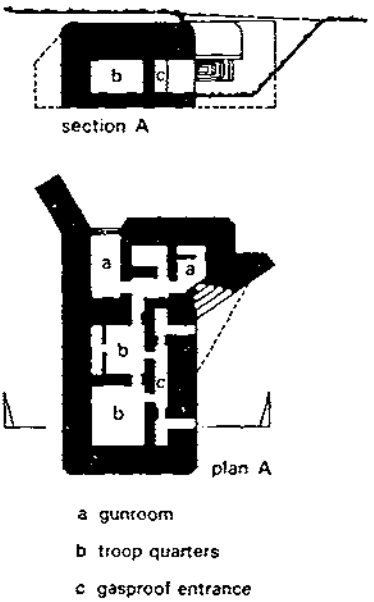


Figure 16. Typical casemate.

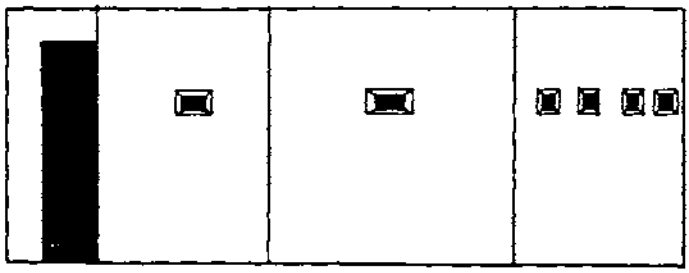


Figure 17. Standard Hexagonal Pill Box.

ments had been made to the system since 1940. Secondly, a beaten Germany did not defend the wall with the same resolve in material and men that might have been expected. Following the failure of the Ardennes offensive the priorities of the Eastern Front meant that there were few mobile forces to reinforce the Shield.

The Pill Box Row

The 'Pill Box Row' was the name given to events surrounding the construction of a defensive system in France in 1939 and 1940 by the BEF (British Expeditionary Force). Row referred to argument rather than a line of defences following the criticism of the defensive system by Hore-Belisha, the Secretary of State for War. The controversy surrounding his comments, after a visit to the BEF in November 1939, was not cleared until an article in the *RE Journal* in 1960. In this article Major General Pakenham-Walsh, the EinC, BEF, sharply countered the allegations published in Hore-Belisha's private papers. The background to the row was the supposed requirement to construct defences equivalent to the Maginot Line in the rear of the BEF sector. This was clearly impossible due to lack of time, materials and suitable labour. Hore-Belisha visited the defences only six weeks after work began and he was comparing them to sections of the Maginot Line that he also visited. The expanded criticism in his papers was probably fuelled by his belief that "scheming officers in France" had forced his resignation in January 1940. It was a pity that the row clouded an excellent effort to provide hardened defences for the BEF with such limited resources.

The Commander-in-Chief, Lort Gort, had decided that pill boxes in depth would better satisfy the requirements of the situation. A force of two Royal Engineers battalions was deployed in October 1939 to construct the defences. They became known as 'X-force' and in six months they constructed 400 hardened defences with the help of Corps Engineers. This effort hardly compares to Rommel's Bar on the Atlantic Wall in 1944 but the force had far less than half a million men and was not composed of the necessary trades for major concrete works. These disadvantages were offset by the EinC's decision to programme the works on a mass production basis. Designs were limited to five types and each design was capable of holding French or British weapons as it was not certain which nation would eventually hold this section of the front. The stark angular designs were camouflaged by siting in woods or buildings. Standard steel formwork was procured and engineer parks established for cutting, bending and bundling bars in 'pill box packs' for delivery to site. It is worth noting that other Royal Engineers could not be deployed onto the task due to the construction of airfields, rear area installations and the miles and miles of additional roads and obstacle belts. In the coming conflict the pill boxes would play little role but the experience was put to good use as the designs and methods were utilised for British coastal defences in 1940 and 1941. The hexagonal standard pill box was one such design that was to become a familiar landmark on the British coast.

Bar Lev Line

The Bar Lev Line was the name given to the series of defences constructed along the Suez Canal by the Israelis prior to the Yom Kippur War in 1973. Although little

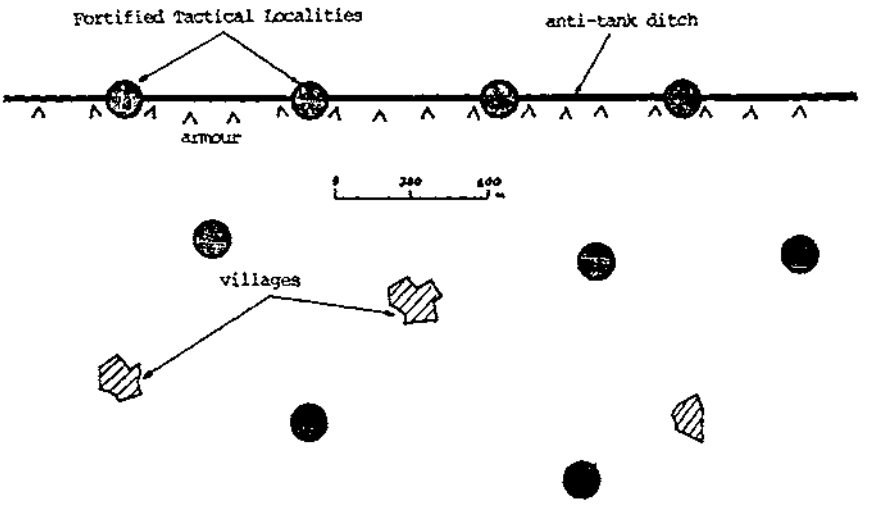


Figure 18. Schematic layout of fortified tactical localities.

is known of the detailed construction, the line consisted of twenty-seven forts and twenty-five bunkers with the main strongpoints built to withstand direct hits from 500kg bombs. It is widely known that the defence system failed and was easily breached by Egyptian forces. However, a similar system existed on the Golan Heights facing Syria and this had more success.

Both systems were similar to the West Wall as they formed part of a "Sword and Shield" defence. Fortified tactical localities were connected by an obstacle line with prepared fire positions for armour. This is illustrated by *Figure 18*. The fortified line lay behind a major obstacle, at Suez this was the canal and on the Golan Heights a massive anti-tank ditch. The fortified positions were section strength and consisted of a reinforced concrete box 7–10m below ground level. This was covered by wire nets holding rocks for resistance to direct hits. A hardened tunnel at each corner of the box led to a four-sided open trench system which was surrounded by mines and wire. The exit closest to the enemy was further strengthened as an observation post. The fortified positions were expected to hold out on the obstacle line whilst armour raced forward to plug the gaps. On the Suez Canal this was not achieved due to the total surprise and rapidity of the assault river crossing. The Syrians were less well prepared for crossing the anti-tank ditch and the defences held.

On the Golan Heights the Israelis had also made good use of their villages behind the front line. Villages were fortified and where they could not give each other mutual support, fortified positions were constructed to fill the gaps. This produced a 'framework defence system', a popular tactical solution for troops without armoured support. The Golan system was so successful in 1973 that the current defence line consists of two main obstacle lines supported by a framework defence system.

COASTAL DEFENCES

British Coastal Defences 1914–1945

In World War One British coastal defences were radically transformed. Before 1914 France had been the traditional enemy and the east coast was devoid of hardened protection, a fact highlighted by the German naval raids on Scarborough and Hartlepool in December 1914. The surprising feature of the rapid construction programme that followed was the use of open casemates. This had been the normal practice towards the end of the 19th century and the advent of the aircraft had done little to change attitudes. Coastal defences demanded large guns to combat battleships

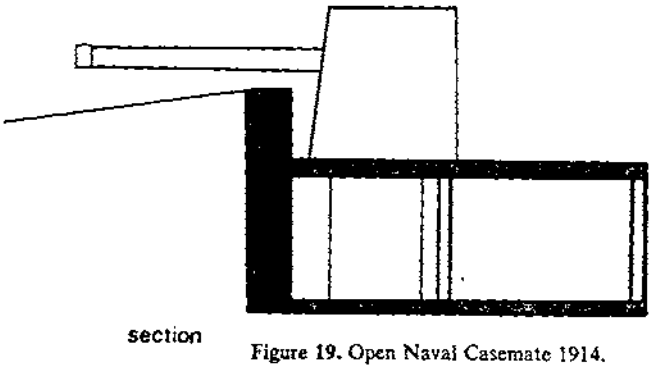


Figure 19. Open Naval Casemate 1914.

at long range. Closed casemates were high in profile and the large embrasures were vulnerable to the accurate rifled gun. The open casemate presented a smaller target and was also less likely to be spotted.

By 1939 little had been done to improve these defences. Britain had not embarked on a fortification programme like her European counterparts as it was believed the Navy and RAF could prevent an invasion. However, the invasion of Norway and Britain's own withdrawal from Dunkirk proved that seaborne forces were not necessarily so vulnerable. The crux of defence against invasion would still be air defence but the Chiefs of Staff also decided fortifications would be required to combat the landing. Following Dunkirk an emergency construction programme began.

The programme mirrored the problems the Germans would suffer with the Atlantic Wall. Priority was given to the defence of ports and construction of gun batteries. Consequently pill boxes and obstacles suffered from poor construction and poor siting. The labour organisation was a mixture of experts from coastal artillery, the Navy and the RE Services. Labour was contract or available servicemen. The effort on the coastal batteries was worthwhile. Siting was co-ordinated and they received the best labour and materials. All batteries were housed in closed casemates due to the air threat. One hundred and fifty-three batteries were completed in the last six months of 1940. Pill box design was standardised using the BEF designs constructed in France. However, siting was left to local commanders and many pointed out to sea rather than using cover and providing enfilade fire positions along the beaches. Many were sited too close to eroding cliffs and fell into the sea after a few months, others were constructed on sloping boulder clay and initiated their own slips. Workmanship was very poor and it has been estimated that only 20% of the workforce had construction experience. A site near Hull had the novel situation of a construction foreman passing orders through a trawler captain as the labour gang were his crew. Despite these drawbacks the most innovative feature was the camouflage, particularly in the seaside towns. Ice-cream kiosks, merry-go-rounds and beach huts were built around pill boxes.

Having completed the coastal defences some effort was made to construct inner defence lines. The principal line was the GHQ line which was sited along natural obstacles to protect London and the industrial Midlands. Although grand in design it consisted of a few pill boxes. Fortunately neither the costal defences nor the GHQ line were required, for the Battle of Britain had been won by the Spring of 1941.

The Atlantic Wall

The Atlantic Wall was constructed from 1940 to 1944 and covered the entire coastline facing Britain from the south of France to northern Norway. The construction programme followed four distinct phases and it was destined to suffer from the combined problems of the West Wall and Britain's coastal defences. Behind this lay the decision to allocate responsibility between the Army, Navy, Airforce and Organisation Todt(OT).

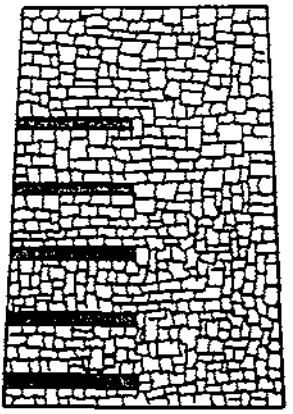


Figure 20. Control Tower camouflaged as Martello Tower.

The first phase took place immediately after the conquest of France and this included works to support an invasion of Britain rather than coastal defence. Plans included the construction of massive naval batteries in the Calais area to provide preliminary bombardment and intercept naval attacks on the invasion force. As the Battle of Britain was being lost the second phase developed. The protection of U-boat bases became paramount and the Channel Islands were also heavily fortified. These latter defences were seen as politically essential as Britain might try to recapture her only occupied territory. A feature of the Channel Islands defences was the use of natural camouflage. Concrete control towers were shaped and painted to resemble the Martello Towers which had been constructed on the islands in the Napoleonic Wars (*Figure 20*). The Mirus Battery with a 305mm gun was hidden in a farmhouse and the White Hart Hotel, dominating the main habour, was converted into a concrete command post. The hospital tunnels carved into the Jersey rocks were another unique feature of the islands defences. Today they serve as a museum of the occupation.

When America entered the war against Germany, Hitler had seriously to consider a second front with his forces heavily involved in Russia. Phase 3 began with the issue of Directive 40 in March 1942. Whilst this was composed of much formal military language Hitler's personal briefing to Albert Speer was more succinct (Speer took over control of OT when Todt was mysteriously killed in a plane crash). This gave some idea of how closely Hitler became involved in his fortification programme. Hitler's requirements were for 15,000 bunkers to be manned by 350,000 men with 150,000 in reserve. The ten most vital war bases (ports) were to be defended by a girdle of bunkers 50 yards apart with the rest of the coastline protected by bunkers at 100 yard intervals. Submarine bases and naval gunsites were to have walls and ceilings at least 12 feet thick and be able to withstand the heaviest bombs. Troops should be able to sleep and perform bodily functions whilst under bombardment and all installations should have gas tight areas with an oxygen supply. Embrasures were to have steps and ledges to prevent burning fuel from entering emplacements. Hitler even spent his evenings sketching designs for emplacements. These were passed on to Speer and many were incorporated into the defences. The purpose of the fortification was to prevent the enemy gaining a foothold in Western Europe so mobile reserves could smash the invasion on the beaches.

The directive also set out the thicknesses of concrete to be used. Fortifications were to be West Wall standard with the 'strengthened thickness' of 1.5m and 'standard thickness' of 0.4m replaced by 3.5m and 2m respectively. West Wall designs were also expected to be used but this was impossible. As already explained the West Wall lacked any standardisation in design and the Atlantic Wall was to utilise captured equipment for armament. Twenty-eight different gun calibres had been collected from

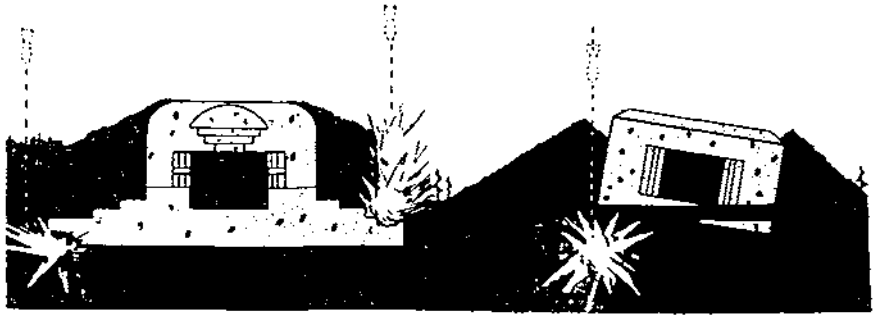


Figure 21. Naval and Army installations compared. (*Alarm i Atlantervallen* by Bertil Stjernfeld. Hörsta Förlag Sweden, 1953)

The directive also failed to clarify the roles of the services. The Navy had more influence with OT and Hitler so they were able to construct better installations at the expense of the Army. *Figure 21* illustrates the basic difference between naval and army installations. The former had a collar to resist overturning effects from bombs and near misses.

The Navy saw their role as a land ship to destroy enemy ships. Hence, the installations consisted of large artillery pieces placed well forward on the headlands. Embrasures pointed towards the sea and not the shore. The Germans were also faced

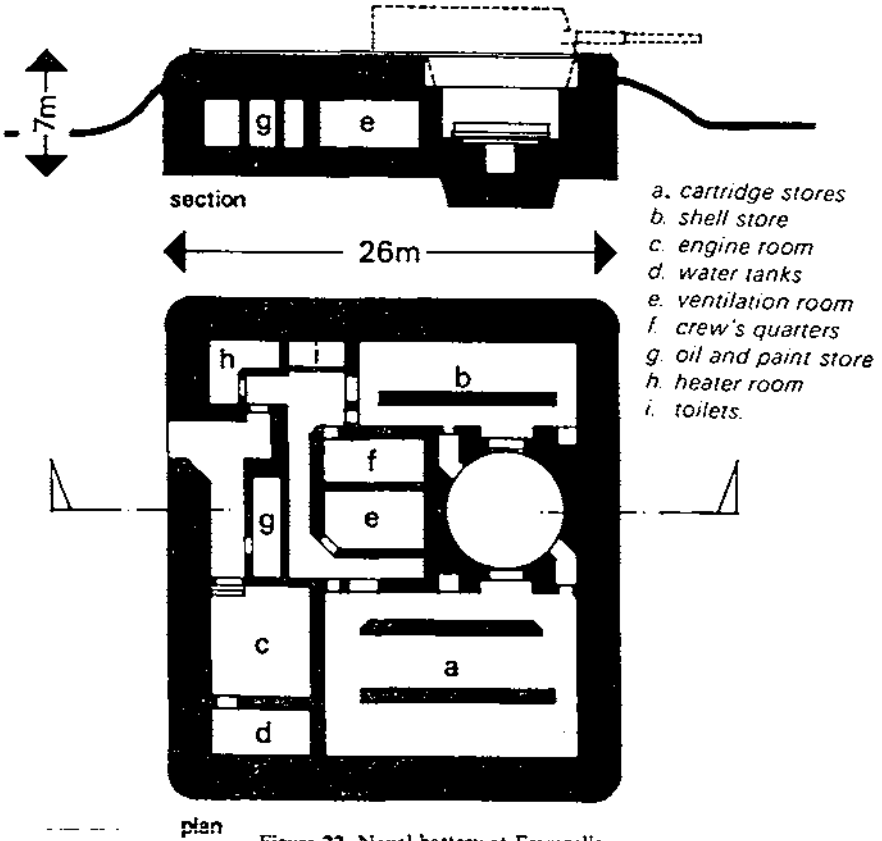


Figure 22. Naval battery at Framzelle.

with the problem of considering open or closed casemates. Due to the air threat they also chose the latter. A shortage of steel meant that few casemates had steel cupolas and the large fixed casemates were easily identifiable from offshore. The problem of large embrasures was reduced by restricting arcs of fire to 120° and individual emplacements were sited so the whole battery covered the required field of fire. Camouflage was enhanced by rounding all corners and texturing the concrete; paper balls were pushed into the formwork to give a pitted effect. Earth banks were also built up to try and merge the obvious structures into the headlands. The minimum 3.5m of concrete was used for walls and roof, the roof being reinforced by steel plate supported by I-beams. Perhaps the biggest drawback was the siting. Hitler believed the allies had to capture a port as part of the invasion and all but two naval batteries were clustered around the ports. The allies selected the Normandy beaches as they were out of range of the guns at Le Havre and Cherbourg. They also produced an outstanding piece of engineering, the Mulberry Harbour, so that a port would not be required. The naval batteries were, however, the outstanding feature of the Atlantic Wall and the example in *Figure 22* illustrates how closely the design met Hitler's vision.

Meanwhile the Army were developing their fortifications along the lines of the West Wall. Although 15,000 hardened defences were constructed, they included mainly open artillery emplacements and bombardment shelters for troops. The infantry were expected to fight from field defences and only a few coastal batteries had overhead protection. Collars were not used and edges were chamfered rather than rounded.

The final phase began at the end of 1943 as the threat of a second front grew. The existing defences provided sufficient means to complement the German plan of delaying the invasion force and then defeating it with mobile forces. Field Marshal Rommel was appointed Inspector of Fortifications and he was appalled by the state of the Atlantic Wall, particularly the disparity between naval and army defences. In January 1944 he was appointed Commander-in-Chief of the Atlantic Wall and began improvements that became known as Rommel's Bar. This included a further 9,300 hardened defences and an obstacle belt. He also tried to change the tactics and

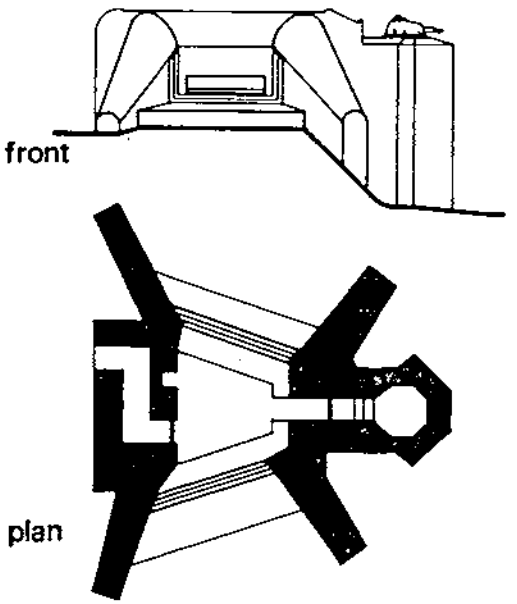


Figure 23. Flanking emplacement for two anti-tank guns.

intended to defeat the invasion on the beaches. Although this was perhaps more in line with Hitler's intentions, he was denied the chance to hold the mobile forces well forward due to opposition from his peers. All guns were casemated but the lack of time meant that speed was more essential than quality. As there was insufficient room for ammunition storage in the gun pits these were constructed separately. Personnel shelters were simple. Arched steel shuttering was placed in trenches and left in-situ with a 0.4m covering of concrete. Communication shelters were constructed in similar manner between emplacements. With additional protection from an earth covering, the shelters were considered bomb proof. Many of the fortifications were sited in enfilade with natural camouflage and protection. *Figure 23* is a typical flanking emplacement for two anti-tank guns. Protection against seaward assault was often provided by an armoured cupola, from a captured tank or armoured car, on top of the emplacement. Major problems were provided by allied air raids destroying supplies and formwork on half-completed structures. Blockwork was used as formwork and left-in-situ to offset air-raid damage. By June 1944 the Atlantic Wall was composed of 17 million tons of concrete and 1.2 million tons of steel. It was a formidable defence but it remained "so many knots on a piece of string".

The fall of the Atlantic Wall found its inception in the Dieppe Raid of 1942. The allies learnt more lessons from this military disaster than the Germans. The landing away from ports, the Mulberry Harbour and the use of specialist tanks were direct developments from the lessons. The Atlantic Wall was defeated due to flawed military tactics and fundamental problems of design. The only naval battery covering the beaches was the Longues battery. This withstood direct hits from 2,000lb bombs but two casemates were destroyed by direct hits, through the 2.5m by 3.85m embrasures, from naval guns. The poorly constructed army batteries were simply flattened by air and naval bombardment. The smaller installations protected by their profile and camouflage were missed by the bombardment but were easily dealt with by specialist tanks with petards and flame-throwers. It was significant that the Americans were the only ones to suffer serious delay and they had refused the use of most of the special equipment. Albert Speer ruefully recognised the superior innovations that the allies had used to render useless two years effort of labour and materials.

AIR RAID PROTECTION

British Air Raid Protection

Britain was one of the few countries to consider air raid protection (ARP) in World War One. This was due to the Zeppelin raids in 1915 and later attacks by Gotha bombers. The London underground stations were a satisfactory solution but Britain's concern was highlighted by the formation of an ARP committee (the Anderson Committee) after the war in 1924. Its report concluded that "the next war would be won by the nation whose people could endure aerial bombardment the longer and with greater stoicism".

Britain, therefore, might have been expected to lead the way in ARP at the beginning of the Second World War but nothing was done until after the Munich crisis in 1938. The Anderson Committee met again and made several proposals, the most important being a Dispersal Policy as the best means of reducing casualties. Large shelters were discouraged and ARP was to be provided by a mixture of family shelters (the Anderson Shelter) and public shelters for 10% of the population. The latter were to be provided by local authorities and would consist of masonry and concrete structures or trenches lined with pre-cast concrete sections. Capacity would be limited to fifty people per shelter. 2.3 million Anderson Shelters were produced at a cost of £5 each. Issue was generally free dependent on a means test. They consisted of split hairpin CGI sheets covered with earth. It was a good invention but they only provided protection from splinters and blast. They were also designed to be sunk into the ground 0.6–0.9m and this led to cold, damp conditions and frequent flooding.

During the Battle of Britain only light air raids had tested the defences. The Anderson Shelters coped very well but the masonry structures proved useless. Blast

lifted roofs and splinters penetrated walls. When the Blitz began people flocked to the underground stations, existing shelters had neither the protection nor the facilities to endure long, overnight bombardments. The government discouraged the use of the underground stations as they feared it might induce a shelter mentality. Improvements had been made during the Blitz particularly to shelter facilities. The masonry structures were also strengthened by a RC lining. However, a census had established that 40% of the population remained inside their houses. This led to the issue of the Morrison Shelter, a steel cage for indoor use. 400,000 were produced and issued on a similar basis to the Anderson Shelter. When the Blitz ended the shelter programme ended and materials were diverted to higher priority projects. Britain had made hardly any contribution towards ARP design and this was despite the efforts of private concerns.

Several proposed designs were never built as they were against the Dispersal Policy. Finsbury Council had commissioned Ove-Arup to design a multi-storey shelter, circular in shape with a continuous ramp spiralling around a central column. Various sizes were considered ranging from protection for 50 to 12,300 people. The circular trace was to maximise the area and it also gave a better profile to dissipate explosion compared to a straight wall of the same thickness. The design utilised a 10 foot thick RC roof or burster course to resist direct hits with the walls designed to resist blast

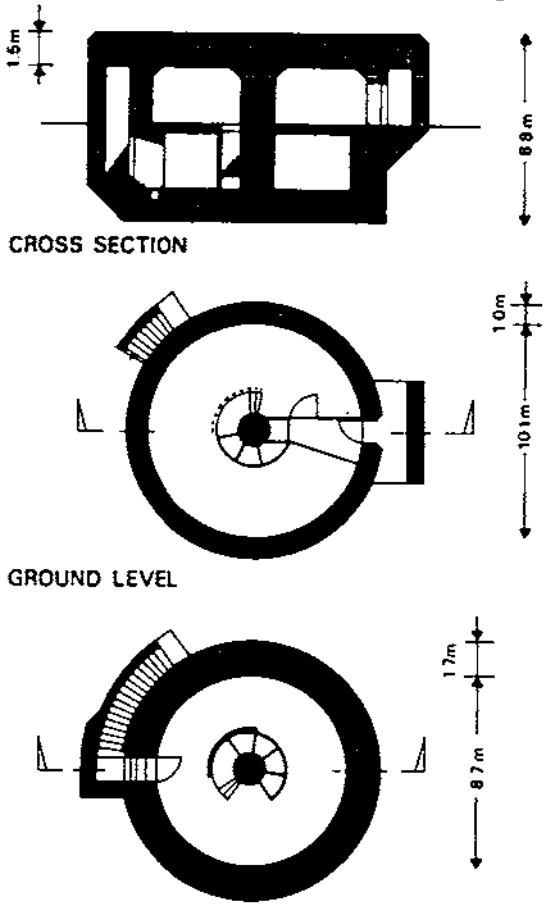


Figure 24. Design Panels Circular Shelter.

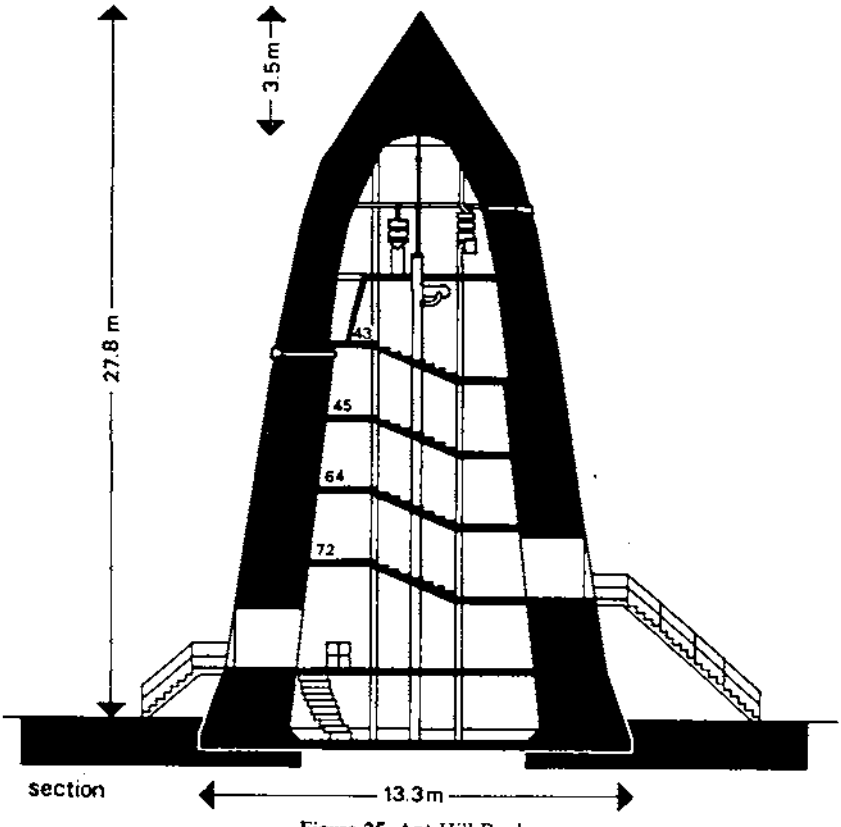


Figure 25. Ant Hill Bunker.

from near misses. A Home Office sponsored panel of engineers proposed a similar design (*Figure 24*). The Design Panel of the Engineering Precautions (Air Raid) Committee was formed from the Institution of Civil Engineers. They used bombing trials to suggest RC thicknesses of 1.52m to resist 250kg bombs and 2.29m to resist 500 kg bombs.

The USA utilised the British experience to publish a design guide in 1943. The *Fundamental Principles of Structural ARP* is probably the most detailed design publication to emerge in World War Two. It considers bomb patterns, ballistics and general effects on structures. It is highly critical of some of the British designs particularly the masonry structures, which are called "dangerous outmoded shelters". One design feature is the use of 'scabbing plates' to protect the inside of structures. A non-penetrating hit can cause scab particles to project from the back of a slab. A scabbing plate does not prevent penetration but it can retain the projecting material. This is a similar theory to that used by the Germans and British in World War One where permanent formwork was found to strengthen structures considerably. The book was never required in World War Two but much of the design information is relevant today and it should be mandatory reading before considering ARP design.

German Air Raid Protection

The Germans attitude to ARP is summed up by the Führer-Bunker in Berlin. Roofed with 16 feet of RC and 6 feet of earth it was the safest place in the capital. By the end of the war 75% of the population could be accommodated in bomb-proof accommodation. This reliance was a function of the allied bombing campaign. Churchill had many supporters in his belief that Germany could be defeated by

bombers alone. The culmination was the fire-storm in Dresden in February, 1945. 135,000 were killed in twenty-four hours.

From the outset the Germans planned huge concrete shelters with facilities for 500 to 18,000 occupants. Planned programmes began in 1940 and standards were maintained by building to *Codes of Practice for Building (Planning) ARP Shelters*. This was developed from field tests and outlined RC roof thicknesses of 1.4m, 2.0m and 2.5m to withstand 500 lb, 1,000 lb and 2,000 lb bombs respectively. (The 1.4m thicknesses for 500 lb bombs compares to the British and American 1.52m). Variations to designs were a function of material shortages and ground conditions. The Germans used many standard designs, the most remarkable being the 'ant-hill bunker' (*Figure 25*). Similar rocket-shaped structures were used by the French in World War One and for steel ARP warden posts in Britain. The shape made it impossible to receive a direct hit but the lack of space meant only 300 personnel could be accommodated.

In contrast to the Dispersal Policy the Germans found large structures most cost effective. Four thousand man bunkers required only 1.8 cu.m per person compared to 3 cu.m for 500 man bunkers. The ultimate in German ARP design were the ten-storey flak towers constructed in Berlin and Vienna. These were fighting platforms apart from ARP for civilians. Several other military designs considered aerial bombardment as the principal threat. The naval casemates on the Atlantic Wall were one example and others include the V-weapon sites, arms factories and submarine bases. The submarine bases saw further use of the air-space theory and permanent formwork. The Germans found that 3.5m RC was quite inadequate against allied blockbuster bombs. One method was to add a heavily reinforced 2m layer with steel beams. Another was to add a 1.5m burster slab with a 2m air-space. The slab was supported at 6m centres. As the allies were discovering these massive structures on their advance through Europe the Germans were leaking details of their final propaganda wall. The concept of a 'National Redoubt' in Bavaria seemed credible considering the Atlantic Wall, West Wall and ARP structures. Such defences never existed but the threat made a further contribution to Eisenhower's broad-front strategy.

Hardened Defences in the 1980s

General

Following the end of World War Two the hardened defence was considered redundant in a mobile war. France re-furbished the Maginot Line but this was finally abandoned in 1964. The USA followed their ARP study with a design guide for non-nuclear protective works. *Fundamentals of Protective Design (Non-nuclear)* was first published in 1946 and reprinted in 1965. This detailed publication includes design examples. It has been used by the British Army for designs in Northern Ireland and remains today the most important design aid for hardened defences. Apart from Israel, only the USSR are believed to have a line of military hardened defences. The Sino-Soviet border is protected by RC fortifications with old tank and warship turrets for armament. The defences are sited in depth to offer mutual support and main bunkers are proof against NBC (Nuclear, Biological and Chemical) weapons. These defences also return the historical analysis to where it began, some of the headquarters make use of the old forts of the Russo-Japanese War.

ARP has reached rather more sophisticated levels. Sweden, Switzerland and the USSR have expended vast sums of money to protect the civilian population in the event of a nuclear war. In a similar vein western hardened protection is limited to nuclear weapon silos in France and the USA.

Northern Ireland

The political necessity of keeping military and civilian casualties to an acceptable level has meant the construction of small-scale hardened defences in Northern Ireland. As the principal threat is small arms fire and blast from home-made bombs or mortars, they hardly compare to the defences analysed earlier in the paper. However, two examples reinforce the theme that the military engineer can learn from a historical analysis.

Readers with a knowledge of Northern Ireland's defences may have been surprised that the Moir pill box and air-space theory were First World War inventions. In the 1970s MVEE Christchurch (now RARDE Christchurch) 'invented' the Christchurch Block. This was a pre-cast concrete block that could be used to assemble a rapidly constructed blast wall or sangar (pill-box). It was invented without knowledge of the Moir pill box and the only reason that a patent was not awarded was due to a similar invention by the British Nuclear Fuels Industry! Hardened accommodation was constructed at Crossmaglen and Forkhill to protect troops against mortar attack. Steel frame buildings with pre-cast concrete wall panels and cast-in-situ roofs utilised the 'sacrificial slab concept'. The following quote is from the Forkhill project final report, "62 CRE (Const) was requested to consider a design based on a 'sacrificial slab' concept originated by Mr P S Rhodes of the Department of Finance, Belfast. The concept is that any mortar bombs hitting the top of a building are made to explode upon a false roof (sacrificial slab) which absorbs the energy sufficiently to protect the floor beneath. Anything between the sacrificial slab and the floor beneath is liable to be damaged, but anything below the floor is safe. The concept is based on the experience of bomb damage to normal buildings in Northern Ireland . . .". This is clearly a re-invention of the burster slab or air-space theory.

Conclusions

The paper has covered a wide variety of examples of the general design and use of hardened defences in 20th century warfare. The lack of hardened defences in the 1980s illustrates that the modern military engineer has little personal experience on which he may base future designs. He must therefore study the historical concepts and designs used in the 20th century. They are still relevant because the basic materials and type of conventional firepower remain unchanged. The value of a historical study is highlighted by the examples from Northern Ireland where concepts over fifty years old were re-invented.

In considering the design of a hardened defence the military engineer should take note of both tactical and structural features. Material in this paper has been selected to illustrate both these features and generally the defence has failed when they have not been considered together. Most modern tacticians believe the hardened defence is outmoded and an expensive luxury on the modern battlefield. The military engineer can only persuade the tactician that hardened defences are a viable solution if he holds a view on their tactical use. The conclusions that follow are therefore both the tactical and structural design lessons that the author has drawn from his historical analysis. They relate to the modern battlefield and therefore future designs.

a Tactical Lessons

1. The fortress is obsolete.
2. Small hardened defences sited in depth and offering mutual support are generally successful. They also provide better protection for troops than trenches sited in a similar manner.
3. Hardened defences are one means of covering obstacles with direct fire and protecting the occupants from similar hostile fire.
4. Hardened defences should be sited and protected to prevent capture by *coup de main.*
5. Hardened defences backed by mobile forces are one of the strongest means of defence ("Sword and Shield").
6. The time required to construct hardened defences limits their tactical use. This can be mitigated by peace-time construction or rapid-construction techniques.
7. Hardened defences are the only means to guarantee ARP.

b Structural Design Lessons

1. The type and amount of hostile fire to be expected are the principal criteria in hardened defence design (Von Brunner's principle).

2. Protection is a function of profile and camouflage as well as thickness of material. Curved profiles with textured concrete are better designs.
3. Standardisation of design will lead to quicker construction and cheaper defences.
4. Use of permanent formwork strengthens the design and speeds construction.
5. Design and construction should be to the same standards set by civilian codes. Site supervision by trained personnel is essential.
6. Ground conditions should not be ignored.
7. Designs that are constructed to last a number of years should consider future developments in both hostile fire and any weapons that arm the defence.
8. The air-space theory is a useful aid to consider during design and to strengthen existing defences.

The future use of hardened defences on the battlefield seems limited to either a framework defence or protection of a major obstacle. The terrain of Western Europe offers both these circumstances but it is unlikely that political clearance would be granted to construct such defences in peace-time. The military engineer may therefore be limited to battlefield designs which can be rapidly constructed in war. Peace-time designs are more likely to involve Internal Security operations or ARP. The latter may include the hardening of key headquarters or a civilian shelter programme similar to Sweden and Switzerland. The hardened defence has played such a major role in previous wars that it should not be neglected today. Their design, construction and tactical use should be part of every military engineers training.

ACKNOWLEDGEMENTS
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Demolitions in a Retreat

MAJOR GENERAL I H LYALL GRANT MC MA MICE

Major General Lyall Grant who retired from the Corps in 1970 after thirty-five years service, and was Colonel Commandant from 1972 to 1977, was at the time the article describes Officer Commanding 70 Field Company, KGVO Bengal Sappers and Miners.

RETREATS are an unpopular subject and few commanders or staffs care to study them. This is understandable as by the mere mention of the word "retreat", as opposed to "withdrawal" a commander may risk the swift arrival of a bowler hat. Nevertheless retreats do occur and demolitions are often a most important part of them, so it behoves Sappers, if no-one else, to give the matter some thought.

The retreat in Burma in 1942 is an example worth studying. It was a very long retreat, over 1000 miles, and included many large and dramatic demolitions. There is no space here to describe the campaign except in the briefest terms. The truth is that the British at the end of 1941 were over-extended and just had not got the resources to defend Burma. Much useful preparation could, however, have been done had Whitehall agreed to General Wavell's request to delegate the defence of Burma to GHQ India. Unfortunately they didn't. Thus at the outbreak of the Japanese war, which was by no means unexpected and in which Burma with its oil and its unique supply route to China was a certain target, Burma found itself ludicrously weak. To defend a 1200 mile frontier with the enemy it had three untrained brigades (one Indian and two Burmese of uncertain value) and a single RAF fighter squadron equipped with obsolescent aircraft (Brewster Buffaloes). Worse still little attempt had been made to mobilise the country for war and a leisurely peacetime atmosphere prevailed.

Once Japan entered the war desperate efforts were made to retrieve the situation. Wisely, reconnaissances were made of the most important targets in the country and the approaches from Thailand and demolition plans prepared. Before Rangoon fell another four Indian brigades and the British 7 Armoured Brigade were landed, while the RAF was strengthened. Unfortunately, with the notable exception of 7 Armoured Brigade all these hastily assembled formations were untrained. Indeed more than half the soldiers came straight from recruit training battalions and many officers came straight from OCTUs.

The Sapper element of these forces consisted of six independent field companies and a field park company. One field company was Burmese, four were Indian Sappers and Miners (as was the field park) and one was from the Indian State Forces. However by the time the last company arrived the Burma Sappers had almost ceased to exist so the effective strength never exceeded five field companies. To back up these divisional Sappers there were just three artisan works companies (two Indian and one Burma Auxiliary Force) and one pioneer battalion. There were virtually no engineer or defence stores and improvisation was the order of the day. This was not a very strong force for the Chief Engineer, Brigadier Charles Swift (who had been CRE Burma when the campaign started) and he had to make the best of his works organisation, supported by a good liaison with the civilian PWD.

Major General I H Lyall Grant MC MA MICE
Demolitions in a Retreat

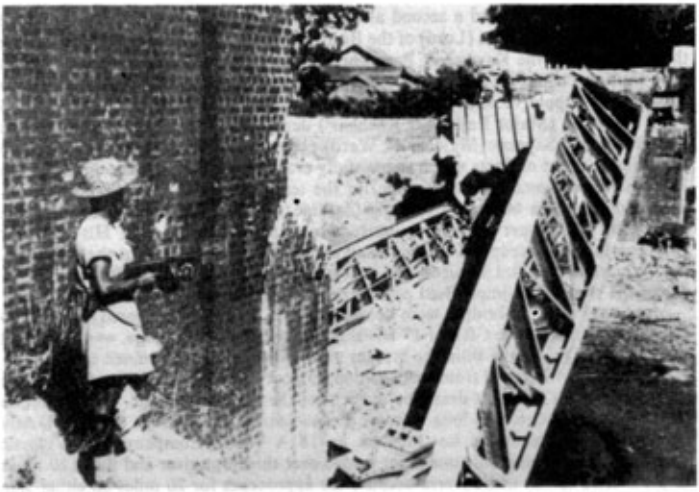

Photo 1. A bridge in Burma demolished by the 'one and a half cut' method.

This is no place to discuss in detail why the British retreated. After four years of fighting against China the Japanese were tough and war-experienced soldiers and remarkably good at fieldcraft. Their leading troops moved off the roads along forest and village paths, making good use of their copies (over-printed in Japanese) of large-scale maps of Burma of which, unlike the British, they had a plentiful supply.[1] Their tactics were to attack at night, using the abundant cover to infiltrate our positions, while simultaneously digging-in astride the road behind the position being attacked. Our forces, reliant (in Burma) on a single road for supply and for evacuation of casualties, were eventualy forced, if they could not clear the block, to withdraw. In 1942 the Infantry, though full of spirit, were scarcely trained and with only the minimum, if any, of air, artillery or armoured support were rarely able to overcome these blocks. In 1944 it was to be a different story.

The Sappers, as usual, were constantly occupied either with helping the mobility of our own forces or with restricting that of the enemy, and often with both tasks at the same time. It was hot, latterly very hot, and water supply was also a problem on occasion. Most of the bridge demolitions were not technically difficult as the bridges, though frequently large, were nearly all of through-girder steel construction. The main difficulty in the early stages was the shortage of explosives and efficient detonating fuse but this was overcome later by the provision from civil sources of cordtex and commercial gelignite. This latter substance would detonate every time if hit by a bullet or shell splinter but this was fortunately not appreciated until after the campaign. It was normal to attack at least two spans of multi-span bridges and the usual method was to cut one end of each span completely and half the other end so that the girders were distorted when they fell (*Photo 1*).

There were three likely invasion routes[2] across the hills from Thailand to Burma. 1 Burma Division defended the northern one and 17 Division covered the two southern tracks. The Japanese chose the latter, sending one division through the Kawkareik

[1] Each field company had only one 32 miles/inch road map of Burma.
[2] *See Map p. 109.*

Demolitions In A Retreat (1)

pass (their main axis) and a second along the track through the undefended Three Pagodas pass. A subaltern (Lord) of the Burma Sappers opened the ball by destroying the road through the Kawkareik Pass where it ran along a steep rock-face. Though pack transport could get through, it took the Japanese more than three weeks to open the route to supply vehicles and this caused them much anxiety. At Moulmein 60 Field Company (Major Rajkumar Kochhar[3]) demolished the main targets and then with the Burma Sappers (Major Dick Ward) played a notable part in organising and operating the fleet of boats which successfully evacuated 2 Burma Brigade across the River Salween (some two miles wide) in the teeth of a heavy Japanese attack. A Sapper officer from 60 Field Company (Jardine) was killed gallantly defending the jetty with his Sapper demolition party while the last boats left. His Jemadar (Malligarjunan) thereupon took command and concealed the party for the rest of the day. When darkness fell he succeeded in extricating them, and several British officers, across the river on an improvised petrol-drum raft under the noses of the Japanese.

More road and rail bridges were demolished as 17 Division retreated to the Bilin river. Unfortunately the CRE of 17 Division, Lieut Colonel Armitage, was evacuated sick at this stage. At the Bilin the bridges were blown and a determined stand made. However, the withdrawal from this position was not well handled and as a result the scene was set for the most dramatic incident of the whole campaign, the demolition of the Sittang bridge. The long, narrow, eleven-span railway bridge (*Photo 2*), only decked for vehicles at the last moment by 18 A Works Company, was a classic bottleneck, there being only one other bridge over this large river and that 120 miles to the North. It was made worse because the approaches for 20 miles on either side of the bridge were along a dusty track, running on the East side mostly through forest. The Japanese, following up with two divisions, appreciated this. They had been held up for four days of heavy fighting at the Bilin river 30 miles away but when the withdrawal started they sent one brigade through the forest round the north flank to capture the Sittang bridge and another round the south flank, partly by sea, to block the British retreat. Meanwhile the bulk of the Sappers had been sent back across the Sittang, 60 Field Company by rail on the 19th February and 24 Field Company in MT on the night of the 21st/22nd, their task to strengthen bridges further back for the impending arrival of 7 Armoured Brigade. The Burma Sappers were no longer operational and the Malerkotla Sappers (Major Richard Orgill), who had marched on the 21st from Kyaikto, were given the task that evening of demolishing the Sittang bridge. Working through the night, they did what they could with the inadequate supplies available. The only detonating fuse they could obtain was the notoriously unreliable FID and there wasn't much of that. After twice nearly losing the bridgehead on the 22nd, the Brigadier commanding the bridge site telephoned the Divisional Commander early on the 23rd expressing doubts about holding the bridge much longer. He was thereupon ordered to demolish it. This the Sapper firing party (Bashir Ahmed Khan) did just before dawn on 23 February, dropping one 150 foot span and seriously damaging another[4]. This desperate and controversial decision (judged correct by many who were present) left two and a half brigades, more than half the fighting troops then in Burma, on the wrong side. Though many men succeeded in crossing the deep, fast river, here about 600yds wide, their vehicles, guns and other weapons were lost. It was a major disaster but the check it imposed gave time for 7 Armoured Brigade and 63 Infantry Brigade to land at Rangoon and for 17 Division, with remarkable resilience, to re-organise and continue the fight. As part of the re-organisation Major Dick Ward, late of the Burma Sappers, became CRE.

Rangoon has always been the key to Burma being the only major port and having all the major installations grouped there. Heavily bombed by the Japanese it was virtually deserted by the end of February but the CRE Rangoon, Lieut Colonel

[3] Later QMG in India.

[4] It is believed that it was not repaired until 1944.

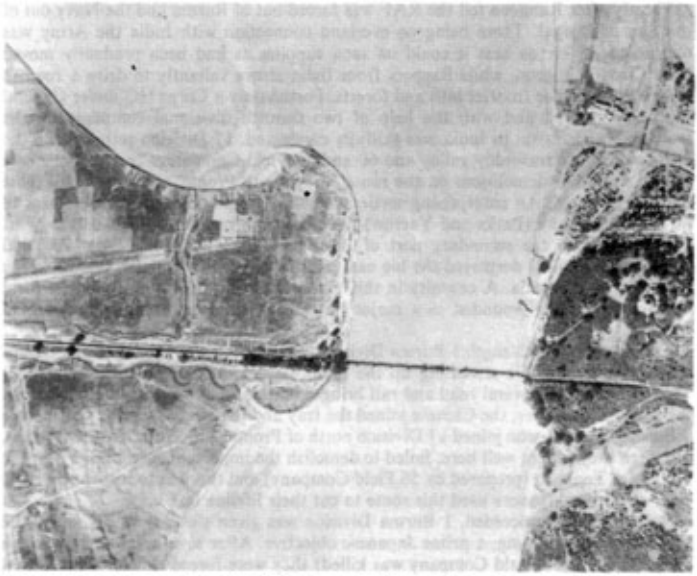

Photo 2. This photograph taken in 1944, shows the Sittang Bridge still under repair. (Imperial War Museum photograph CB(OPS)5008).

Walker (who died later in the campaign), was successful in keeping the main services going to the very end. He was also in charge of the demolitions, his only resources being a handful of Sapper officers and a platoon of Burma Sappers. The important Syriam oil refineries were destroyed by the Burma Oil Co with Sapper assistance and their stocks of oil ignited. The power stations, wireless station and telephone exchanges were destroyed and 70 Field Company (mobilised from a cadre four weeks before) arrived just in time to destroy the only oxygen and acetylene factory. The cranes at the docks were demolished and the warehouses, full of US stores for China, fired. Two big bridges, one rail and one road, over the deep Pazundaung Creek were attacked but the important rail one, carrying a double main line to the North, was damaged but not demolished, again because of an FID malfunction. Insufficient attention seems to have been given to this key demolition. Another serious omission was the main Burma Railways workshops at Insein, a few miles from Rangoon. Responsibility for this had apparently been delegated to the Burma Railways staff but, according to the Japanese, it was left substantially undamaged.

While Rangoon was being evacuated, a decision dangerously delayed and nearly leading to a second major disaster, the rump of 17 Division was fighting a desperate battle to hold up the Japanese at Pegu, 30 miles to the North. An incident here reveals the confused nature of much of the fighting. There was at first uncertainty as to the direction in which the withdrawal would take place over the main bridge (there were three) and the exploder had to be moved twice from one side to the other and back again. Finally when the bridge was blown the Sapper subaltern went forward to check the result and on returning found a party of Japanese sitting in his getaway truck and trying to start it. He was lucky. They failed (Kochhar had fitted all his trucks with hidden switches) and ran off into the dense cover of the village so he was able to recover his driver, hiding nearby, and rejoin the rearguard unscathed.

Demolitions In A Retreat (2)

Shortly after Rangoon fell the RAF was forced out of Burma and the Navy out of the Bay of Bengal. There being no overland connection with India the Army was obliged to survive as best it could on such supplies as had been prudently moved North from Rangoon, while Sappers from India strove valiantly to drive a road to Burma through the frontier hills and forests. Fortunately a Corps HQ under General Slim now arrived and with the help of two staunch divisional commanders, the inevitable withdrawal to India was skilfully conducted. 17 Division retreated up the route along the Irrawaddy valley and 60 and 70 Field Companies carried out many bridge and other demolitions on the route Rangoon to Prome, and North of Prome to Taungdwingyi. An enterprising sortie across the Irrawaddy by two subalterns of 60 Field Company (Parks and Yarrow) destroyed two big rail bridges on the West bank leading to the secondary port of Bassein, while a subaltern from 70 Field Company (Higgins) destroyed the big east bank bridge at Gamonzeik leading to the river port of Henzada. A casualty in this phase was Major John Smith of 24 Field Company seriously wounded in a major but unsuccessful counter-attack South of Prome.

The much under-strength 1 Burma Division, whose CRE was Lieut Colonel Dennis Swan, was meanwhile retreating up the main axis of the Sittang valley and their Sappers destroyed several road and rail bridges on this axis to the south of Toungoo. At Toungoo, however, the Chinese joined the fray and they took over this sector from 1 Burma Division, who joined 17 Division north of Prome. Unfortunately the Chinese, although they fought well here, failed to demolish the important road bridge over the Sittang at Toungoo (prepared by 56 Field Company) and this was to cost them dearly later on as the Japanese used this route to cut their lifeline to China.

As the retreat proceeded, 1 Burma Division was given the task of defending the oilfields at Yenanyaung, a prime Japanese objective. After severe fighting (in which Major Sloot of 56 Field Company was killed) they were forced to withdraw but not before 56 Field Company, with the help of the BOC staff, had thoroughly destroyed the oilfields and the Malerkotlas had done the same with the nearby airfield installations at Magwe. 17 Division then rejoined the main axis to cover the withdrawal of the British and part of the Chinese forces across the great Ava bridge, the only bridge over the Irrawaddy and the getaway to northern Burma. A very successful rearguard action by 48 Gurkha Brigade at Kyaukse held up the fresh Japanese 18 Division (ex Singapore) for 36 hours and 70 Field Company demolished nine bridges to support them, the destruction of the main road bridge in Kyaukse being the climax to the battle. This and the successful crossing of the Irrawaddy by the bulk of 1 Burma Division in requisitioned boats (a move organised by the CRE) relieved the pressure on the Ava bridge (*Photo 3*) and this great bridge[5], together with the two bridges over the River Myitnge to the South, was demolished by 24 Field Company (Major Vernon Darley) before the Japanese arrived. Unfortunately only one span of the big Myitnge rail bridge was attacked (it had been planned as a conventional demolition with a single cut at one end) and within six weeks the Japanese succeeded in lifting this span on to an improvised pier. Its life was shortlived, however. The RAF knocked it down again a few months later and for the rest of the war the Japanese were forced to use a ferry.

Although the Japanese enjoyed air equality for the first half of the campaign and total air superiority for the second, the direct effect on the demolitions was minimal. Apart from a petrol storage tank firing party nearly incinerated by a fighter/bomber attack south of Prome and a heavy 27-bomber raid, apparently designed to inhibit the demolition on the empty village at the north end of the Ava bridge a few hours before it was blown, there were no air attacks on demolition parties. No doubt the Japanese were as anxious to avoid damage to the targets as we were to destroy them.

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[5] The Ava Bridge, perhaps the largest bridge ever demolished by British forces, carried two roads and a railway some 70 feet above the river at low water. It was 1330 yards long and consisted of nine main spans of 360 ft each and seven lesser spans.

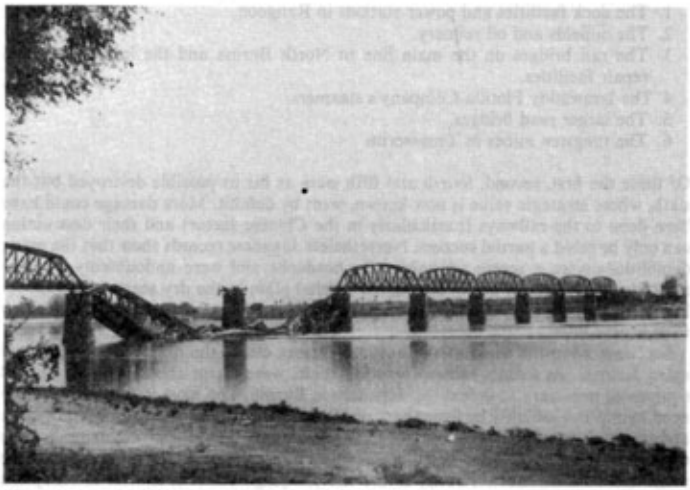


Photo 3. The Ava bridge over the Irrawaddy demolished in 1942. (Imperial War Museum photograph SE 3644).

From here on the problem was one of moving the Burma Army to India across forest tracks, a footpath and a large unbridged river (the Chindwin) before the monsoon inhibited movement or the supplies ran out. This was achieved with a few hours to spare. Although this move kept the Sappers very busy, the only demolitions (apart from the destruction of many vehicles) were a few minor bridges and some short sections of hill track. Hence the story, which reflects much credit on the toughness and discipline of the fighting units, and not least the Sappers, is outside the scope of this article.

It would be tedious to list all the demolitions but the main recorded ones are summarised in the table below. This list is not comprehensive and does not include, for instance, the Irrawaddy Flotilla Company's steamers all of which are believed to have been sunk, or any minor targets. Only bridges of more then 100ft span have been included; the heading "Other Targets" includes railway stations, power stations, saw mills, pumping plants, telephone exchanges, rice mills etc.

	Rail Bridges	*Road Bridges*	*Other Targets*
Thailand to Rangoon	8	17	18
Rangoon to India	21	21	46

With hindsight our tactical demolitions, directed by two very capable CsRE, were undoubtedly effective. They nearly always enabled a clean break to be made with the enemy while slowing up the arrival of his artillery and supply vehicles. This was, however, the dry season in Burma and the rivers were often fordable or easily bridged so delays were not great.

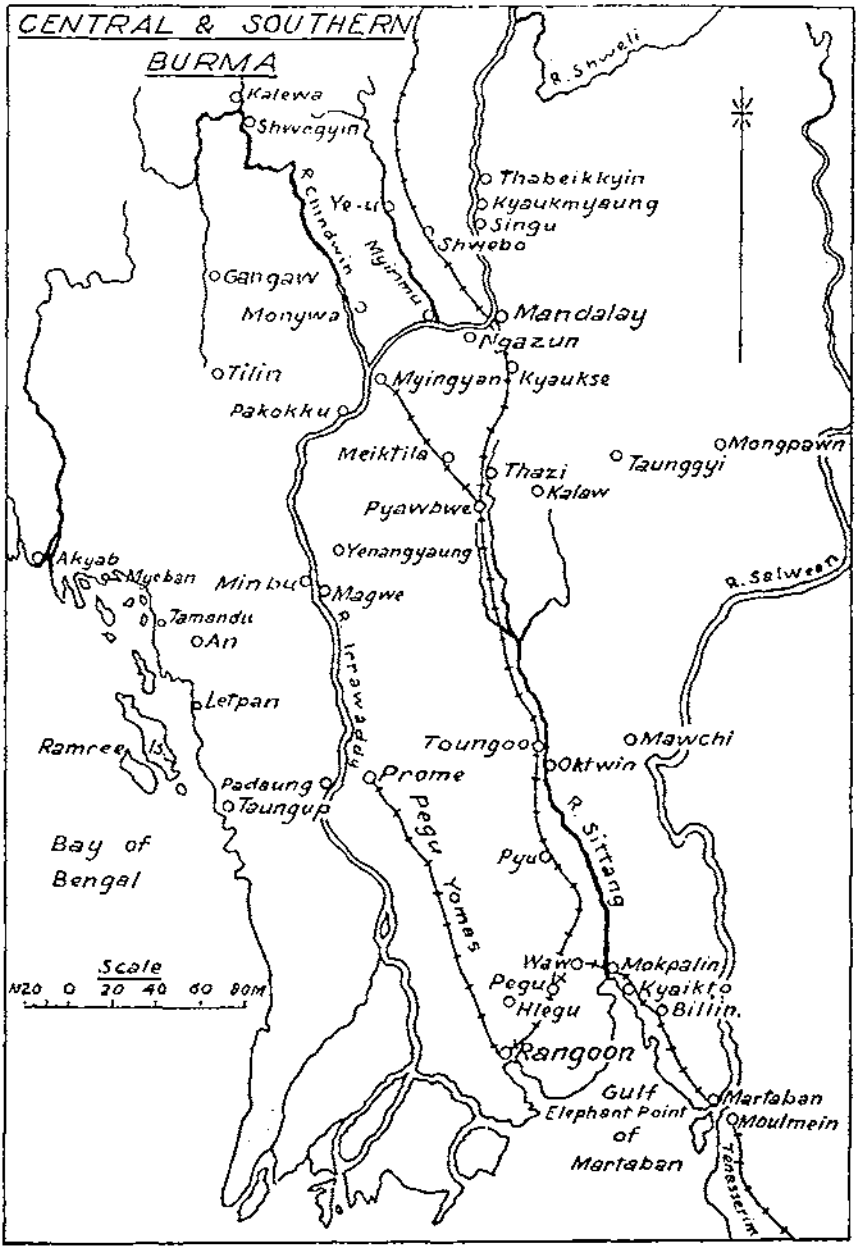
Strategically the position was slightly different. The most important targets were probably, in this order:

1. The dock facilities and power stations in Rangoon.
2. The oilfields and oil refinery.
3. The rail bridges on the main line to North Burma and the locomotives and repair facilities.
4 The Irrawaddy Flotilla Company's steamers.
5. The larger road bridges.
6. The tungsten mines in Tenasserim.

Of these the first, second, fourth and fifth were as far as possible destroyed but the sixth, whose strategic value is now known, went by default. More damage could have been done to the railways (particularly in the Chinese sector) and their destruction can only be rated a partial success. Nevertheless Japanese records show that the many demolitions were a severe administrative headache and were undoubtedly a major factor in their decision not to invade the Imphal plain in the dry season of 1942/43. Had they done so, their chances of success would have been far better than when they tried a year later.

So, what were the lessons? An arduous retreat clears the mind wonderfully and many lessons, not strictly relevant to this article, were learnt about the training and equipment necessary to defeat the Japanese in Burma. The most important were the need to improve mobility by living hard and abandoning the lavish scales of equipment and transport considered appropriate elsewhere and the need for all combatants to be competent infantry soldiers in an emergency. From a demolition point of view the main lessons were these. Firstly, before the campaign starts it is vital to study the problem from the enemy's point of view. The main Japanese aims were to close the Burma road to China and to obtain a supply of oil. Their supply system relied much on railways. Hence Rangoon, the oil and the main railway system were of prime importance to them. Secondly, a comprehensive plan to define the main strategic targets and their priority, and to assess and provide the resources needed to demolish them, is essential. Not easy; apart from the political factors, few will admit, until it occurs, that a retreat is a possibility and there is always the hope of a change of fortune. Thirdly, the main civilian agencies must be brought under military control and encouraged to help with the demolitions; again not easy, apart from the political factor no-one likes having to destroy in a few hours what they may have spent a lifetime in constructing. Finally, the main targets must be so thoroughly destroyed that, like the Ava bridge, they cannot be repaired during the war or at least before air superiority can be regained.

It may be that we shall never again fight a war in these sort of conditions but I doubt if it would be wise to bet on it. If we ever do these lessons may perhaps prove helpful.


CENTRAL & SOUTHERN
BURMA
Katewa
Shwegyin
R. Chindwin
Ye-U
Myitmu
R. Shweli
Thabeikkyin
Kyaukmyaung
Singu
Shwebo
Gangaw
Monywa
Mandalay
Ngazun
Tilin
Myingyan
Kyaukse
Pakokku
Meiktila
Thazi
Taunggyi
Mongpawn
Kalaw
Pyawbwe
Yenangyaung
Akyab
Myeban
Minbu
Magwe
R. Irrawaddy
R. Salween
Tamandu
An
Letpan
Ramree I.
Toungoo
Mawchi
Oktwin
Padaung
Taungup
Prome
Pegu
R. Sittang
Bay of
Bengal
Pyu
Yomes
Wawo
Mokpalin
Pegu
Kyaikto
Hlegu
Billin
Rangoon
Gulf
of
Martaban
Elephant Point
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Moulmein
Tenasserim
Scale
N20 0 20 40 60 80M

Think First About the Motherland, and Only Then About Yourself

THE ROLE OF ENGINEER TROOPS OF THE SOVIET ARMY IN THE CHERNOBYL CLEAR-UP OPERATION

S P C DALZIEL BA

The author graduated in Russian Studies from the University of Leeds in 1981, having spent over a year studying in Kiev, Moscow and Sofia. He then served on a Short Service Volunteer Commission with the 15th/19th King's Royal Hussars in BAOR, before joining the Soviet Studies Research Centre at the RMA Sandhurst in 1982. As well as writing a number of articles, he was a contributor to the book Communist Military Machine *(Bison Books, London, 1985). Mr Dalziel has lectured to Royal Engineer regiments in BAOR, as well as to courses at Chattenden and at Minley.*

Photo 1. Engineer equipment working in the shadow of the reactor.

In battle, Soviet Engineer Troops are allocated a number of different, yet clearly defined tasks. These include the maintenance of routes, the clearing of obstacles and providing support for crossing rivers and canals. For smooth operation in combat, the Engineers have to co-operate not only with the teeth arms, but also with other arms of service who, like the Engineers, come under the Soviet definition of "special troops". These include Chemical Defence Troops, Transport Troops and Pipeline Troops. Thus, in the "battle" to eliminate the consequences of the accident at the Chernobyl Nuclear Power Station which occurred in April 1986, there were certain tasks which were wholly the responsibility of the Engineers, and others where they worked with, or ahead of other troops and workers.

The principal tasks taken on by the Engineer Troops were: the clearance of obstacles and radioactive debris deposited by the blast which destroyed reactor No 4; the damming and bridging of the River Pripyat, to prevent contaminated rainwater from flowing into the river and to speed up the flow of essential supplies, and; blasting

Think First About The Motherland, and Only Then About Yourself (1)

holes, firstly to drain the contaminated water from under the reactor, and then to insert pipes by which liquid concrete would be poured in to seal the bottom of the reactor. The decontamination of the area around the power station was carried out by Chemical Defence Troops (and by helicopters in some of the more remote parts of the 30 kilometre exclusion zone), and the actual tunnelling under the reactor was performed by miners. Much of the equipment used in clearing the debris was civilian engineer equipment. However, this in no way detracts from the achievements of the Engineer Troops; rather, it highlights the high level of co-operation that was achieved, which greatly helped the swift resolution of the serious problems caused by the world's worst nuclear accident.

Engineer Troops were amongst the first military units to be sent to the Chernobyl Nuclear Power Station, following the accident at 0123 hours on Saturday 26 April. These included not only units from the Kiev Military District, but also from neighbouring districts, such as the Carpathian. It is still unclear exactly when they first arrived, despite the large volume of information on the disaster which eventually flowed out of the Soviet Union, following the initial silence. It would seem likely that the first Engineers arrived three or four days after the explosion. It is unlikely that they were there before this, as the initial, and most urgent, task involved civilian firemen and military helicopter pilots: to extinguish the fire which not only was sending vast quantities of radioactivity into the atmosphere, but also threatening to engulf the neighbouring No 3 reactor. The first firemen were on the scene within minutes of the explosion, and the helicopters began their flights to extinguish the fire and seal the reactor from above on Sunday 27 April.[1]

The first task for the Engineers was to clear a path to enable bulldozers to advance on the reactor to begin to entomb it. This was done either by means of controlled explosions to remove large pieces of concrete, or by use of the Engineer Obstacle-Clearing Vehicle (IMR). The uniqueness of the situation at Chernobyl meant that many problems, great and small, were encountered for the first time. One of the earliest problems which faced the Engineers was that, whilst the four-fingered "hand" of the IMR had no problem shifting large pieces of debris, the smaller pieces slipped through the gaps. The solution was crude, but effective. A metal web was woven around the "hand", thus enabling pieces to be picked up which were "as small as a

Photo 2. Decontamination of an IMR.

[1] For an account of the initial measures taken after the disaster, and the subsequent actions of the helicopters, see this author's article "Helicopters Over Chernobyl", in *Defence Helicopter World*, Feb–March 1987, pp10–13

Think First About The Motherland, and Only Then About Yourself (2)

matchbox". As with so many of the improvisations swiftly and effectively brought into operation at Chernobyl, this illustrates that, whilst the Soviets may sometimes lack the sophistication and initiative of the West, they are adaptable enough to make the best of a situation when the need arises.

The difficulty of the work to clear the debris was vividly portrayed in an article in the Soviet NCO's journal, *Znamenosets*:

> "Sergeant A Starodubchenko . . . had to work in a narrow gap between three-metre high gas canisters. Driver-Mechanic Junior Sergeant A Murtazaliev carefully guided the heavy machine into the clearing. 'It was like going into a forest', Murtazaliev later recalled. 'It was hot, and the sweat was pouring into my eyes. You can imagine what the visibility was like, because of course you couldn't open the hatch. Most of all I was afraid of catching on the canisters, because they would have collapsed like a stack of dominoes and blocked the entrance to the next objective'."

Sergeant Starodubchenko's task was even more delicate and more difficult than that of his driver, as he had to operate the arm of the IMR. Extreme care was needed, yet not a minute could be wasted, as all the while the damaged reactor continued to pour out radiation. Even soldiers who thought that they were well trained for operations in difficult conditions found working in a real nuclear situation frightening:

> ". . . when they got to the place and (Private Sadykov) saw the reading on the dosimeter, he started to shake all over. His hands went stiff, and his fingers refused to obey his brain. Driver-Mechanic Sergeant Sergey Tyzhin understood the condition of his comrade. He took the controls from Sadykov and, saying over and over again 'See, this is how we do it', picked up a concrete slab in the pincers and moved it to one side. He then calmly repeated the operation a number of times until he had cleared a few metres of the path. 'You see that fragment? I'll push it a bit, then you grab it', and be handed the controls to Sadykov."

Private Sadykov recovered his composure and worked on, but doubts must hang over the futures of those who worked for periods of an hour at a time in conditions of such high radiation.

Once the route to the reactor had been opened, the area immediately surrounding it had to be cleared. According to press reports, this took some three weeks, yet the level of radioactivity was still so high around the reactor itself that it was impossible for men to work there. Therefore, remote-controlled bulldozers were brought in. The first of these weighed in at 19 tonnes, and had been flown the 3,000 or so kilometres from the tractor plant at Chelyabinsk in an Il-76. By the end of May two such bulldozers were in operation beside the reactor, and experiments were being carried out to employ more. Although these bulldozers were of civilian manufacture and were operated by civilians, this highlights once again the co-operation between civilian and military personnel at Chernobyl.

Whilst the crews of the IMR obstacle-clearing vehicles were carefully picking their way through the debris blown out by the explosion, a few kilometres away other sappers were working twenty-four hours a day on a different, though still vital, project: to dam the River Pripyat, thus preventing rainwater from the contaminated area from polluting the river with radioactivity. Had this happened, the consequences would have been extremely serious. The Pripyat flows directly into the Kiev Reservoir (known locally as the Kiev Sea, as it is 100 kilometres from north to south). At its southern end, the River Dniepr flows out of the reservoir and through the city of Kiev. Thus, had the Pripyat become contaminated, so would the water supply for the capital of the Ukraine, a city of nearly two and a half million people. The long range weather forecast predicted—wrongly as it turned out—that within ten days of the disaster there would be heavy rain in the area, so time became too precious for a second to be wasted. The description of the clear-up operation as a military operation applied to this task for the Engineers, too. *Pravda* reminded its readers of the military operations, including river crossings, that had taken place in the area in the Great Patriotic War, and spoke of the "Chernobyl theatre of operations.".

Photo 3. Practising the operation of a remote controlled bulldozer.

Lieutenant Colonel Belousov, a decorated veteran of Afghanistan, was given the task of creating a dam to prevent contaminated water from flowing into the Pripyat. He knew that his battalion was quite capable of the task; the only doubt lay in whether it could be carried out in the time before the rain was expected. Normally such a task would take at least a month, possibly two. For the first few hours the work seemed hopeless. The river seemed to be swallowing up the earth with no result. The crews worked on through the night. Eventually, the next morning, they could begin to see the fruits of their labours, as the dam started to rise above the water. There was still a long way to go, however. As the threat of rain increased, larger and more powerful engineer machines were introduced to replace the bulldozers. Amazingly, in a little over a week the work that some felt should have taken six was finished. The operation was completed by the construction of a large reservoir to hold the contaminated rainwater.

Elsewhere on the River Pripyat, other sappers were given the task of establishing and maintaining a pontoon bridge across the river. Under the guidance of Major Sergey Chumakov the bridge was quickly put in place, and then used as a permanent thoroughfare for vehicles taking supplies to the site of the power station on the western bank of the river.

Back at the reactor itself, the success achieved by the helicopter pilots in plugging the reactor from above with sand, marble chippings, dolomite, lead and boron caused a major new problem for those on the ground. Although the fire had been extinguished, the reactor core remained highly volatile, with a temperature of 3,000°C. Furthermore, the plug which was now sealing it weighed over 5,000 tonnes, and was pressing the

Think First About The Motherland, and Only Then About Yourself (3)

reactor down into its concrete base, which was beginning to disintegrate. Unless urgent measures were taken, disasters lay ahead which would have made the initial catastrophe seem like a mere trial run. Firstly, the chamber underneath was flooded with water from the damaged cooling system. If the reactor core made contact with this, there would be an explosion of far greater ferocity than the first one. The core would then continue to burn its way down into the earth, polluting the water table and possibly causing a "meltdown", as envisaged in the film *The China Syndrome*. Thus, two immediate tasks had to be accomplished. The water under the reactor had to be drained away into the extra reservoirs which, fortunately, were part of the power station's design. This done, a little more time would have been bought in order to construct a concrete shield under the reactor.

Exactly how, when and by whom the task was carried out of draining the water remains unclear. Certainly Engineer troops were involved, although it would appear that they worked in conjunction with power station workers, rather than on their own. The most likely chain of events seems to have begun on or about 10 May, when Major General Aleksey Fedorovich Suyatinov and Captain Petr Zborovskiy carried out a reconnaissance to establish a way of getting hoses into the water under the reactor to drain it off. This would then give access to the valves of the actual reservoir under the reactor, which would have to be drained separately. Having eventually succeeded in cutting a hole for the hoses, pumping began. This stage of the operation took two days, carried out by Captain Zborovskiy's company working in shifts, though Zborovskiy himself remained there throughout. According to the Ukrainian newspaper *Radyanska Ukraina* (27 May 1986), however, another mission to release the water was carried out by three Ukrainian firemen, with the help of advice from Captain Zborovskiy. Nevertheless, it is clear that Zborovskiy was the central figure in the operation, and that he very quickly was removed from the area for hospital treatment (an interview with him published in the Army newspaper *Krasnaya Zvezda* on 17 May was conducted from his hospital bed; when asked about what he had done, he replied "Think first about the Motherland, and only then about yourself").

The next task, to drain the water from the actual reservoir under the reactor, was carried out by power station workers. This was necessary, as they were the ones who knew exactly where the valves were located which would have to be turned to release the water into the emergency reservoir. Working in a team of three, they made their way through the cramped corridors. Before they got to the valves, however, the light gave out and they had to grope their way along the pipe. Eventually they came to the valves and managed to turn them. The sound of the water rushing down the pipe was the signal that the immediate danger of another explosion had been removed.

With the water drained from underneath the reactor work could begin on tunnelling underneath it to emplace a giant concrete slab to end the threat of a "meltdown". This was yet another operation wherein the Soviet Sappers worked in close co-operation with other workers. Most of those who built the actual tunnel were miners, from various parts of the Soviet Union: the Donbass, the Moscow area, the Kuzbass, the Baltic Republics and the Pechora Basin. The Engineers' role was to pave the way for these "attacking troops", as they would do in battle. In order to pump the concrete under the reactor, it was necessary to lay a pipe. This had to go through three walls of ventilation shafts, and it was the Sapper's task to blast a route with controlled explosions. A hand-picked team under the command of Lieutenant Colonel O Galyas was detailed to carry out the mission. They practised by blowing holes in identical concrete walls to those under the reactor, though in a safe place. After then studying in detail the charts of the approaches to the points of the explosions, Lieutenant Colonel Galyas and Senior Lieutenant Genze carried out a reconnaissance and then set off the three explosions at accurately established intervals. For their exemplary fulfilment of the task the Sappers won the praise of Marshal of Engineer Troops Sergey Aganov, the Chief of Engineer Troops of the Ministry of Defence of the USSR. By the end of May the 130 metre tunnel under the reactor had been constructed by the miners, and by the end of June the concrete "cushion" was safely in place.

Photo 4. Building the tunnel underneath the reactor.

Any examination of the role of a particular group involved in the Chernobyl clear-up operation inevitably shows just one piece of a complicated jigsaw, and how this piece fits in with its neighbouring pieces. If there is one picture which emerges, however, not only over the whole of the jigsaw but in each of its pieces it is one of courage, heroism and outstanding bravery. In the case of the Engineer Troops these qualities were displayed by the delicate operation of clearing the area in the initial days after the disaster, despite the appalling high levels of radiation; by working around the clock to ensure that the water supply for the city of Kiev did not become contaminated; and by going right underneath the reactor in order to prevent yet greater disaster. Many lessons have been learnt in East and West from the accident at the nuclear power station at Chernobyl, by scientists, civilians and the military. The latter should take particular note of the qualities displayed by Soviet servicemen, of the smooth co-operation which they achieved and of the way in which the Soviet Army was able to improvise successfully when the need arose. The cause of the accident may have been human error; but it was resolved by human skill.

Think First About The Motherland, and Only Then About Yourself (4)

Nellie—A Most Unusual Machine

MAJOR L H K DUNSTER

This article has been produced from the script of the talk given by Major Dunster, President of the Derby Society of Engineers, at their meeting on 2 February 1987.

The author enlisted in the Corps in 1939 and was commissioned in 1942. During the war he served in Gibraltar, India and Burma. In 1946 he rejoined his old firm UK Contractors becoming Plant Department manager until 1962. He then worked for Hymac Ltd and Steel Group until 1973 when he joined Derby City Council Construction Department as Plant and Transport Officer. He retired in September 1983.

In 1952 there was a recall to service for a large number of emergency commissioned officers at that time still on reserve service rolls. It fell to the lot of the writer to be so recalled and a posting to a company forming up for trial mobilization at Long Marston engineer depot ensued.

Whilst engaged in sorting and stocking enormous random piles of Bailey Bridge panels with the aid of a Lima 2400 crawler crane a curious and derelict large piece of machinery in three portions was discovered. Curiosity prompted a more thorough investigation. It was evidently an excavator of some kind, possibly even for tunnelling, though it was not easy to see how it had worked in the state that it then was. No one on the depot staff seemed to know anything about it, nor did they care anyway.

Interest, though retained, stagnated until 1978. The editor of the *Journal* of the Corps of Royal Engineers then agreed to publish an item in the February 1978 *Supplement* requesting interested parties to write in. Sorting out the varied opinions of what the subject of the enquiry might have been was amusing as some very enquiring and inventive minds had obviously been at work. One correspondent however somewhat succinctly and abruptly referred to the works of Winston Churchill *The Second World War* Volume 1 Appendix 'O' and this led to more and protracted research into this fascinating affair.

Amongst other weighty matters Churchill had forseen that the task of invading Germany would very likely require an assault on the long fortified defensive work on the German borders known as the Siegfried Line. Late in 1939 Churchill sent for the current director of Naval Construction, one Stanley Goodall and required him to design a machine capable of assaulting the Siegfried Line. The requirements set out in specification were awesome in the extreme and were largely based on an *ad hoc* design mostly in Churchill's mind and imagination, tempered by his personal experience in warfare.

For the basic idea for such an assault one must have an understanding of the age old principles of siege warfare. The creation of the lines of Torres-Vedras in the Peninsular War were examples of this. Those assaulting had to provide some sort of protection for themselves as they moved close to the defence and so came under fire from those in the beseiged fortress. The Romans locked their shields together forming the *testudo*, a tortoise-like shell, which protected them from the effects of such weapons as the defenders could use to be effective at some distance. The advent of gunpowder in cannons changed all such ideas, in that now large projectiles could be thrown long distances. The only satisfactory defence counter was to gain protection

Major L H K Dunster
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from the earth itself, either excavating trenches below it or massive earth walls above it or a combination of both. The work and manpower needed for such procedures was formidable and time consuming and was incapable of being carried out in secrecy so the important surprise effect was eliminated.

Now if a machine could be devised to do the work it could feasibly start some distance beyond defensive fire range and working in the dark overnight be capable of forming a protective pathway right up to the fortress by first light. Down this path, immediately behind the machine would pour assorted assault troops, their weapons, machines, supplies, ammunition and rations.

Stanley Goodall had an assistant named Hopkins and they began work. In the way of things a name had to be allocated to the project and with all the naval flavour inculcated by Churchill it became 'Naval Land Equipment'. Inevitably this became shortened to NLE and, following the new tendency to produce acronyms, became Nellie. In rather curious and amusing attempts, presumably to confuse the enemy, it was also referred to as 'White Rabbit 6', being the sixth curious idea that Churchill dreamed up and later it was known as 'Cultivator 6' possibly to associate it with agriculture and the farming community in Lincolnshire where it was constructed.

An experimental grant for £100,000 was allocated and a young naval architect, quite appropriately named Spanner, was appointed by Goodall. He and three draughtsmen from the department were shut in a bedroom at the Grand Pump Room Hotel at Bath and left alone to study the problem given a rather vague and inadequate specification but very strict conditions as to secrecy.

After a month's work Spanner had six sketch designs and during this time Messrs Ruston Bucyrus of Lincoln, excavator manufacturers known worldwide to all in the construction industry, had been nominated as constructors. Their chief engineer, Savage, and some of his design team were in touch.

The favoured sketch plan was selected and approved and given to Messrs Basset Lowke of Northampton, famous model makers. In six weeks they had made a satisfactory working model. In the meantime Churchill had a mock up of a comparable type of terrain that might be encountered laid down at the Admiralty at Whitehall, London. The model was brought there for trial after an amusing journey from the makers. The extreme caution used to keep it secret en route meant that it was enclosed in a rectangular stout wooden box some four feet long which was carried somewhat reverently by the attendants and accompanied them on the train in first class compartments. Its resemblance to a coffin caused several to think that that was what it was and so reverence predominated. Gentlemens' hats were doffed at its passing and some even stood to attention with bowed heads. In the basement it purred into action and successfully dug an impressive trench in the conglomerate which was satisfactorily piled up each side by the conveyor belts. Later the model was taken to France under control of a Sapper Major one Millis Jefferis and was demonstrated to the Commander-in-Chief of the British Expeditionary Force and other high ranking officers of that force and equivalents in the French forces.

About this time troops making patrols near the Siegfried Line were required to collect samples of the earth in the vicinity for evaluation as to the potential ability of the machine to cope therewith.

Initially Spanners' calculations looked rather like this:

Dimensions 75 feet by 10 feet high, 18ft 6ins wide over the plough blades
Weight 125 tons
Turning circle 1 mile
Dig rate 100 tons per minute
Speed of advance ½ to ¾ miles per hour
Engine Horse Power 1200
Trench out 7ft 6ins wide and 5ft deep

As can well be imagined many problems would arise, but the very first one was a blow, for it had been decided to base the power needed on output of a Rolls Royce Merlin engine. Events now well known moved so that of vital necessity the Air

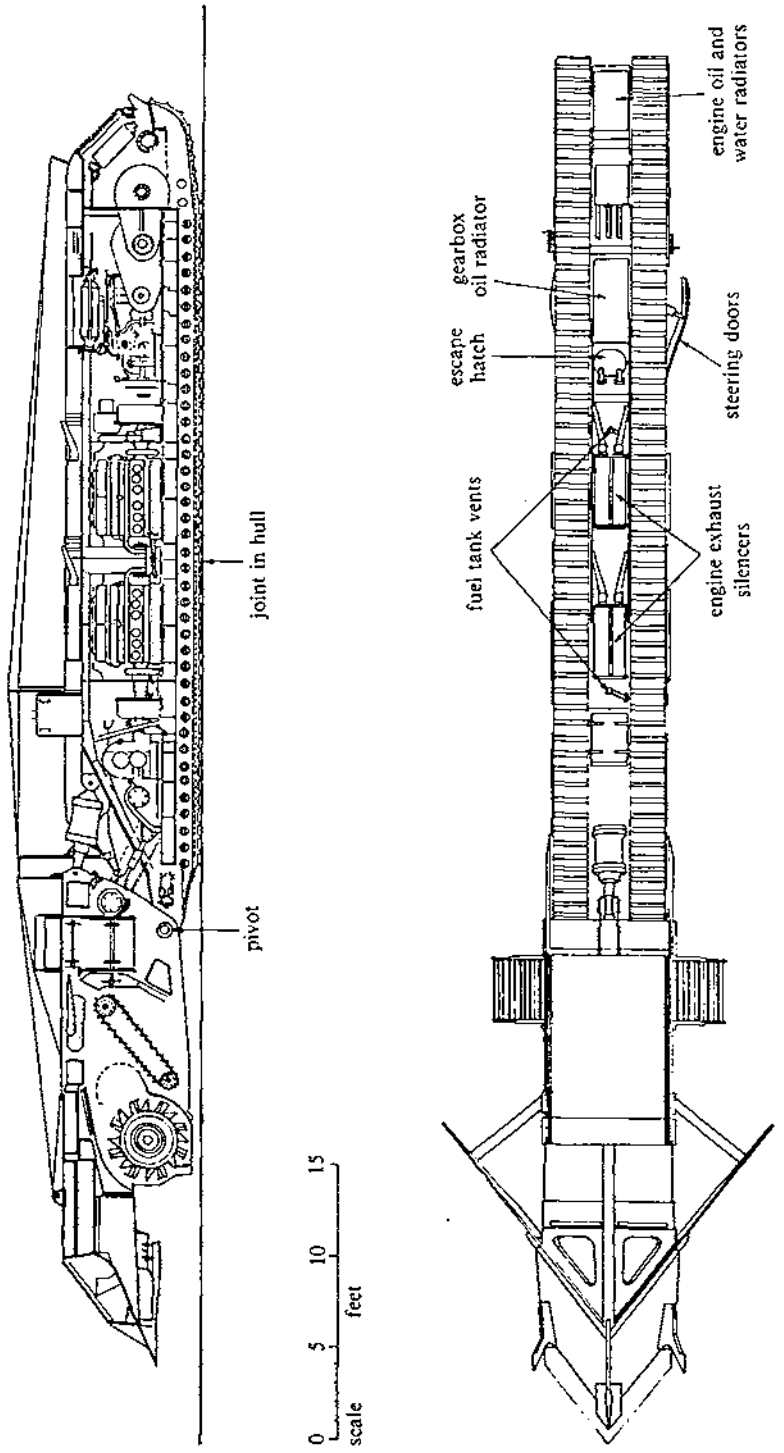

Figure 1. Plan and elevation of the trench excavating machine showing the excavating section at the front and the tracked section for engines and fuel behind (from an original drawing by Dick Harley).

Ministry cornered all these engines for the defence of Great Britain. An alternative power unit had to be found and one was selected from Messrs Paxman modified by Ricardo who himself had been involved in tank engines some twenty-five years before. This engine was a water-cooled, dry sump diesel of twelve cylinder Vee configuration. The above dictated by *force majeure* meant that size and weight were much over what had been envisaged and as a consequence the whole machine necessarily increased in size and weight too.

The revised design was now considered and as a result of deliberations, two hundred standard type to be referred to for security reasons as 'Infantry' and sometimes 'Private' and forty of a larger design, to cut a wider trench for tanks, known as 'Officer', were ordered. This order was based on Churchill's original concept of assault on a twenty-five mile front at a density of ten machine-dug trenches for mile of front. The manufacturers were now able to get things really going the whole affair having been seemingly put on a more realistic commercial footing.

Savage and his staff had to cope with many other problems and not only from the engineering angle. Security was very tight. At the Lincoln works a whole shop was bricked in and entry and egress very tightly controlled. All persons involved were sworn to secrecy. All drawings were classified as 'Most Secret' and had to be moved swiftly to a special place of safety in the event of an air raid warning being given. A wooden model of the final concept had also to be destroyed in the event of invasion and hand axes were kept right with it to cope with such an event.

Some three hundred and fifty firms of supplies were involved and all supplied the demands made from them without knowing what they were specifically for.

Other major design problems which concerned the group of technical experts were:

Heat dissipation from so much machinery in small places
Noise from operation and from immense cooling fans installed to combat the heat
Steering from outside when the machine was in above-ground position
Provision of full or partial armour plate to resist armour piercing bullets or at least small arms fire around the operations positions
Sudden shock loads imposed on the gearboxes, transmission and operating machinery
Conveyor clogging
Internal heat and fumes
Attempts to make a simpler turn to avoid enfilading fire
Means of coping with break down in the dug trench and extraction of following vehicles in this event
How to recover the casualty

There was also inevitably a small amount of internal inter-departmental strife. The situation was probably not too well defined administratively. A concept started with a naval flavour and by a directorate of naval construction, doubtless well loaded with work themselves, to provide something entirely new in thought and use, for another branch of the armed forces of the Crown (namely the Army) to operate, was bound to produce a certain amount of inter-service friction. This more especially as the Army had not even asked for such a device. Overall was the all pervading influence and interest of the Prime Minister himself. This is illustrated by a few extracts from minutes of meetings and correspondence:

Director of Naval Landing Equipment to the War Office liaison: "Instructions were approved in the sense that they were approved by the Prime Minister as President of the Committee".

Chief of the Imperial General Staff to Director of Military Ordnance and Personnel: "I cannot imagine that we can state categorically that no contingency will arrive when these machines might not be a tremendous advantage".

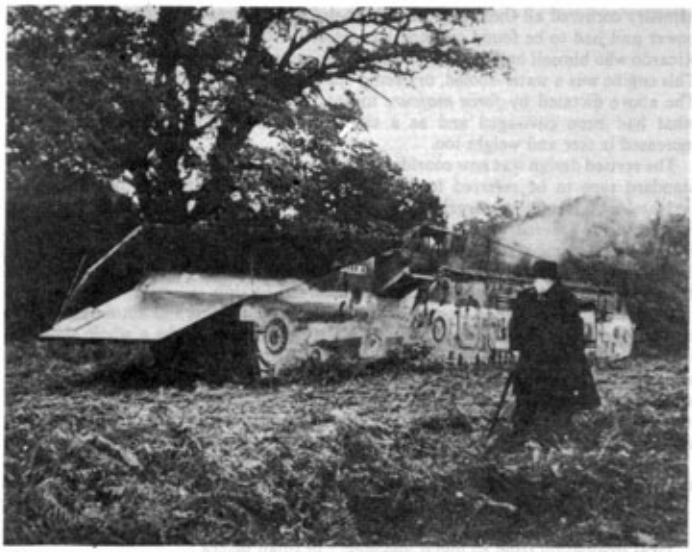

Photo 1. Undergoing trials at Clumber Park watched by Sir Winston Chuchill. (Imperial War Museum photograph MH 957)

Director of Military Ordnance and Personnel in reply to the last above: "They might be useful".

Extract from minutes of a committee formed for production of machines: "The tactical problems involved in the use and deployment of these machines appear to this committee to be much greater than manufacturing problems".

As production proceeded, trials of prototype portions of the machine were staged and notably the effect of the plough and the churn section were observed at Skellingthorpe near Lincoln. As soon as a prototype complete machine was available 796 Mechanical Equipment Company Royal Engineers under their commanding officer Major T Whitehouse took on work of further tests. The unit was established at Clumber Park in the Nottinghamshire Dukeries area and there the Prime Minister witnessed a trial run successfully carried out. Further tests were staged at Hitcham and Lilley-Hoo near Hitchin to see what performance could be obtained in harder, stickier ground conditions. Barbed wire and buried anti-tank mines were cleared, the latter turned over without detonation.

Effort had concurrently been put into making a trailer to take the loads up to fifty tons. The design produced a vehicle weighing twenty-three tons mounted on solid axles and the travelling effect was on four caterpillar type tracked bogies. It had simple, conventional turntable type steering. It was not a happy affair. The tracks tended to clog and were difficult to keep clean and as a consequence became almost impossible to rotate after even a short stand, due largely to corrosion. The trailers were pulled by Caterpillar D8 tractors, the largest in the country then available. Some of the time one would suffice but even a small gradient required the use of two. Being unsprung and unbraked, and loaded with fifty-two tons, the weight of the rear piece of the machine, progress was a nightmare. Damage claims after a move were legion

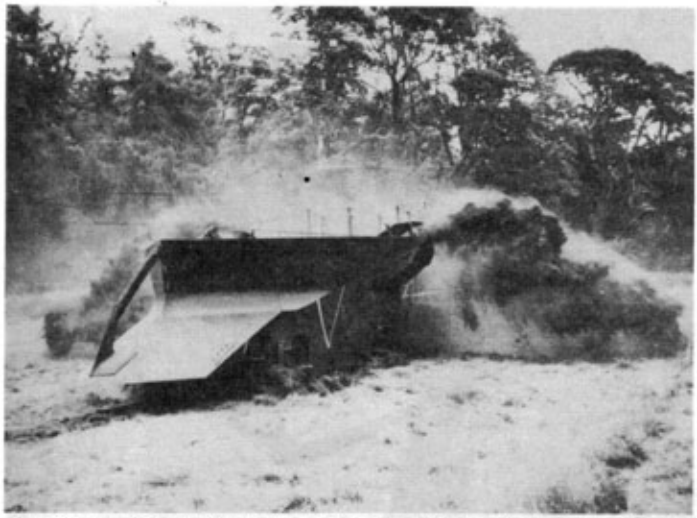

Photo 2. Start of the run. Nose down and digging in. (Imperial War Museum photograph MH 927)

and disgruntled utility representatives and others, themselves burdened with wartime conditions, were not easily placated. Unfortunately research has not been able to trace any real evidence of the trailer and what has been said above is made up from information given in interviews and correspondence with sundry retired Royal Engineers.

The time had come to study the problems of deployment of the machines, if and when they were taken into combat use. It is not difficult to see that these would have been formidable in the extreme.

Consider getting two hundred plus machines from somewhere near Lincoln, where they had been made, to a position in Northern France somewhere near the border with Germany and hence near the Siegfried line. Each machine had to be knocked down into three parts weighing thirty-two, forty-two and thirty-five tons respectively. This meant three fifty-ton trailers. There were then two track assemblies of one hundred and twenty six shoes each. This lot would likely need five tractors to move it any distance at about four miles per hour. There would then have been several large loads of gear and special tools, a lorry mounted crane of probably fifteen tons capacity of lift, jacks, grillage timber, erection gear, simple tools, welders, air compressors, battery chargers, lights, camouflage nets and scrim cloth and many other items. All this would have been followed by the labour content with all their administrative train, personnel baggage, weapons, ammunition and rations, specialist vehicles, fuel and water-bowsers.

All this would probably be taken by road to a loading bay, thence onto rail flat cars to be worked, likely out of gauge, to a port of embarkation onto a sea ferry; off the ferry at a continental seaboard port, onto rail flats again thence once more worked out of gauge onto specially laid railway spur lines at the assembly point near the objective.

The machines would also have had to be deployed to be ready on a start line for the word to go to start the assault to synchronise arrival close up to the objective at first light of the appointed day, and what of the most important facet of all military

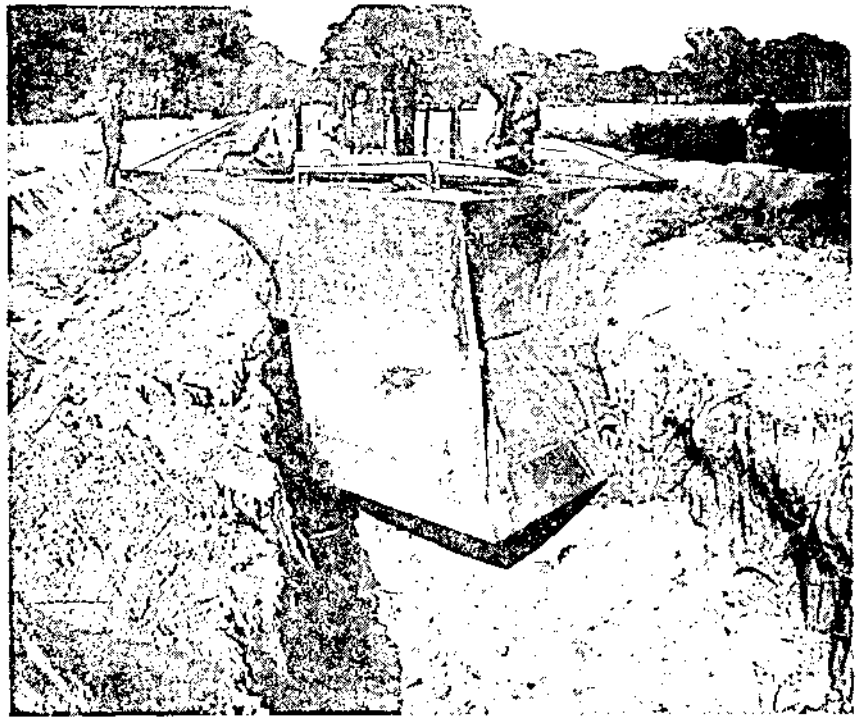

Photo 3. Machine backed along trench. (Imperial War Museum photograph MH 945)

offensive operations, namely surprise? Overall thought would have to be given to camouflage, hiding from air observation, deception of spies and informers, security en route, protection from sabotage and so on.

Imagine all this now at dusk some two hundred plus machines poised for a start and behind them arranged a great army of fighting men and their attendant machines of war. The start gun, cannon or signal is given. Imagine the noise of all these diesels probably augmented by a sustained artillery barrage of explosive and smoke as part of a mighty hate strafe to blind or mask the engine noise. The machines move forward and gradually the nose section and its great plough is lowered, the rotary cutter bites in, the conveyors begin to spew out earth both sides then the plough digs in to its full depth and cleaves through the earth. In about two minutes the machine has dug itself in and is obscured from the nearby observer. Steering in the cut to keep the machine going straight ahead was to be effected by push plates hydraulically actuated which, pushing against the excavated trench side, moved the leading edge of the plough. To effect movement in the vertical plane there was to be a deflector plate at the top of the main conveyor on each side which could be operated to deflect some spoil down a chute and under the leading bottom edge of either track. A series of tensioned steel wire ropes suspended above the machine would act like the jumper wire on a submarine to enable the machine to pry under barbed wire. To shape up the tumbled spoil heaps from the lateral conveyors, cowls were provided on the discharge end. Super-sharp cutting tips could be fitted to the ends of the plough wings to cut tree roots and similar.

By the time this stage of planning and building had been reached the whole character of the war had changed and it became obvious that the likelihood of using the machines in their designed role was remote. Alternative uses for the few that had been built or were in process were sought. Ideas of anti-tank ditches, aircraft and

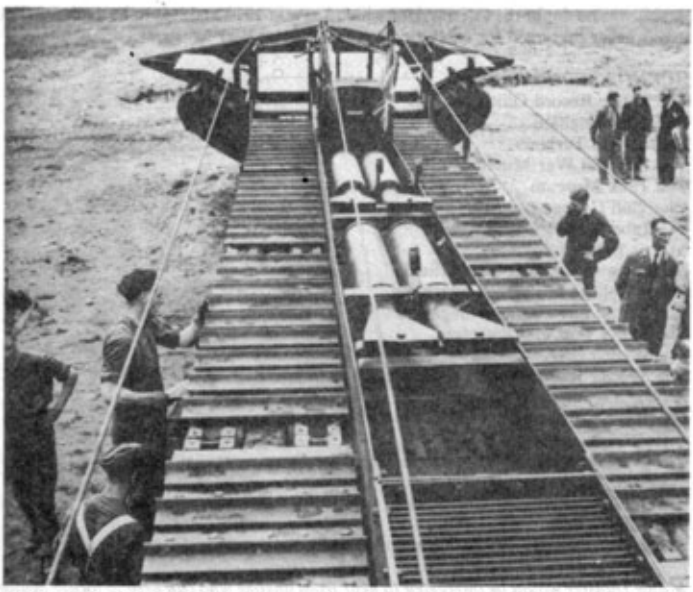

Photo 4. View on top looking forward. Anti-tank trench ahead. (Imperial War Museum photograph MH 920)

glider landing obstacle creation, drainage trenches, minefield lifting and others were suggested but none was seriously entertained and so the programme was wound down and all those who had been concerned were speedily absorbed into more urgent and probably more sensible occupations.

The death knell was sounded by the Prime Minister in his memorandum of 1 May 1943:

> Prime Minister to Secretary of State for War
> "Cancel and wind up all officer types but keep four infantry types in good order. Their turn may yet come"

A further memorandum of 21 May 1945 accomplished the demise of all but one:

> Prime Minister to Secretary of State for War
> "One machine to be kept. Dispose of the rest as you suggest".

A final comment from Churchill: "I am responsible but impenitent". This in response to observations made by some wag who, now armed with hindsight, wryly said "£8,000,000 might have been more profitably employed". Tempering the wind he also said "despite this, in developing an original weapon a proportion of failure must be envisaged and accepted."

One must remember that, although the machines were never used offensively, it was obvious that the wear-out rate would have been great and this apart from enemy offensive damage that would have surely occurred. The design concept of such contrivances for warlike purposes will inevitably tend to consider only one use and expendability prevails.

It was no doubt the sole survivor which I saw in 1952 and it is to be deplored that it was never preserved for exhibition at the Imperial War Museum.

ACKNOWLEDGEMENTS
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The Library of Science
Messrs Basset Lowke
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Derby College of Further Education
The Editor *The Engineer* magazine
The Editor *War and Warefare* magazine USA
The Second World War, WS Churchill
A New Excalibur AJ Smithers
One Hundred Years of Good Company, Ruston Bucyrus
The War and Colonel Warden, Gerald Pawle
The White Rabbit in Clumber Park, RS Pickersgill
Sundry correspondents who worked on or with the machines

Major Dunster would be interested to hear from anyone who can help to locate Major T Whitehouse, RE or assist with information on the trailer. Please correspond with the Secretary, Institution of Royal Engineers, Brompton Barracks, Chatham, Kent ME4 4UG.—Editor

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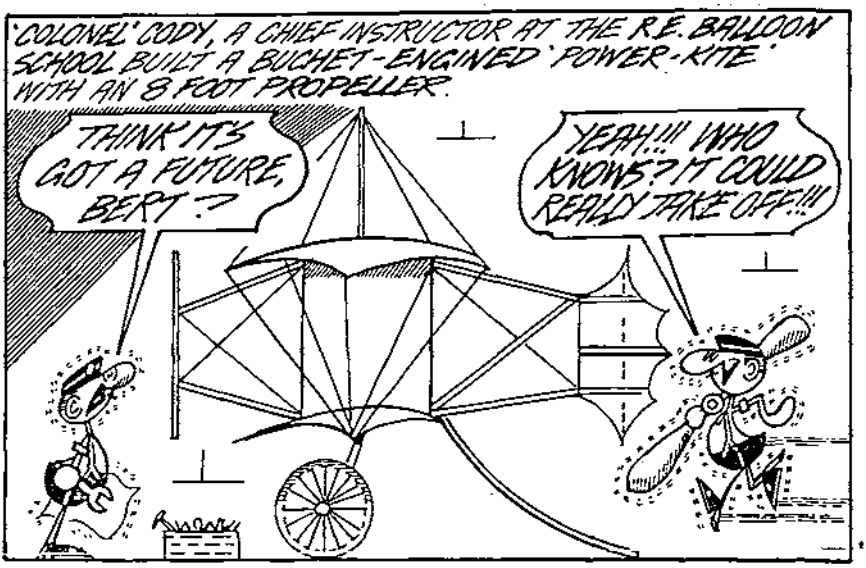
KNOW YOUR HISTORY



Some Memories of National Service in the Corps

JOHN RICHARDSON BSc (Eng) FICE FI Mech E FIEE ACI Arb FBIM F Inst D

John Richardson joined Balfour Beatty Ltd, in August 1949, did National Service from 1951 to 1953 and then went back to Balfour Beatty Power Construction Ltd for some years. He worked on contracts, living overseas, in Kenya 1956 to 1958 and Argentina 1970 to 1973. He was involved in bidding and operating contracts in a number of African, Middle East, Far East and South American countries.

April 1987 was the thirty-fifth anniversary of a land mark for me, commissioned into the Royal Engineers at Brompton Barracks in 1952. It is a long time, but some recollections seem remarkably fresh. It was an experience from which I gained a lot and I think gave something. This is seen in retrospect and was not evident at the time.

I was twenty when I graduated in 1949, having had to wait for a year for a university place in engineering as post-war priority had gone to servicemen who had delayed or broken their academic training. There was then a choice of National Service or applying for a two year deferrment to move into practical employment first. I chose the latter and I think this contributed to the benefits I was to gain from my time in the Corps.

During the two years I worked with Balfour Beatty, mainly in the Midlands. On call up I travelled from Scotland to Cove: 3 Training Regiment RE in Guillemont Barracks. Of Guillemont, memories are only of odd snippets of events amongst the general background of activities.

After War Office Selection Board at Barton Stacey, a most enjoyable few days with a memory of a great confrontation interview with a Colonel psychologist, the next stop was Mons Barracks, Aldershot, for basic officer cadet training. Memories here are of all movement at the double, fantastic bull, boot-polished floors and the achievement of remarkable standards of drill, the late RSM Tibby Brittain overseeing all; of being condemned to the guardroom by Tibby for laughing at two drill sergeants demonstrating army bicycle drill and, on asking for how long it would be, being told, "When he remembers he put you here".

We moved on then to Officer Cadet Squadron at Gordon Barracks, Gillingham. It was a real change, alongside the basic continuation of drill training and bull, to be introduced to military engineering, the needs to be fulfilled, and the ways to meet them. Amongst the interesting subjects were improvised bridging, planning jeepable tracks up closely wooded hillsides and, top of the pops, explosives, gun cotton and the more magical plastic. I think we would have happily spent our whole time blowing up the old Cement Works wherever it was and no amount of imploring and entreating would allow us to be let loose on the lovely high chimney stack! Using Bailey was fairly mundane, except for tricky launching sites, when no-one was shooting at you.

In the midst of all this, the appointment as Senior Under Officer (SUO) came as a bit of a surprise. The initiation involved a considerable amount of drinking, a

John Richardson
Some Memories of National Service in the Corps

Photo 1. The author receiving the SUO's cane from the EinC, Major General C N Tuck CB OBE

mammoth course of swinging round rafters (having been stripped at some earlier stage) and finally being thrown outside. I recall that was a bit of a shock on a frosty snowy night but cannot remember how or when normality was re-achieved. Then came the fascinating time of being SUO which, looking back, gave an amazing early opportunity to balance what I saw in later life as the correct placement together of authority along with responsibility.

The great day of the Passing Off Parade arrived. Nervous tension was at its peak, though we had been well rehearsed by the SSM but, despite some near disasters, all went all. The Engineer-in-Chief Major General Tuck took the salute. Afterwards we made a quick change to Second Lieutenant's insignia and went into the Officers Mess for coffee before the Church Service.

After some more training at Gordon, I received a posting to the Canal Zone and a passage to Port Said on the *Empire Trooper*. Money normally having been tight once mess bills were paid, this trip was great, no mess bills and tonic a little more than the gin. It was an RAF run troopship and soon a Royal Marines major, a couple of RAF officers, myself and another Army officer had settled down to a good poker school, which was soon starting before breakfast. We finally disembarked at Port Said and embussed into hired buses for the first experience of the exhilaration involved with Egyptian drivers.

We soon arrived at 22 Field Engineer Regiment, Waggon Hill Camp, near Fanara. Although we were not the first national servicemen in 22 Regiment, I think four of us arriving together caused some trepidation. The four of us were David Lee, Peter Mills, Ted Lowe and myself. David and Peter joined the Field Park Squadron, Ted became Assistant Adjutant after a time (but we still remained friendly!) and I joined 23 Field Squadron.

Three of us elected to share one tent in the officers' lines. This did not seem to meet with approval, as two per tent was normal, but we said we would have sufficient room and no-one seemed to present a good argument as to why we should not be together. This was perhaps an early example of our different attitude. It was by no means a matter of acting awkardly but more that if someone could not explain reasonable grounds for something we tended not to be automatically acceptive and perhaps to be a bit resistive. Some word of explanation was usually all that was needed to gain our compliance and cooperation. I think integration actually took place without undue traumas on either side.

Some Memories of National Service in the Corps (1)

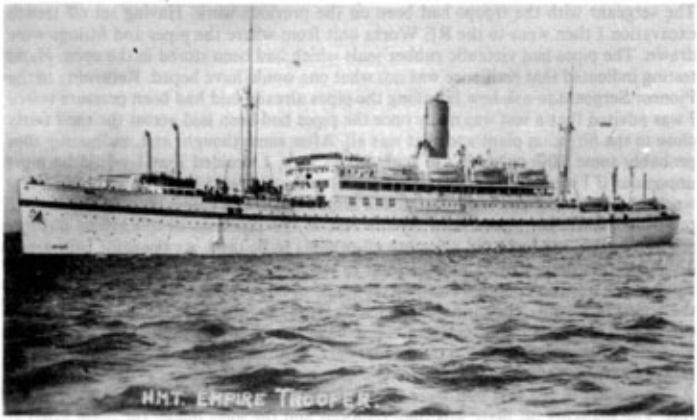


Photo 2. The *Empire Trooper*

I would now revert to my mention of having had two years experience with a contractor as I think this had a bearing on how I became involved in what would seem to be an enormous number of extra curricula activities after three months of settling in. Put alongside sailing and the normal regimental duties of a troop officer these seem hardly possible in retrospect.

Many odd jobs came the way of the Regiment. Two examples illustrate the way national servicemen with a little previous experience were given considerable responsibility.

In the first, a leave camp was being constructed near Kabrit Point at the South End of the Great Bitter lake. A water pipe was being laid from one of the Sweetwater Canal filtration plants. I was told it was about half laid and I was to complete it, being allocated some Seychelles pioneer troops, and set off with great enthusiasm.

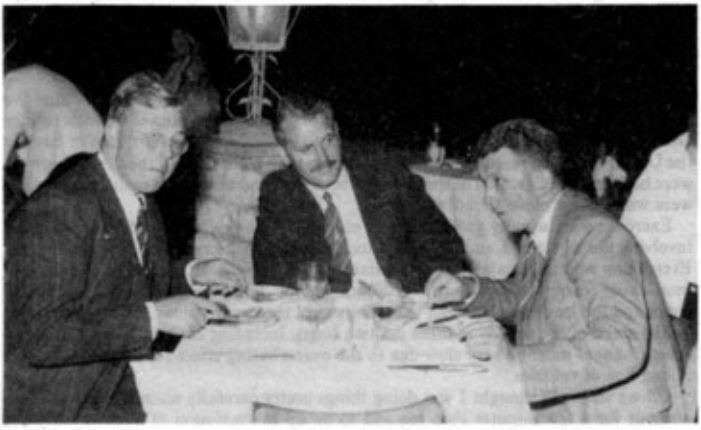


Photo 3. The three national service officers, *l* to *r* David Lee, Author and Peter Mills

Some Memories of National Service in the Corps (2 & 3)

The sergeant with the troops had been on the previous work. Having set off trench excavation I then went to the RE Works unit from where the pipes and fittings were drawn. The pipes had victaulic rubber seals which had been stored in the open. Hand testing indicated that resilience was not what one would have hoped. Returning to the Pioneer Sergeant to ask how far along the pipes already laid had been pressure tested I was advised that a test was made once the pipes had been laid across the road fairly close to the filtration plant and that was all. After some thought and, estimating that probably some 10% or so of the seals would leak, I decided that I would be most unpopular if I went back at the end of my first day and said I will be spending a few weeks re-excavating and testing what had already been laid before making any further progress. I therefore planned to lay the rest of the pipelines as quickly as possible without backfilling but hand selecting all rubbers to be used. At the same time I had a blanking off plate made to fit the joint to the newly laid pipes and switched on the valve at the filtration plant. Patrolling on motor cycle over the next few days indicated the hoped for result. The sand was very soon visibly damp where the worst leaks were taking place and at minor leaks in a few days time and the sand showed a "green bloom" of sprouting seeds! A few men were then detached and each faulty joint remade with a replacement rubber under personal supervision.

The repairs in the first half were thus completed concurrent with the laying of the rest. The blanking off plate was then removed and the joint made, the plate fitted at the Kabrit end and the whole of the length put under pressure. Remedial work was done as necessary on the second half which was then backfilled. The water supply was on before the target date.

In the second example I was to classify all the bridges and culverts over the Sweetwater Canal from Fayid South for Centurions on transporters, transporters or centurions on tracks. This took quite a few days and was considered a very interesting skive. In due course I made the report and it was apparently found satisfactory. I think at the time I must have thought it was a figment of imagination of someone who liked having reports and it was soon forgetten.

One evening, sometime later, I was passed a message in the Mess to say that my troop sergeant wished to have a word with me. His news was that at 0730 hours the following morning Centurions on transporters were going to be driven over all the crossings according to the report classifications—thoughts of how long it would take to pay off £¼m for a Centurion on a national service Lieutenant's pay! I told Sergeant Parker to gather all the survey instruments from anywhere, including 35 Corps Engineer Regiment down the road, selected the NCOs and Sappers required and by 0700 hours the following morning there was a manned instrument at every crossing and an order to stop whatever it was if a deflection of more than ½ inch took place pending me being called up on the radio. However all items passed over safely.

Later I found the real reason for the classification exercise. Around this time the Army actually stood by to move back into Egypt proper, something to do with politics and General Neguib, though nothing seemed to be heard of this by the folks back in the UK. It had been realised that if such a move took place that all the tank regiments were based on the East side of the Sweetwater Canal and as many crossings as possible were wanted if a move should take place.

Exercises were usually good fun. One, named "Triangles" after the divisional signs involving the whole of 1 and 3 Division took place on the Sinai side of the Suez canal. Everything was to cross at the El Kantara railway bridge fifty miles or so North of most units' camps and then travel South on the Eastern bank. I was chosen to command the lead vehicle for all the transport of the two divisions. I was well briefed on the speed of the convoy in miles per two hours, including the rest periods, and that speed changes must be very slow due to the exacerbating effect that takes place over a long line of vehicles.

Off we set and I thought I was doing things pretty carefully maintaining five miles an hour for a few minutes then ten and so on up to maximum of about twenty-five miles an hour. During the second two hour stint I was confidently heading South and

Photo 4. On exercise

came within sight of vehicles across the Canal, I suppose twenty miles or so behind me in the convoy, heading North. Five-tonners with huge gaps were apparently flat out at about 50mph. I certainly appreciated what I had been warned about, though to this day I cannot analyse the scale of the effect.

The exercise attack was to disgorge into the Sinai plain and the existing route through was the Mitla Pass (of later fame). Having slept out happily not knowing until the following morning that scorpions were under many rocks, somehow I finished up in charge of sweeping for mines that were suddenly announced to be laid in the pass. At the same time the next, narrow, wadi south was being bulldozed for vehicles and I knew it was being assumed that this could only be done working from the West. However a reconnaissance done by a Sapper Ivory, a Scammell low loader driver of the Field Park Squadron, revealed that he could get his low loader through so that dozing could also proceed from the East, and I had had a radio message that this was being effected.

The chaps on the mine detectors were doing a good job but it was not fast enough for some of the red tabbed gentlemen who appeared on the scene. The lowly national service officer politely stood his ground as to the time required, if the job was to be done properly, whatever delay occurred to the attack into the plain. Fortune smiled, a radio message came through that the lower pass was cleared and 3 Division were moving from the back of the Mitla Pass down that one, about half a day earlier than had been thought possible. thanks to Sapper Ivory. The pressure was off.

As an example of more mundane regimental duties, I was appointed as the third, much the junior member, of the Regimental Audit Board to Major Reggie Trench, the President, and a lieutenant. I thought: how nice, obviously the other two being experienced will do all the work and I can watch.

However things having been underway for a short time, Reggie went off, I think playing cricket in Cyprus and then the lieutenant damaged himself badly during battle simulation for 1st Guards Brigade and so I had to do a lot of the work, Major Bertie Bloomer, the regimental second-in-command was a gem in guiding me and by doing many hours of slow laborious work all was ready for final tidying up when Reggie came back. There is no way of learning like having to do something and, with this grounding, accounts were no longer a dark mystery to me and with some polishing

Photo 5. *Meander* en route to Famagusta

up the experience stood me in good stead as the basis of dealing with Divisional and Company accountants in my later years.

As to sailing, with the RE Yacht Club nearby on the Great Bitter Lake there was every opportunity and it was a great form of recreation. With Bertie Bloomer as mentor, I was able to achieve a decent proficiency on RNSA dinghies and Snipes. However Bertie also introduced me to *Meander*, and big boat sailing really stole my heart.

There was at the time a lot of work to do on *Meander* but the many hours became a labour of love. Sailing something like *Meander* was an absorbing task with the old fashioned rigging of mainsail, jackyard topsail, mizzen, jib and staysail. Sailing in overnight round-the-lake races was a beautiful experience. A particular aspect was that the forward vision from the wheel in the cockpit was pretty restricted and I was happy to spend hours as lookout on the bowsprit where the view of the fluorescence as the bows cleared the water went back actually lighting up the white topsides and fishes darted away in their trails of light. My first Mediterranean sail involved flying to Benghazi to be met by Olive Bloomer and then driving along the fascinating coast road, with a number of Bailey Bridges built by 23 Field Squadron, through the fertile Barce area, down the hairpins to Derna and then to Tobruk where *Meander* was moored. I then had a few days to get *Meander* ready which included stowing crates of gin and whisky, bottles bought at the Tobruk NAAFI under the floorboards for stocking the Waggon Hill mess (Canal Zone prices being kept up to the Egyptian

price levels to avoid problems). Bertie and the rest of the crew arrived and off we sailed. About two nights out a terrific storm came up and following seas were pounding under *Meander's* long counter, probably her least seaworthy aspect. I was delegated to crawl into the counter with a torch every hour or so to check that timbers had not sprung. I was not seasick but I can clearly recall that the pounding we were getting brought about a mental state that as one went to and fro along the leeward rail the feeling was "well if I fall overboard it cannot be worse in the sea than it is up here". Bertie was probably thinking that it was a bit rough. We did finish up hove to, streaming a few buckets and things as sea anchors.

On to Port Said in the aftermath of the storm. *Meander* had a pretty deep keel and, although she had an engine it was an old inboard diesel that could only be started by first charging the batteries—itself a performance with a temperamental chorehorse. All this meant tacking into Port Said up the shipping channel. The only problem was that a convoy was exiting and the manoeuvre involved the dumbfounding experience of Bertie tacking through the ships with calm aplomb.

Eventually I gained Bertie's confidence sufficiently to skipper *Meander* myself and had a wonderful trip to Cyprus with an adventurous return into the shipping lanes at Port Said.

Finally my time in Egypt came to an end and I was offered a berth on a troopship to Trieste and thence home on the "Medloc" route by train. This attractive offer was withdrawn at the last minute and so, after a last interview with Colonel Evill the Commanding Officer in which I had to decline his flattering offer of applying for a regular commission, I returned on a mundane trip by York trooping aircraft.

Postscript

My contact with the Corps has happily continued. After National Service I was assigned to the AER, TA being unsuitable for someone moving around with a contractor. Then in 1956 I was transferred to RARO to avoid being called up whilst in Kenya under the Mau Mau emergency on a project for Balfour Beatty.

I remain in touch with my friends from 22 Regiment. Then in about 1980 I sat beside Colonel Eddie Peel at dinner after a joint professional meeting and he enlisted me into the Institution of Royal Engineers. I was also present at the Reunion on 11 May 1984 when the Chief Royal Engineer, General Sir Hugh Beach presided at the removal of the old square in Gordon Barracks, the last remains of the Sapper presence there. On 9 April 1986 I was again in Chatham as a liveryman of the Worshipful Company of Engineers for the very interesting visit arranged by the Engineer-in-Chief.

I really feel that my time in the Corps was good for me. It was a great help in growing up generally. In my view, those who say that National Service was a waste of time lost out by missing opportunities. It helped that I went overseas and was lucky that Waggon Hill was a temporary camp where all officers but two lived in.

It has been a great experience remaking contact. Thank you, Sappers.

Collecting Sapper Postcards

MAJOR G C JONES TD MSc BSc MIQ RE

The author first enlisted as a sapper with a TA Field Survey Squadron whilst studying at Bristol University. He subsequently entered the Army as a National Serviceman, was commissioned and served with Malayan engineer squadrons. On demobilisation he was posted to RMonRE(M) and continued to serve as a volunteer eventually commanding 100 Field Squadron. A transfer to the Watchkeepers' Pool, and service with HQRE 3 Armoured Division preceded his current job as an LO with HQ 30 Engineer Brigade.

SOMETIME in the late 1970s I became interested in old topographical postcards and started modestly by visiting antique shops and specialist fairs to acquire a collection of the Lower Wye Valley. At one such fair I noticed a couple of cards, obviously part of a set depicting Sapper activities at Chatham, priced at 10p each. These were purchased merely out of interest rather than thoughts of a rival interest to topographicals: but they did whet my appetite. At subsequent fairs I made a point of thumbing through the "military section" to locate, if nothing else, more of that first-found set.

I was not immediately successful in that direction, but I did unearth other cards with sapper connections and I was hooked; the topographicals were consigned to a shoe box; the album, now vacant, was available to receive an ever increasing number of military cards.

The first recorded issue of the earliest postcards was October 1869 in Austria, and some twelve months later the British General Post Office issued its first official printed card at ½d with an impressed stamp. In 1872 they relaxed their monopoly and permitted commercial cards to be printed, but still retained, at a premium, the stamp embossment. By 1875, resulting from an international agreement by some twenty-two member countries of the General Union of Posts, postcards could at last be sent abroad and this agreement permitted the entry of continental style cards. Victorian attitudes, however, considered postcards somewhat vulgar, and their immediate impact was minimal with commercial cards remaining dominant. In 1874 the GPO agreed under pressure to relax their monopoly to permit adhesive stamps for postage and distribution within the United Kingdom. Prior to 1902 the forwarding address was written on one side of the card, and any message appeared alongside the illustration. With the introduction of the divided card, full picture development could take place on the reverse side and this change heralded the 'boom' period which lasted until 1918 when postage was raised to 1d and sales dropped dramatically.

Sapper postcards cover an enormous range of subjects but from a collector's point of view the different styles of postcard can be grouped into four basic types: Real cards, Printed cards, Silks and Moderns.

If you are thinking of collecting you can find cards at antique and collectors fairs or in postcard shops, and pay as little as 10p. The more usual price would be between £1 and £2, but in excess of £5 for rare, early or highly prized subjects like Air Balloons, or cards produced by Harry Payne.

Major G C Jones TD MSc BSc MIQ RE
Collecting Sapper Postcards

Photo 1. The start of it all—part of a Gale and Polden set depicting Royal Engineers Chatham in black and white. Amongst the publishers of military cards, Gale and Polden show, as one would expect, an eye for detail, accuracy and good reproduction.

Photo 2. Royal Engineers Barrel Bridge—part of Naylar's 'Eastgate' series in sepia printed in Rochester. A good example of a Real postcard which was produced by a photographic rather than a printing process. In the Chatham area three presumed local photographers produced at least six series of numbered cards as brown prints, (which have survived the passage of time very well). W N, Eastgate, Naylar and W Naylar, Eastgate were from the same studio, Thornton & HJD show a close similarity of style, and the third was Ive and Lowe.

Collecting Sapper Postcards (1&2)

Photo 3. A Real photograph of a horse-drawn bridge pontoon. The original superior glossy finish has faded with age and being stored. The original black and white has changed to a dark sepia, so losing much of the clarity and detail. On some cards sepia was deliberately adopted as the card colour.

Photo 4. A Militia Christmas card of the First World War. It was at this time that silks were produced. Usually an embossed postcard showing a regimental badge with a simple often personal text. The detail of both the badge and the message were picked out in fine coloured silk thread. During the Great War there seems to have been little or no attempt to institute control of sales, and photographs of military equipment, camps and even war-damaged bridges or towns were freely available.

Collecting Sapper Postcards (3&4)

Photo 5. Engineers Ballooning, Long Valley Aldershot—one of an early Valentine's Series with the words "Souvenir Post Card" printed on the back. Ballooning is one of the rarest of Sapper post card subjects and not easily found. Other aspects of the Corps featured on post cards are Steam Traction, early forms of Wireless Telegraphy, Sea Mines, Field Telegraph, Cable Laying and of course Bridging in all its forms.

Photo 6. A true modern—from 'War in the South Atlantic' published by Prescott-Pickup and Company Ltd—the work of clearing mines begins. Moderns depict a wide variety of subjects using the latest printing techniques. They sometimes take the form of revival of older cards but often show contemporary social or political events or recent military campaigns such as this one.

Collecting Sapper Postcards (5&6)

Royal Engineers Parachute Team 1986 Army Parachute Champions

CAPTAIN I ROSENVINGE RE

Captain Rosenvinge was educated at the Royal Grammar School in Newcastle finishing his 'A' levels at the North Tyneside College of Further Education before joining the Army in August 1976. He completed an 'O' Type engagement with the Training Regiments at Cove before starting Sandhurst in January 1977. His first tour was with 9 Parachute Squadron RE with whom he saw service in Belize and Germany. He took up sport parachuting seriously whilst at RMCS Shrivenham before being posted to 25 Engineer Regiment in Osnabruck. Whilst serving in BAOR he organised three service parachuting expeditions in Florida. He was posted to the Junior Leaders Regiment RE at Dover in September 1983 where he organised parachuting as an extra mural activity introducing over 300 individuals to the sport in the first year of operation. Captain Rosenvinge is now 2IC of 8 Field Squadron RE where he has been since June 1985. In September he captained the Army Parachute Team that won a Gold Medal in the National Parachute Championships, beating the Royal Marines in the 4-man team Canopy Rotation Event. Last year he captained the Corps Team to victory in the Army Championships. He has now decided to retire from Corps competition parachuting and hopes to represent the Army at the World Championships, to be held in Brazil during September 1987, before settling down to concentrate on a career as a staff officer.

It may not be widely known that the Corps Parachute Team had outstanding success in the 1986 Army Championships. This short article gives the background to the competition in a sport which is growing in popularity.

Background

Corps preparations for this years Championships began in the Spring with regular weekend training taking place at both the Army and Headcorn Parachute Clubs. This meant considerable commuting for many Corps skydivers, and as it was to turn out mainly at their own expense! (Units please note that an authority exists for Corps sport—for parachuting it is A6300B). Some of our squad members travelled from as far afield as Ripon and in some cases BAOR. By the end of June 1986 team selection was finalised and two training camps organised for the two weeks immediately prior to the Army Championships. Our senior team trained at Avignon Pujaut in France utilising the services of Rob Colpus (ex National Team Captain) as coach and Malcolm Woodgates as an in air video cameraman. The remainder of the Corps squad trained at Headcorn Airfield in Kent.

Composition

The Corps entered a squad of thirty sappers into the 1986 Army Parachute Championships—by far the largest contingent at the meet. In all there were 204 competitors forming 40 accuracy teams, 35 relative work teams, 8 canopy relative work teams with 171 individually entering the Style and 199 the Accuracy events. The Army run

Captain I Rosenvinge RE

Photo 1. RE Parachute Team training near Avignon for the Army Parachute Championships 1986. From left to right: Sapper C I Lynch, Captain I Rosenvinge, Sergeant P Osgood and Staff Sergeant S J Clarke.

an Open as well as a British Army competition at the same meet and had invited many foreign nations to participate as well as the Royal Navy, Royal Air Force and Royal Marines. The foreign teams included the American Army Parachute Team—the Golden Knights (current US National Champions), the German Army, Belgian Army, Spanish Army, Sultan of Oman's Armed Forces and an all-Chinese Team from Hong Kong. Within the British Army the Corps opposition included the Parachute Regiment's Red Devils who fielded two teams (one who had for some months been in full time training), the REME whose individual team members had more jumps than two or three of ours added together, the JSPC at Lippspringe, Light Division, Scottish Division and Royal Artillery who fielded virtually full time teams that had been together for some time. It should be noted that only one of our winning team members could be considered to be employed full time in parachuting—that is Sergeant Osgood the Corps Display Team Leader who also instructs our junior soldiers to parachute as a programmed activity at Dover.

Performance

There was no doubting the talent within the Corps squad, our preparation had been comprehensive and if we could keep our competition nerves we were up to competing with the recognised big three; the Red Devils, RA and REME. The same nerves had played an important part in our poor results in the 1985 Army Championships and as it turned out were to do so again in 1986. In Round One of the team accuracy event we scored a team total of 2.43m compared to a Round Two team total of only 7cms! This was to be the only team event in which we did not take a gold medal. By the end of the meet the Corps squad had won six gold medals at senior level, one at intermediate and had taken first, second and third places in both the novice and junior trophies.

Event Disciplines

Canopy Relative Work (Rotation). This involves linking the canopies together into a quadruplane to score the first point. Subsequent points are scored by removing the top canopy from the formation and redocking on the bottom. A three minute working time is allowed and four jumps undertaken.

Sequential Relative Work. A free fall event where the jumpers execute links between them to make a formation. One point is scored for each complete formation undertaken. Thirty-five seconds working time is allowed, complete separation must be shown between formations and eight jumps are undertaken.

Accuracy. The aim is to register the lowest score. A score is a measure of the distance landed from a 5cm disc. An electronic pad is used to measure the first 15cms. Team totals are added together and eight rounds completed.

RE Parachute Team 1986 (1)

Style. A series of loops and turns are performed in free fall. The competitor to complete these in the lowest times over three rounds is the winner.

Overall Army Champion Team Trophies. These are decided on a squared placing system. The definition of the term "placing" was to be the bone of contention over a full three days, depending upon the eligibility of certain teams and whether guest teams should be included in the reckoning. As the placings were to be squared and added to determine the Champion Team the effect foreign and ineligible teams could have on British Army team placings was to be crucial. One interpretation saw the Gunners believe themselves to be Army Champions. The official interpretation saw the Meet Director declare the Sappers Army Champions. This latter decision was to be reversed by the APA Chairman, having taken advice from an inner quorum of the APA committee. A full committee meeting then reversed that decision declaring the Sappers once again to be the Army Champions! I believe this decision to have been the right one on the premise that foreign team placings should not be allowed to determine the British Army Championships!

ANNEX A

RESULTS

CANOPY RELATIVE WORK (ROTATION)

Army Event	Gold	Senior A Team
Open Event	Gold	Senior A Team

Note—No intermediate, novice or junior class in this event.

SEQUENTIAL RELATIVE WORK

Army Event	Gold	Senior A Team

Note—No open event: had there been, Corps team would have been placed third behind the Golden Knights "A" and "B" teams. There was also no intermediate, novice or junior class in this event.

ACCURACY

Senior Event	5th	Senior A Team
Intermediate Event	Gold	Sapper K Gallagher 38 Engineer Regiment
Novice Event	1st	Lance Corporal Farrell 8 Field Squadron
	2nd	Sapper Omand 8 Field Squadron
	3rd	Lance Corporal Hammil 6 Field Support Squadron
Junior Soldiers	1st	Junior Sapper Grundi Junior Leaders Regiment RE
Silver Stars Trophy	2nd	Junior Sapper Reid Junior Leaders Regiment RE
	3rd	Junior Sapper Small Junior Leaders Regiment RE

Note—No team events at intermediate, novice or junior levels

STYLE

Senior Event		Lance Corporal Wagstaff entered but was unplaced
Intermediate Event	Silver Medal	Sapper K Gallagher 38 Engineer Regiment
	4th	Lieutenant Stevens 22 Engineer Regiment
	6th	Sapper Yeo 22 Engineer Regiment

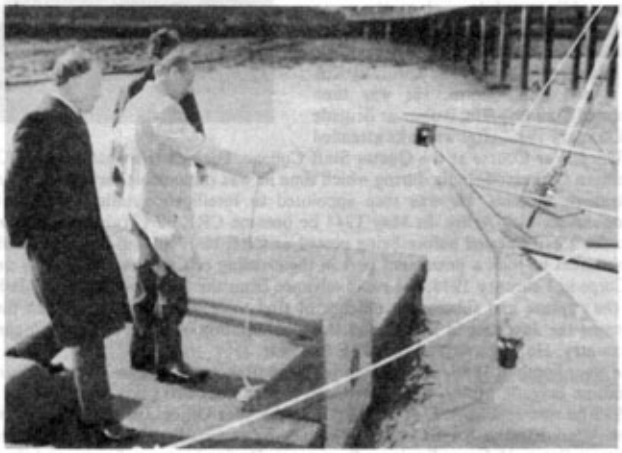
Note—There was no novice or junior class in this event

OVERALL ARMY CHAMPION TEAM TROPHIES
The official results are recorded as follows:

a. Army Champion Team	RE Senior A Team	Captain I Rosenvinge 22 Engineer Regiment Staff Sergeant S J Clarke 42 Survey Engineer Group Sergeant P Osgood Junior Leaders Regiment RE Lance Corporal S P Wagstaff 33 Engineer Regiment EOD Sapper C I Lynch 22 Engineer Regiment
b. Best Team Outside Airborne Forces		
c. Best RE/RA Team		

* * * * *

HRH The Duke of Edinburgh Names the New REYC Yacht



ON Friday 27 March 1987 HRH The Duke of Edinburgh—in his capacity as Patron of the Royal Engineer Yacht Club—honoured the Club by carrying out a naming ceremony for the new yacht. The ceremony took place at the Lower Upnor Hard after a formal luncheon in the Chattenden Officers' Mess with REYC members, Corps dignitaries and staff of the RSME.

At Upnor the Mayor and Mayoress of Rochester, and various REYC members and wives, were presented to HRH prior to the actual ceremony. The yacht—a Sadler 34—was formally named *Right Royal of Upnor* with the traditional breaking of a bottle of champagne across the bow. The Corps Band were in attendance to provide the appropriate musical accompaniment for the occasion.

The REYC is amongst the first of the Service Yacht Clubs to purchase a Sadler 34 as the "one design" recommended by the Army Sailing Association. After her naming ceremony, *Right Royal of Upnor* was returned to her base at Whale Island, Portsmouth, from where she is now available for racing and charter.

HRH The Duke Of Edunburgh Names
The New REYC Yacht

Memoirs

MAJOR GENERAL T H F FOULKES CB OBE MA MICE

Born 29 May 1908, died 29 December 1986 aged 78

THOMAS HERBERT FISCHER FOULKES, the son of Major General C H Foulkes, CB, CMG, DSO was educated at Clifton College, the Shop and St Catharine's College, Cambridge.

He was commissioned in the Royal Engineers in February 1928 and after courses at the SME, Chatham, and at Cambridge, went to India in early 1931. PAE remembers: "What struck me almost immediately was the speedy way he 'understood the problem'. Although speaking then little Urdu he quickly 'got on' with the Indian soldiers and in a short time was genuinely popular with them". He served continuously with the Royal Bombay Sappers and Miners until 1938, mainly at Kirkee, Wana and Quetta. He was then appointed Staff Captain, Peshawar Brigade until January 1941, after which he attended the Third War Course at the Quetta Staff College. For nearly a year he was SORE 2, Eastern Command, India during which time he was responsible for siting a number of strategic airfields. He was then appointed to Intelligence duties as GSO 1 at Headquarters 14th Army. In May 1944 he became CRE 39 (Training) Division in India for a brief period before being posted as CRE to 17 Indian Division in which appointment he took a prominent part in the crossing of the River Irrawaddy under IV Corps in February 1945, the rapid advance from the Gangaw Valley to Meiktila and the capture and subsequent defence of that town, the operations which finally overcame the Japanese in Burma and the rehabilitation of the south-eastern part of the country. He was awarded the OBE in 1945.

He went home in 1946, after fifteen years' continuous service in India and Burma, to become Brigade Major, SME, at Ripon for the next two years. Towards the end of 1948 he was appointed GSO 1 (MT2) at the War Office. In 1950 after a course at the Administrative Staff College at Henley he assumed command of 35 Engineer Regiment (later, 35 Corps Engineer Regiment). During his tour of command the unit prepared to take part in a number of planned operations in the Middle East and was involved in a series of emergencies in the Canal Zone. In 1953 he was promoted Colonel and given command of 25 Engineer Group (TA) in the UK. Two years later he was appointed Colonel AQ, North West District, and a year afterwards became CCRE, 1 British Corps in BAOR for a few months, as a temporary Brigadier.

His next appointment was Chief Engineer MELF in March 1957, and eighteen months later he became Chief Engineer Southern Command, UK. Finally, from April 1960 to July 1963, he served as Engineer-in-Chief, War Office, a period of great change in the Armed Forces. During his tenure of this appointment he was able to visit almost every unit, detachment and establishment of the Corps throughout the world, and received a CB for his services. DWC writes: "I was Chief Engineer Canadian Army when General Foulkes was EinC. During those years and later I held him in the highest regard, with affection and respect. His judgement and his understanding coupled with his experience and his gentle sense of humour were of

Major General T H F Foulkes CB OBE MA MICE

significant benefit to me. He became a most trusted friend and I sincerely believe I benefited more from my associaton with General Foulkes than with any other senior officer". He retired on completion of this appointment on 1 August 1963.

He always took a very active interest in regimental games and sports and played in many unit teams in India. But his keenest interest was always in shooting with rifle and scatter gun; and this and a certain wanderlust took him to such remote places as Northern Kenya in 1932, Hungary in 1934 and the furtherst parts of Ladakh and Chitral in 1936 and 1939, as well as to many of the jungles and snipe *jheels* of India.

On retirement he played an active part in local politics, becoming a very respected Chairman and then President of his local Conservative Association. He was also an active member of the Livery of the Worshipful Company of Plumbers, succeeding to the Mastership in 1973.

When, in 1963, he was appointed a Colonel Commandant, he followed in the steps of his father then still alive, and took quiet pleasure in the fact that both of their names appeared on page 2 of the *List*. During his tour as Colonel Commandant he was a very active President of the Institution from 1965 to 1970.

He married, in 1947, Delphine Smith who survives him with their two sons, one of whom is now serving in the Corps.

PCS, PAE, DWC

LIEUT GENERAL SIR ALEXANDER CAMERON KBE CB MC

Born 30 May 1898, died 25 December 1986 aged 88

ALEXANDER MAURICE CAMERON came from a family with a strong military tradition. His father was a Sapper (and later, Crown Agent for the Colonies); his grandfather died of wounds in command of the Black Watch during the Indian Mutiny. He himself was commissioned into the Corps in 1916 but had to wait until he was nineteen years of age before he could be sent on active service. He joined 200 Field Company in 1917 and took part in the third battle of Ypres in which he was wounded and awarded the MC.

In 1918 he went to India, joining 54 Field Company, Bengal Sappers and Miners, and almost immediately found himself on active service again, this time in Persia and later in Iraq. In 1919 he was mentioned in despatches and by the time he returned to UK in 1921 for his Supplementary Course he had had a spell in command of 8 Field Company. Postings then followed as Adjutant 46 (North Midland) Divisional Engineers (TA) and SORE Western Command until he went to Staff College at Camberley in 1928. After a year as Garrison Engineer in Jubbulpore he went to 6 (Lucknow) Infantry Brigade initially as staff captain and taking over as brigade major in 1933.

In 1935 he returned to UK and then began a period of ten years in which he was employed almost continuously in anti-aircraft defence, first as OC of a company in a searchlight battalion (this tour included an attachment to the Royal Navy in the Mediterranean); and later in a series of appointments on the staff and in command. Promotion came rapidly and he ended the war as a major general having commanded

Lieut General Sir Alexander Cameron KBE CB MC

6 AA Group, which covered the invasion fleet on the South Coast; and finishing as Chief AA Defence SHAEF. It was during this time that he started tests on building an Allied version of the V2 rocket. After the war a group under his command took over the Krupp works at Cuxhaven and assembled rockets from the parts they found, carrying out tests using the German rocket troops.

In 1945 he was appointed DQMG at the War Office and remained there for three years until he went to GHQ MELF as Major General, Administration.

He was a popular figure amongst the society of GHQ which lived in the somewhat closed community surrounded by the barbed-wire perimeter fence of Fayid. He and his wife (whom he had married in 1922) entertained generously, often with musical evenings in which Lady Cameron took a leading part.

Beneath the genial exterior of the General there lay high intelligence and considerable determination. Thus the personnel and logistic problems of a vast command were managed quietly and successfully. He also did much to relieve the monotony of life in the Canal Zone for all ranks by inaugurating such matters as visits to Cairo and leave camps in Cyprus.

His last tour in the Army was as GOC East African Command. He took up his appointment in 1951 and directed operations against the Mau Mau rebellion which started in 1952. He was appointed CB in 1945 and a KBE in 1952.

After his retirement from the Army he became Director of Civil Defence for the South Eastern Region, based in Tunbridge Wells, a post he held from 1955 to 1960.

CLR, WMB, JCC

BRIGADIER C R NICHOLLS CBE BSc FBIM

Born 26 June 1911, died 30 July 1986 aged 74

CECIL RAYMOND (CHARLES) NICHOLLS was commissioned into the Corps in 1933 obtaining his regular commission from the TA a year later. His first posting was to 1st Anti-Aircraft Searchlight Group in Egypt and Palestine where searchlights were being used in the ground role against terrorists. He remained with anti-aircraft until the outbreak of war when he was posted as Adjutant of 6 Training Battalion RE. Staff College and two staff tours then followed until he took 55 Field Company to Normandy on D+1 in 15 Scottish Division and on through France, the Netherlands and Germany until very nearly the end of the War in Europe. In 1945 he went to the Quetta Staff College as a member of the directing staff following a brief period in the jungles of Burma, with 14th Army. Post War appointments were in UK, Malaya, Gibraltar and BAOR. He was a GSO1 in General Templer's headquarters in the Malayan Emergency, an appointment which he described as, "the most interesting job of all". After a brief tour in command of the Depot Regiment at Barton Stacey he went to Gibraltar as Chief Engineer, returning in 1959. His last five years on the Active List were spent as Director of Pioneer and Labour in BAOR and the War Office. He was appointed CBE in 1965.

Charles Nicholls retired to Hatherden in Hampshire and then began his second

Brigadier C R Nicholls CBE BSc FBIM

career as an RO Author at Middle Wallop. DN writes: "For the next eleven years he was a familiar, well known and friendly face at Wallop. He 'assimilated' Army aviation and by diligent study and a willingness to listen to all and sundry, to attend exercises and study periods whenever possible, he very soon came to know as much about the tactical side of Army Aviation as many much more experienced and serving aviators. He patiently wrote, compiled and amended again and again the embryo Army Aviation pamphlets that he had prepared, until they were honed to the perfection that he demanded and until they could stand the ruthless test of his own logic. In the mid 1970s they were finally ready for their birth and the first nine Army Aviation pamphlets were lovingly seen through the printers and published. He was the most approachable of men who in his period in the directorate became a focal point to which officers of all ranks would bring their ideas, theories and problems. Always sure that they would get a good and friendly hearing, they would leave having benefited from his great experience and penetrating intelligence."

He leaves a widow and one son to whom we extend our deepest sympathy.

DN, REJ

BRIGADIER P R ANTROBUS CBE MC DL BA

Born 15 August 1898, died 29 July 1986 aged 87

PHILIP REGINALD ANTROBUS was commissioned into the Corps in 1917. He had been educated at Winchester and at Cambridge University where he obtained a first class honours degree. He was one of that group of Sapper officers who joined RE Signals early in their careers and remained in Signals until the formation of the Royal Corps of Signals.

He went to France in 1918. His active service there, attached to a number of different signals companies, resulted in the award of the MC and promotion to Lieutenant.

In 1919 he went to India and from there was posted to Mesopotamia initially commanding a cavalry brigade signal section and later the District Section in Baghdad. After the formation of the Royal Signals he reverted to mainstream Royal Engineers. It was then that he took his degree at Cambridge and subsequently attended the E & M course. However, thereafter he never again served in a Sapper appointment. By the beginning of World War Two he had attended Staff College and filled two appointments (one in India) and he served for the whole of the War in the War Office as Principal Priority Officer.

After the War he retired from the Army and joined the Control Commission for Germany and Austria based at Norfolk House in London. During this time he was awarded the CBE (civil).

He was appointed Deputy Lieutenant of Hampshire in 1965.

He leaves a widow to whom we extend our deepest sympathy.

REJ

LIEUT COLONEL G G S CLARKE, DSO OBE

Born 12 July 1901, died 16 November 1986 aged 85

GEOFFREY GERALD SEYMOUR CLARKE was born in India and educated at Haileybury and the Shop. He was commissioned into the Corps in 1921 and served several years with the Royal Bengal Sappers and Miners, being employed on a wide variety of civil engineering projects. After some leave in 1932 he was posted to the UK, and promoted captain. In that year he had a personal experience of conversion to a living faith in Jesus Christ; and in the same year he met his future wife, Dorrie Fear. They married in 1934.

He served as DCRE Bordon for three years, then as a staff captain in the War Office branch responsible for the Military Hutting programme for a further three years. His article "Hutting the Militia" was published in the *RE Journal* in December 1985. In 1939 he joined Military Works Services in the BEF and this was followed by a short spell as Intelligence Officer RE at 2 Corps Headquarters until Dunkirk in May 1940.

In the confusion, some 'red tape' delays prevented his intended embarkation on *HMS Grafton,* which was torpedoed and sunk, with the loss of lives of many of his colleagues. He himself was safely evacuated on a fishing vessel.

There followed several staff jobs in England, and in 1941 he was promoted Major, to be OC 253 Field Company. In 1942 he was appointed CRE 53 (Welsh) Division, serving under General Montgomery.

During operations after the Normandy landings his unit was involved in building many tactical bridges; during one of these operations his reconnaissance under fire led to the award of the DSO. Wounded at s'Hertegenbosch in October 1944, he was sent home, and served at Portland until 1946, when he was posted to Egypt, and served there and in Palestine on the staff of MELF.

In 1949 he retired early, as he felt called by God to take on from Colonel Macaulay as General Secretary of what is now the Soldiers' and Airmen's Scripture Readers Association, in which capacity he served faithfully and effectively for twenty-one years. He was a member of the General and Executive Committees of the Officers' Christian Union for over twenty years, and was Chairman of their Missionary Committee. His other Christian activities included Chairmanship of the Evangelization Society, and membership of the Council of the Central Asian Mission.

HAT J-K writes "I knew him best during his period as General Secretary of SASRA, and we on the Council came to rely very much on the wisdom given to him, and valued his detailed and forthright presentations, and 'staff work'. He laboured unflaggingly to further the twin aims of the Association, to win Service men and women to faith in Jesus Christ, and to build them up in that faith. These aims stemmed from the Army Scripture Readers Society, and the Soldiers' and Airmen's Christian Association, which had been merged to become SASRA. Colonel Clarke did much to weld these organizations together. His special contribution to the work, under the wise leadership of the late General Sir Arthur Smith, was to further the co-operation and support of the Service Authorities and Chaplains Departments in official recognition of the Association. This involved very careful drafting of the official Charters, with frequent visits to the Chaplains Departments, and to Com-

Lieut Colonel G G S Clarke DSO OBE

manding Officers. In the meticulously planned discussions, his firmness and tact won the respect of the Chaplains; and his military background was a great asset in his visits to Commanding Officers to introduce Scripture Readers to their stations". It was fitting that at the end of his period of service for the Association he was awarded the OBE.

Our deepest sympathies go to his widow and family.

HATJ-K

BRIGADIER P J KENT OBE

Born 6 March 1915, died 24 January 1987 aged 71

PETER JAMES KENT was educated at Eastbourne College. He was commissioned into the Corps in 1938 as a Lieutenant, and was posted to 16 Fortress Company RE (AA Searchlight). As reinforcements reached Malta at the beginning of the War a Gunner searchlight regiment was formed which took 16 Fortress Company under command. Peter Kent was appointed OC and, resisting all attempts to rebadge his unit, remained with them during the hectic days of the siege. In early 1941 when *HMS Illustrious* came into harbour German air-raids of up to a hundred aircraft were taking place day and night. Despite a number of casualties 16 Fortress Company maintained a far higher percentage of illuminations than the batteries.

In March 1942 Peter Kent relinquished command of the Company, having seen them through the most demanding period of their history and joined the CRE Works in Egypt as a garrison engineer for a short time before taking part in the invasion of Sicily. He returned to UK after seven years overseas and joined 282 (Welsh) Field Company in North West Europe in 1944. He was wounded and evacuated from Germany in 1945.

After a spell as Chief Instructor with 9 Training Regiment, he was posted to Palestine as DAA and QMG Gaza Sub-District and then, in 1948 returned to Malta for two years as DAAG and DCRE.

In 1950 he joined JIB in London in what was to be the first of several appointments in Intelligence as a result of one of which he was awarded the OBE in 1959. He was a natural choice for service as an attaché and spent two years in Athens during the Colonels' regime retiring in 1969. In between these two appointments he filled an intelligence staff appointment in HQ LANDCENT at Fontainebleau.

After retirement from the Army in 1970 he took up the post of Works Bursar at Charterhouse School where his principal task was to set up and apply a preventative system of maintenance for the School buildings (housing 700 pupils) built a hundred years ago. For the next ten years he carried out this job on a strictly controlled budget, combining the upkeep of the main buildings with another fifty flats and houses owned and occupied by the School. During this time close on half the School was rebuilt from new and as each new building was completed so he took on its maintenance coincidentally with the sale of the old blocks outside the curtilage.

His previous experience and technical expertise equipped him well for this work. He dealt almost exclusively with schoolmasters, an esoteric skill which he gradually acquired and where his tact, diplomacy and sense of humour were all well tested and invaluable.

He retired aged sixty-five in 1980 when his talents were at once seized upon and he was appointed Warden of Guildford Cathedral.

There he did a magnificent job from 1980 to 1984 and was instrumental in picking up the backlog of repairs and maintenance to the Cathedral and house which had built up. He took his bag of tools with him on his morning rounds and dealt on the spot with minor repairs that needed doing. He was always cool and efficient, but always helpful and charming.

It is apt that a summary of Peter Kent's attributes comes from a non-Sapper: "He was in every way an outstanding officer who combined a keen and penetrating mind with infinite kindness and helpfulness to all he met. Goodheartedness, loyalty and integrity seemed to shine out of him. Blessed with so many talents, he was unfailingly modest and considerate and his cheerful sense of humour resolved many a difficult situation".

In Malta in 1940 he married Geraldine Edgar who survives him with their son and daughter to all of whom we extend our deep sympathy.

KFD, JCD, JC, DS-P, IRB

PROFESSOR N E ODELL PhD MIMM FGS FRSE FRGS

Born 25 December 1890, died 21 February 1987 aged 96

Professor N E Odell PhD

The Corps is rightly proud of its strong mountaineering traditions. Sapper officers and soldiers register strongly in the leading ranks of the Joint Service and Army Mountaineering Associations; their involvement in any service mountaineering expedition is taken as a matter of course. Mountaineering is an inspiring and spiritually lifting way of life that encourages the principles of courage, daring, endurance, intelligence and individuality required of our best sappers. This combination of quality was clearly reflected in Professor N E Odell, one of the outstanding mountaineers of his generation.

We are indebted to The Times *for the remainder of this memoir* "Odell served in the Royal Engineers throughout the First World War and was wounded three times. During the Second World War he joined up again and saw service in the Bengal Sappers and Miners.

"Noel Ewart Odell was born on Christmas Day, 1890, the son of a clergyman, and educated at Brighton College and the Imperial College of Science and Technology. He then went to Clare College, Cambridge.

"A professional geologist, he acquired his field experience in Persia in the 1920s and later held a number of academic posts, mostly in overseas universities within reach of mountain country. He managed with singular success to combine the tasks

of a geologist with the pleasures of mountaineering, and will be chiefly remembered for his part on the 1924 Everest expedition. He was the mainstay of the support for the assault parties, and established new records, climbing once to 25,000 feet and twice to 27,000 feet on lone ascents in search of Mallory and Irvine, who had been lost on their way to the summit. He returned a hero, and was received in private audience by George V.

"He was university lecturer in geology and tutor at Harvard University from 1928 to 1930.

"His performance on Nanda Devi in 1936, when he and H W Tilman reached the hitherto unclimbed summit (25,645 feet), so impressed Tilman that he picked him as one of his small Everest team in 1938. Eric Shipton, also on the 1938 expedition, and Tilman had long maintained the superiority of small, lightly-equipped parties for Himalayan exploration, but in 1938 an early monsoon prevented a serious attempt on the summit, and so the chance of proving their point was lost. (The debate was to continue until Hunt's highly organized and successful expedition of 1953 rendered the argument academic.) Odell was disappointed by the lack of scope for geological research afforded by Tilman's 'shoe-string' expedition; and the theft of the box containing his geological specimens, followed by the loss at sea in 1941 of his Himalayan notebooks, prevented his ever completing his studies of Himalayan geology as he would have wished.

"In 1944 he received the Livingstone Gold Medal of the Royal Scottish Geographical Society for 'services to exploration in Spitsbergen, Canada, North Labrador, Greenland, Nanda Devi and Mount Everest'.

"His last academic post was a professorship at Peshawar University, Pakistan, from 1960 to 1962, after which he retired to settle in Cambridge.

"He was a familiar figure at both the Alpine Club and the Royal Geographical Society. He was made an Honorary Fellow of Clare College in 1983, an event which much pleased him.

"Three years ago, at the age of 93, he was at the Britannia Hut in the Alps, making the ascent by cable car, but the last part of the trip involved a half-mile glacier crossing. He retained into old age his earnest enthusiasm, and the tall, spare figure and purposeful gait which had carried him to record heights on the earth's surface.

"He married, in 1917, Gwladys Jones, who shared his passion for the mountains. She died in 1977. There was one son of the marriage."

Lord Hunt later wrote to The Times:

"All who knew Noel Odell and especially those of us who had climbed on Everest, will hold in affectionate memory this lean, clear-eyed, keen-minded elder statesman among climbers.

"He seemed to have the secret of unending youth, and he endeared himelf to the younger generations through his active interest in their aspirations and achievements.

"I recall that, in 1941, while recovering in Catterick Military Hospital from a climbing accident in Snowdonia in which I had fallen 120 feet. I received a surprise visit from a smart, soldierly if also middle-aged lieutenant in the Royal Engineers, who was stationed nearby.

"He saluted as he stood to attention at the foot of my hospital cot. My astonishment at this form of deferential greeting from one of my climbing heroes, albeit that I was a captain at the time, was quite considerable.

"It was typical of his modesty and quiet humour."

RM

(*Photograph courtesy of Times Newspapers Limited*)

COLONEL W T CALVERT

Born 15 July 1911, died 14 November 1986, aged 75

WILKIE TELFER CALVERT was commissioned into 26 YO Batch from Bradfield and The Shop in August 1931. He was one of four Sapper brothers; Brian, the eldest, was commissioned in 1924, the other three maintained an unbroken Calvert presence at The Shop from August 1928 until December 1932, a remarkable record. Wilkie Calvert completed the usual courses at Chatham and Queen's College, Cambridge, where he played hockey for his College and was a great swimmer and a virtually unsinkable water polo player. His first posting from Chatham was to 10 Railway Company at Longmoor for a railway course, which set him off on his career as a Railway Sapper. In 1937 he was posted to Palestine to take command of the detachment of 8 Railway Company working with the Palestine Railways. Their role was to help keep the railway running in the teeth of persistent Arab sabotage, a task which kept all ranks pretty busy.

In 1938 he returned to Longmoor, and on the outbreak of war became Adjutant of 8 Training Battalion, training some 2000 recruits for Transportation units. In early 1940 he was promoted major and given command of 165 Railway Survey Company, operating briefly in France before being evacuated through Cherbourg. In January 1941 he was posted to the Middle East as DAD Tn, Haifa but almost immediately found himself in Eritrea taking over 10 Railway Company, following the death of the previous OC in tragic circumstances. At the end of the campaign Calvert brought the Company back to Egypt, and served with them for the next eighteen months in the Western Desert. From there he was posted to India, but was soon recalled to the Mediterranean Theatre to command a Railway Construction Group in Sicily and then Italy. Anyone who served in the Italian campaign will remember the comprehensive destruction of the railways carried out by the Germans, and can imagine the magnitude of the task faced by Calvert and his Railway Sappers.

In early 1944 he was transferred to Allied Force HQ, and while at Caserta served for a time as AD Tn to the Military Liaison Staff, Yugoslavia. January 1945 saw him back in the War Office, but six months later he was on the move again, this time to Singapore as AD Tn (Railways). From there he moved to HQ East Africa Command as SORE (Tn), and in 1948 he returned to Longmoor to command 8 Railway Company. Promoted Lieut Colonel in 1951 he became Second-in-Command of No 1 Railway Group, and then abroad once more, to command the Middle East Transportation Regiment. He returned home for the last time in 1955, commanding the AER (Tn and MC) units before becoming Deputy Commandant of the Transportation Training Centre. In 1959 he was posted to the War Office as Colonel E4 (Tn), from which appointment he retired in 1963.

Calvert married in 1945, but his wife, Jean, died in 1964. In 1967 he married Moira Phillips, and they then moved from Longmoor, where he held a retired officer appointment, to her family home at Ewelme in Oxfordshire. Here they set up a contract gardening business, among many successful contracts being one for providing the floral arrangements for the Stewards' Enclosure at Henley, which they did for fourteen years. They played a full part in village life, both being members of the

Colonel W T Calvert

Parish Council. Wilkie also served as Churchwarden for twelve years and was Chairman of the Parochial Church Council for three years. The Rector of Ewelme writes: "He was scrupulously fair and firm, if somewhat self-effacing. On matters of principle he was solid as a rock and he was a good man to turn to for advice. One did not look for profound wisdom, rather straightforward common sense, and it was never lacking. There was something immensely re-assuring about his friendship and support". Never one to push himself forward, Wilkie Calvert attracted esteem and affection from all who knew him, as was witnessed by the very full congregation at his memorial service in Ewelme Church, which included eight of the ten survivors of 26 Batch (the other two being out of the country).

GWD

MAJOR GERALD SHEPHERD TD C ENG MICE

Born 30 January 1920, died 26 December 1986, aged 66

GERALD (GERRY) SHEPHERD was educated at Duncan House School, Great Yarmouth and joined the Corps in 1940. He was commissioned at 140 OCTU RE Newark in 1943 joined 24 Field Company on their return from Malta, and subsequently served throughout the campaign in North West Europe being mentioned in despatches for his part in the Rhine crossing.

DRV, a brother subaltern in 24 Field Company writes "Gerry was not only a first class field engineer with considerable ability for original thought, he was also a good regimental officer who earned the respect of his men and the confidence of his equals and superiors. He was an excellent mess companion with a musical talent which ensured that a *collaborateur's* grand piano given to the Company in September 1944 by the Mayor of Chambray-sur-Eure became a treasured item of the G1098!"

Demobilised in 1946, he devoted twenty-one years to the interests of the Territorial Army, firstly at Norwich with 251 Field Park Squadron which he subsequently commanded and then with the 54 East Anglian Divisional Engineers, which later became 122 Corps Engineer Regiment. Gerald's long association with the TA merged well with his other great interest in sailing, and his yacht on the Norfolk Broads was never without the REYC burgee at the mast.

In civilian life Gerry joined the East Anglian Roadstone and Transport Company—later Tilbury Roadstone—becoming Director and Chief Engineer. There are few miles of East Anglian roads that do not bear testimony to his ability as a road-maker.

Gerry's death only two years after retirement is a great loss to his family and many friends.

We offer our deepest sympathy to his widow Lesley their son and daughter and two grandchildren.

WCW, RE, DRV

Major Gerald Shepherd TD C Eng MICE

Correspondence

A Technical Corps?

Brigadier F G Bevan, BA, MINucE
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Sir,—I welcome Stuart Campbell's article "Are we playing at being a Technical Corps?" in December's *Journal*, and the related letters that were published in the March issue, as a useful debate on an important subject—indeed, it is precisely because the subject is so important that the EinC devoted a major part of his last annual Conference to the question of Construction Engineering in the Corps. I trust that the major issues raised were passed on subsequently, particularly to our PQEs. But in any event, it is right and proper that there should be some official answer to the specific points raised in the *Journal*.

Let us put behind us once and for all the question of whether we need PQEs and their brother disciplines of GEs, Clerks of Works and our Plant Specialists in the Corps. Of course we do, and for four good reasons. First, we need them for our role in general war not only on the RAF(G) Airfields but also in the underestimated but potentially vital 'works for and in war' role particularly behind the Corps rear boundary. It is this role which is the prime justification to the rest of the Army for having professional engineer training. Secondly, we need their expertise in anything short of general war in Europe. The Corps could not have achieved the success it did in the aftermath of the Falklands, in its operational engineering construction tasks in Northern Ireland, nor in the other construction tasks at home and abroad, without them. Nor should we take for granted the contribution that our technical officers and NCOs make in NATO headquarters and in support of the PSA worldwide, particularly in our garrisons east of Suez. Since the last war both our combat and construction engineering capabilities have played a valuable and important part in the work of the Army; but it is the high profile of the construction engineering tasks which has made such a formidable contribution to the regard and standing which the Corps enjoys within the Services and the Nation. Thirdly, we need officers of chartered status to authorize our designs, to give credibility in our professional dealings with organizations such as PSA, and to provide links with the civilian engineering profession. The support and advice of the latter, covering the latest developments in design, materials and equipment, enable us to maintain the high standards that we achieve. Finally, few of us would wish to belong to a Corps which was confined to combat engineering. We need the technical element of our Corps for the part it plays in adding to the breadth and variety of our capabilities. It is this which helps to retain the interest of those within and to attract the high quality individuals who wish to join the Corps in the first place. We need our technical experts and let none doubt it.

Another often expressed view has been the need to improve the engineering knowledge and experience of officers in the Corps generally, and as a general aspiration I would support this, because in war it will be an officer's feel for engineering that will see him through when the equipment lets him down. However some of the suggested solutions have not taken other important issues into account. To take the four points put forward by Stuart Campbell:

1. *(Accept more engineering degree candidates for commissions).* We recruit as many high quality engineering graduates as we are able. Our current target is that a minimum of 60% of officer recruits should be graduates of engineering or related subjects. To set ourselves a higher target would entail lowering the overall standard of officer we take; we can only meet our recruiting needs by accepting a number

of other quality candidates, some with other degrees, some without: they are all a valued part of our officer corps. The emphasis is, and should remain, on overall quality.

2. *(Stop in-service degrees).* In-service degrees have a number of advantages and produce very good officers who might otherwise not join us. We would not wish to stop them and with our present difficulty in recruiting graduates it would be doubly harmful.

3. *(Employment after initial tour as troop commanders).* With the pressures of other training and commitments, second tour troop commanders are all too rare. The prospect of being able to send many more officers on one year attachments to civilian engineering firms is attractive; but for the foreseeable future we could not spare them the time to do so. In any case it would not be an adequate substitute for the PET course as he implies later.

4. *(Subsequent employment).* As he suggests, it has been our practice for some time to employ experienced captains as instructors at RSME, and we do this because it is important that they should have the relevant military experience. The individuals themselves gain considerable technical benefit from their instructional tours.

Some have suggested that most Sapper officers should become chartered engineers as part of their normal career: others that we should send officers to gain engineer experience rather than to Division I and II of the Army Staff Course. Such ideas have been examined but are simply not practicable; and indeed, in the latter case, there is a real danger that we would be seen as a narrow technical Corps not central to the mainstream of the Army, as has happened to engineers in other national armies. The right answer must surely be a balance between combat and construction engineering.

On the whole I believe this balance is achieved. Squadrons in the UK probably spend as much time on construction engineering as on combat engineering. In 1986, twenty-two of our squadrons, some of them from BAOR, were involved in construction work lasting one month or more. I do not accept that squadron commanders lack the engineering expertise to do anything but use combat engineering equipment, and nor would they.

However the construction engineering we do has limitations. Financial considerations, and our operational and training commitments, are such that in the foreseeable future we are unlikely to be able to undertake more squadron projects than we have in recent years, nor is there scope for larger projects. We are actively seeking an overseas squadron project of the sort we used to do for ODA, and we are also looking for multi-disciplined management team tasks similar to the RE SANG Team; but lack of funds, British and foreign, is clearly a problem. We will continue to press for such work. All this has meant that the projects we have done, although challenging and rewarding for the Corps at large, have not always sufficiently stretched or tested the very high technical ability of the PQE officer. When using other people's money, we have to get it right; a point made very clearly by Guy Kershaw. Our aim must be, therefore, to find tasks that will give our PQE officers a real sense of job satisfaction. We have examined the idea of attaching more officers to civilian engineering projects or of filling more posts with PSA. However, with a limited ceiling, and particularly with the current shortfall of officers, this would inevitably mean a significant reduction in the size of the MWF (and of its command structure). It would also cause a loss of flexibility in having a pool trained and ready to meet emergencies in peace and limited war. Thus while such attachments have their attractions, they also have serious disadvantages. An alternative solution is the MWF to undertake more consultancy work as an agent of the PSA or DMAO, and we are pressing hard for this.

Stuart, supported in Mike Cooper's letter, also raised the particular issue of our lack of an in-theatre fuels engineering capability in BAOR. I will not attempt in this reply to explain fully why that is so, but it is a longstanding problem which comes down to relative priorities in competing for manpower within BAOR ceilings. Recently our priority has been to achieve an in-theatre ADR capability, and this has now been approved. The fuels engineering problem is recognised and we have yet to find a

solution to it, but we have not given up. In the meantime, our very busy regular STRE (Bulk Petroleum) supported by our three STRE(V) must continue to provide this vital engineering support which cannot be found elsewhere in the Army or the RAF.

In conclusion, let there be no doubt that the Corps does have a demanding general engineering role and any of us may be called upon to play our part in it. We must take full advantage of any opportunities to practise it, but with all the constraints on training and the pressure on units, we are unlikely to be able to do substantially more than in recent years. Although what we have may not be ideal, the combination of field units and specialist officers and Clerks of Works has achieved some remarkable successes. There has been no requirement for a fundamental change in the PQE career structure because neither the Brooks report nor all the comment and discussion since has suggested a radical solution that was achievable and was better than the present system. Nevertheless, what it has done is valuable. It has focused our minds on the problems and highlighted a number of areas where improvements can be made. We are still working on some of them but be assured they have not and will not be forgotten.—Yours sincerely Frank Bevan.

(It may be noted that two senior officers in the Corps have achieved chartered engineer status without attending the long engineer courses. One is now EinC, the other is D EinC! Editor)

General Sir George Cooper, GCB, MC
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Sir,—I have read the correspondence about 'Are We Playing at Being a Technical Corps?' with some surprise. A perfectly sensible article by Major Campbell, with proposals for improving engineering standards in the Corps, seems to have aroused all sorts of self-doubts. Why is it 'time that the Corps decided if we wish or need to be more than assault pioneers only' as Lieut Colonel Speight states? Why does Major Guy Kershaw talk about 'the low standards of engineering within the Corps'? Why are PQEs 'increasingly disillusioned'?

Of course we are going to remain engineers. Like any other engineer, we specialise, and our particular expertise is military engineering, a much broader and, in many respects, far more complex discipline than other specialities. It demands very special talents and no little courage, especially in war. It demands combat engineering expertise based on a sound engineering background for which an engineering degree may be desirable but is certainly not essential. It demands initiative, common sense, drive and leadership. It *may* need extra technical expertise at times and for this we need specialists. We also need specialists for longer term projects in rear of the Combat Zone.

Above all, we need a multi-purpose Corps and that is what we have now. And our standing in the Army has rarely been higher. Other Arms envy us and respect us, so why are we having doubts? Of course it is healthy to debate our problems, discuss how many people we need of any particular discipline and whether we have the balance right, but to talk about whether we even need to be engineers is carrying the debate to extremes.

We pride ourselves on being the Corps of Royal Engineers. A Corps is a Team, and it takes a number of individuals to make up a team, each an expert in his own position. I believe we have a first class team, with great reserves, but if there are any doubters I suppose they can always put themselves on the transfer list (though civilian engineers also have plenty of problems!). However, in this RE 200 year, I believe we can look forward with confidence to remaining in the First Division and I see no one willing or able to challenge our position at the top of it.—Yours sincerely George Cooper.

Peter S Rhodes, CEng, FIStructE, FGS
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Co Down
Northern Ireland

Pooh Bah

Sir,—It was with interest and a lot of empathy that I read the article by Major M S Campbell and the letters of comment which it evoked. Having had the great pleasure of working with quite a number of CREs and their support staffs, as a civilian engineer I am tempted to offer a few words of comment.

Since the Second World War the British Army has advertised itself as 'The Professionals' and as the 'P' of PQE relates to the same word I suggest a definition of what is meant.

A "professional" is one who does that which he professes with the skill, care and diligence of an *average*[1] member of that profession, at any hour of the day or night and anywhere in the world. An "amateur", on the other hand, is one who may do as well as or even better than the professional, but only when he feels like it or has great good luck.

Within the general context of the article and the letters there are two kinds of engineering: military and civil and it appears that these two very different professions are slightly mixed up. Experience shows that people like Michaelangelo are exceedingly rare and that it is most unwise to consider either being or employing anyone who claims that he is fully professional in more than one specialised sphere of work. I suggest, therefore, that the Sappers should define exactly the professionalism which each *individual* is to provide and in peace time they should eschew all temptations to be enthusiastic amateurs in any other. Of course, in wartime circumstances it may be necessary for someone to perform outside his nominated profession and while there are very few Michaelangelos my experience is that we do seem to breed plenty of potential "Admirable Crichtons".

Both forms of engineering employ the same basic sciences, such as statics, mechanics, a little dynamics, hydrostatics, strength of materials and, of course, a modicum of mathematics, and training in all of these up to first degree level requires little or no difference to be made. I see no harm though very little advantage to the Corps if the aspiring military eningeer goes further to seek membership of one or other of the civilian Institutions but doubt if he could prove sufficient experience to gain entry to the Structurals. However, at that stage the ways *must* part because it is then that the real training begins.

It should be understood that a civilian engineer (I think of Structural or Civil) offers his highly specialised judgement for sale and in doing so accepts a considerable and rather awesome responsibility. If a professional decorator, for instance, makes a mistake his client is likely to get the wrong colour of paint or wallpaper but if an engineer, civil or structural, makes a mistake or an error of judgement someone is likely to be hurt or even killed. Beyond the obvious requirement of producing the works at correct first and maintenance costs the designer consultant has a great responsibility for safety and that responsibility is enforceable by the law of the land. Make such a mistake and one could find oneself in court, arraigned for manslaughter. That is why the specialised training and the gathering of experience in judgement takes so long after graduation. I know of very few Chartered Engineers who got to work entirely as principal much before the age of forty and that after some fifteen to twenty years of working under supervision in a quite limited field. It is also the reason why the good civilian engineer will always try to sleep on the problem before committing himself, his client and the public passing by, to an answer.

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[1] The client cannot expect to hire a miracle worker.

The consultant engineer offers his judgement. Calculations are an aid to judgement and the computer is an aid to calculation but good calculations do not automatically produce good engineering. Quoting from Major Campbell: "Engineering must be simple but adequate for the problem of the moment; it takes experience to know what is 'near enough'." In similar vein Lieut Colonel Hill refers to 'feel'. That quotation might have been taken almost word for word from one of my lectures to third year students or to my own staff but the point now to be emphasised is that *my* 'near enough' is not at all the same as that for a Sapper in wartime. I would have no 'feel' at all for a wartime structure of intended short life.

I have tried to indicate very briefly just some of the requirements for a civilian designer consultant, who might be asked to design a barrack block or other construction to be used in peace time. I am not competent to comment on the wartime military requirements. However, perhaps with tongue in cheek, I have never heard of any Sapper being arraigned for manslaughter because a bridge to carry troops across the Rhine failed some time later when they tried to come back.

Gilbert's Lord High Executioner was a specialist only in name, but I do urge my Sapper friends not to emulate The Lord High Everything Else. The Pooh Bahs of this world are potentially dangerous.

As a sort of postscript, I have long wondered about the possibilities of a career in civilian engineering after a Sapper retires from the Service and now suspect that many serving PQE officers have that thought in mind. However, apart from echoing the comments on length of time needed for devoted training to acquire sound judgement, that topic must be for another discussion.—Yours sincerely, Peter S Rhodes.

Colonel R M Stancombe, BSc(Eng), CEng, FICE
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Sir,—The March 1986 *Journal* provides an excellent insight into the scope and challenge of military engineering today. I have been fortunate enough during my service to experience a wide range of technical tasks from improvised/equipment/concrete bridging in Borneo during Confrontation, amphibious engineering in BAOR, marine works and road construction (as site agent) on attachments to civil industry; the whole gamut in Northern Ireland from button-on-fences (which my specialist team designed) to major fortifications at Forkhill and Crossmaglen (with Major Kershaw's help) to more recently, being the project manager of the new £100 million underground war headquarters complex for SACEUR at SHAPE (with Lieut Colonel Hill's help). I know that I have been luckier than some, but I do not believe that I have a monopoly on such experience. I am sure that many of my colleagues can tell similar, probably more impressive, tales and that we would all confidently claim to be competent military engineers. I do not agree with those who suggest that we are playing at being a technical Corps.

I joined the Army to be a military engineer not a civilian engineer. When as a major I spent two and a half years interviewing potential sapper officers as the EinC's Recruiting Liaison Officer (ERLO) even during that period and with my experience and qualifications, I was unable to boost the numbers of Royal Engineer Officers with a true 'engineering bent' to raise the overall level of engineering ability within the Corps significantly. I believe that my eminent successors as ERLO have had similar problems—indeed so does our nation. I am sure that others will confirm that it is very difficult to achieve the correct balance between technically competent (but sometimes dull) officers and those who brim with personality, but who probably struggled to get 'O' level Maths. However, I am in no doubt that the Corps is constantly striving to

achieve this balance. It is unfair and unwise to be too critical. It is also likely to be misleading and bad for recruiting.

My message, Sir, is that being a 'technically competent Corps' these days with the resources we get and the pressures in the modern army is always going to be difficult. There will be a premium on experience, especially in modern technology. My colleagues who plead for all Sapper officers to be more experienced in general engineering are absolutely correct to do so. We, especially those of us who are chartered military engineers, must continue to press for others to gain the sort of experience that we have accumulated—preferably under the stress and strain of operational conditions.

Nevertheless, I believe firmly that the present hierarchy of the Corps has got the message! In my view, we are unquestionably a technical Corps and will remain so, but it will be harder than ever to remain sufficiently competent.—Yours faithfully Mike Stancombe.

Captain M P Carter, RE
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RMA Sandhurst
Camberley, Surrey

Sir,—I read with interest Major Campbell's recent article in which he gave his opinions as to whether or not we are playing at being a technical Corps. Whilst I agree with his final conclusion in his final two sentences I do feel that I have to take issue with one of the preceding remarks in the article.

He states that "Any officer without physics or mathematics at 'A' level is unlikely ever to develop a better understanding of engineering principles than that acquired by a Class 1 Combat Engineer". I feel that this statement is not only patronising in its view of our Class 1 Combat Engineers but is also indicative of the general PQE attitude to those of us in the Corps without a scientific background. If I may quote Laurence Sterne from *Tristram Shandy*—"Sciences may be learnt by rote, but wisdom not".—Yours sincerely, M P Carter.

Major (Retd) A McLachlan
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Sir,—I read Major Campbell's article "Are we Playing at Being a Technical Corps" with ever-increasing enthusiasm, as he articulated my own thoughts so well. I hoped that it would generate some reaction, and in this I was not disappointed. It was interesting to see that the article won such acclaim in the heart of the Corps' technical expertise, 62 and 64 CREs; did it touch a nerve? I only hope that the promised comments from the Deputy Engineer-in-Chief will note the depth and breadth of feeling expressed in the letters and not try to brush the problem under the carpet.

One particular sentence in Lieut Colonel Spaight's letter may hold the key to the problem: "Only the few 'high flyers' will not have time to practice engineering on their way to senior rank". What an admission for a Technical Corps! Why should the Corps not expect all its officers to be capable of, and to achieve, Chartered Engineer status? As long as ever the attitude persists that it is not necessary to qualify as an Engineer, indeed positively harmful for a 'high flyer' to devote time to engineering, we will retain the perception of our Professional Engineers as 'second class' and will only play at being a technical corps.—Yours truly, A McLachlan.

L M Smith, BSc, PhD, CEng, MICE, FGS, RE(V)
R D Thomson, BSc, PhD, CEng, MIMechE, RE(V)
C W Hodgson, BSc, DipEd, RE(V)

71 (Scottish) Engineer Regiment (Volunteers)

Sir,—The recent correspondence on technical expertise prompts us to remind the 60% of the Corps who are Regular Army of the remaining 40% in the Territorial Army. A glance through the RE List will confirm that many TA Officers are highly qualified Engineers, as indeed are many TA Soldiers, but how often has the phrase "better brains than ours . . ." been heard at study periods and lectures. In many specialised areas there are no better brains than are available to the Corps from within the TA. It must surely be possible to make better use of this wealth of expertise which is largely untapped, except in the STREs and ESP, perhaps by the secondment of Professional Engineers as well as Professional Soldiers to RSME and elsewhere.—Yours faithfully, R D Thomson, L M Smith and C W Hodgson.

Emeritus Professor Sir Alan Harris,
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Sir,—"Leonardo Vinci" (the possessive article was yet to come) "was a handsome man. He certainly played the lute and sang very well. He also drew very finely. But he claimed not only to be an artist but a practical man and he wanted me to employ him as my military engineer. I gave him the job, though I never felt very happy about it—I prefer my engineers to be engineers, not engineering lute players. Vinci was never really a success. He certainly had an ingenious mind and a very fair amount of technical information but he was not reliable in the day-to-day details of his work and he had an irritating knack of making simple problems difficult. Instead of making good use of what was at hand, he always wanted to evolve something which, he was sure, would have been far better—if only we had it or could have spent six months making it. His ideas often looked good enough but I always had a feeling they would not have looked so good if he had not been a first-rate draughtsman."

Thus Cesare Borgia in Nigel Balchin's fictionalised biography *Borgia Testament*.

Verb sap—Yours truly, Alan Harris.

Management of Today's Sapper Officer

Colonel I T C Wilson, MBE, MC
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Sir,—Content of the March *Journal* made fascinating reading, balancing the Engineer-in-Chief's Report and engineer construction tasks in Northern Ireland and the Shetlands with correspondence about the Corps' technical expertise, and adding in Falklands War experience, project management by an RAF aircrew officer and Major Mark Norbury's thought provoking exposé of the views of the younger officer. The latter must have been a difficult article to write.

There is no simple remedy to the complex mix of personal aspiration and military requirement. Peacetime soldiering has never been easy and Army life and marriage has seldom blended entirely satisfactorily, at least not below the age of thirty; but I wonder if the fundamentals have changed so very much.

The shape of the Corps and its role does not depend on what the Corps prefers but on how it can fulfil the Army's (and other) needs. At present, and I suspect almost ever, the main emphasis is combat engineering. This is where the path of glory lies and accounts in the main for reputation within the Army, and being graded as an Arm not a Service.

The conflict between field and works is an old chestnut. Recommended reading is Chapter XI of *Memoirs of a Junior Officer* by Brigadier Sir Mark Henniker which concludes: "Generals! Never let your soldiers turn into working men. It is you who, in the end, will have to pay the bill". The Sapper officer as a manager with engineering interests must balance the equation. If the chartered engineers within the Corps feel that they are not getting a fair crack of the whip, then their consolation, apart from the value of their present work, is that they are being well trained for a second career. And, as the influential civilians which so many ex-Sappers seem to become, they will remain of great value to the Corps.

Early retirement has always been a facet of Army life in peace (in war the problem is early death!) but this gives scope for extra responsibilities for those who stay. It is tough on a commander to lose good subordinates, particularly if he feels his confidential reports will suffer, but it is surprising how individuals rise to the challenge when given the chance. I have not yet read General Kitson's new book, but perhaps the Army should actually encourage early retirement, reduce the number of middle-piece officers and give more responsibility to the young.

Every generation is different to the extent that the world is different and certainly modern women are more outspoken and open in the way they achieve their aims, and early marriage is a fact of life today. So I will end with another quotation—Rudyard Kipling's *Story of the Gadsbys:* "White hands cling to the tightened rein, slipping the spur from booted heel. Tenderest voices cry 'Turn again', red lips tarnish the scabbarded steel. High hope faint on a warm hearthstone—he travels fastest who travels alone".—Yours faithfully, I T C Wilson.

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Sir,—I feel I must comment on Mark Norbury's thought provoking article in the March *Journal*. He has expressed some interesting views on aspirations, leadership and on wives which will undoubtedly prompt others to put pen to paper, but, without wishing to appear unduly defensive, it is his general perception of a lack of management of officers careers on which I wish to concentrate.

The function of PB7 is to manage officers' careers. All my officers spend their entire time doing just that. We speak regularly to individual officers, to their commanding officers and to senior officers in the Corps in order to strike the right balance between what is in the best interests of the Corps and of the officer himself. Hopefully these will normally be the same. We also spend a great deal of time talking to our opposite numbers in MS. In addition we visit virtually every part of the Corps once or twice a year when presentations are given and interviews are conducted. It is a sad fact that not many officers come forward for an interview despite our request that they should do so. Commanders at all levels regularly consult us on their officers, and all are free to seek an interview at any time.

As part of my responsibilities, I talk to the COs Designate Course, Squadron Commanders, and to Staff College Students amongst others. In addition to the usual overview of the Corps manning situation I emphasise the fundamental point that career development and management is a function of command and leadership. PB7 has and will always continue to play its part.

I very much take the message that officers reach difficult crossroads when considering Staff Training/PQE or 'sq'. It is an anxious time and we need to provide clearer guidance. In an attempt to do so, we have recently introduced a new initiative outlining the way ahead for junior officers. Each officer now receives a letter from us with his second posting in the Corps. It maps out a series of career paths up to entry to Staff College or first leg 'sq' and covers in some detail JOTES/PET and so on. I believe it is a useful and timely steer and hope it gives them all a broad idea for the next few important years. Likewise, on approaching squadron command we write to every officer asking for their preference and explaining in some detail the process of grading and selecting officers for command at squadron level. We are not in favour of instigating a formal career counselling letter every two years. Such a move would be too time consuming as we have over 1,300 officers. In any event the career management outlined in this letter covers the requirement in considerable depth.

But it is not just PB7 who are concerned with officers' career management. I know, because I see it at first hand, that the EinC, the Deputy EinC and indeed all senior engineer commanders devote a great deal of time to the career management of those under their command. For example, the following boards sit during the year:

a The EinC's Careers Board, which reviews the career of every officer above the rank of captain in the Corps once a year. The aim is to ensure that all are being properly managed and are developing to their full potential.
b Commanding Officers Selection and Appointments Board.
c Squadron Commanders Assessment and Appointments Board.
d Junior Officers Assessment Board.
e PET and Long Plant Selection Board.
F Conversion Boards.
g Commissioning Boards.

All the above boards are chaired by the EinC or the Deputy and senior commanders are members.

I think it is a little harsh to say that, unlike the Infantry, we do not write to congratulate or commiserate. For example, the EinC personally writes to all those who are promoted from Major onwards, to those who are appointed to command regiments, to those who receive honours and awards, or other forms of distinction, and to every officer when he leaves the Corps. He also personally signals to congratulate individuals or teams on sporting achievements. Other senior officers do much the same; to say that they do nothing is less than just.

Finally, may I just make one comment on the need for job satisfaction, which Mark emphasised in his article. Two other articles in the March *Journal* gave vivid descriptions of the challenges which faced the troop commanders in 42 Field Squadron on Operaton *JOLE*, and which faced Adrian Botting at Saxa Vord. As I write, I am also aware of the job satisfaction which two other troop commanders must be experiencing. One has just finished a troop project rebuilding the jetty in South Georgia, and the other is constructing a causeway at Cottar's Camp in Kenya, 150 miles distant from his Squadron Commander!

To conclude, I would challenge Mark Norbury's opinion that there is a lack of interest in officer career management, and I hope that those who read this letter will be better informed as a result. But lest I sound complacent, let me admit that we should always seek improvement. Good practical ideas to PB7 please!—Yours Faithfully, J N H Lacey

Captain R M Tickell, RE (Retd)
20 Apley Close, Harrogate
North Yorkshire HG2 8PS

Sir,—I was delighted to read Major Norbury's article on The Management of Today's Sapper Officer, in which he aired views of considerable significance in the battle to reduce the rate of PVR. From my own experience of PVR two years ago, I would

agree with much of Major Norbury's article. I particularly concur with the view that it is often the combination of many factors, none of which by themselves would be enough, that tilt the balance in favour of a decision to leave.

It seems to me that the PVR of an 'average' Sapper officer is of far less importance than the PVR of a strongly-rated officer. The Corps simply cannot afford to lose high calibre people at the senior Captain stage. My suggestion is to introduce some form of merit pay to reward those officers who are graded 'excellent' or above in their annual CR. The award should be a one-off payment of between 5–10% of salary. It should only be available for substantive Captains and above, and would be restricted to certain posts only—eg in Regiments to the CO, OCs, Regt 2IC, Adjt, and QM. The exact way in which this award would work is not important—it is the principle behind it that is key. It is the top performers that the Corps needs to keep, and ironically it is they who find employment in 'civvy street' the easiest to obtain. To keep the best officers, a merit pay bonus will help towards the shorter term aims of keeping them in the Corps at least until Staff College. No-one joins the Army to get rich, but this incentive payment would allow the best officers to be singled out and rewarded accordingly. Even the NHS Top Management and teachers are beginning to be motivated in this way now, so the proposal is far from revolutionary.

The cost of the proposal is relatively small, and could be 'hidden' in the annual review award by the AFPRB.

The Corps also needs to do more research into the reasons why its officers are leaving early. I found it quite extraordinary that apart from my CO—who did his best to keep me in—no-one else interviewed me either prior to or immediately after my PVR to understand why I decided to leave. The CO is the obvious first filter in the chain, but in addition the Corps should introduce a further *formal* interview by a Senior officer (Comd Engr Sp, Comd Engr 1(BR) Corps, D EinC(A)?) who can listen and question objectively. I believe this would do two things. First it would confirm whether an officer is determined to leave come what may. If the decision is not final, an *unbiased* hearing from this officer might provide a set of actions, which if carried out, would pursuade the officer not to PVR. Secondly, if the decision was final, the senior officer could obtain a full and frank list of reasons (in priority) for the PVR. These reasons can then be pulled together to form a more relevant strategy to reduce the wastage from the Corps. The reasons given to PB7 on a PVR application are necessarily short, and will only tell half the story.

Certainly anyone who decides to leave IBM, my current employer, goes through a formal series of interviews and questionnaires—perhaps one reason why its staff turnover is so small!—Yours faithfully, Robert Tickell.

Lieutenant Colonel D I Reid, RE
(Chief Instructor)
Civil Engineering Wing
Royal School of Military Engineering
Chatham
Kent ME4 4UG

War Headquarters

Sir,—Of the various excellent articles included in the March 1987 edition of *RE Journal*, I particularly enjoyed reading Wing Commander Dennis Akhurst's experiences of War Headquarters (WHQ) Construction. His comments provide a useful guide to many of the important factors that need to be considered by the project management team. We, as a Corps, must be grateful to him for writing the article and I would commend it to all involved in WHQ or similar projects in the future.

I was, until recently, the Staff Officer at Supreme Headquarters Allied Powers,

Europe (SHAPE) responsible for all NATO WHQ projects in Allied Command Europe (ACE). Apart from being the sponsor for the criteria and standards for WHQ mentioned by Wing Commander Akhurst, it was my main task to ensure that NATO funds were allocated for project continuity and that technical standards were achieved. I was fortunate to visit several WHQ sites where work on new construction or upgrading was either in hand or planned. Each was different with its own, often unique, style of management. However, most lessons were common to all and are as described by Wing Commander Akhurst.

At SHAPE, the Corps has been involved for ten years or more with the management of the construction of a new underground WHQ for the Supreme Allied Commander Europe (SACEUR). For this major task, the Corps has always provided the project manager for the Civil Works and, additionally for the past three years, for the installation of command and control systems. Security restrictions, unfortunately, have prevented technical articles on the interesting and unusual aspects of the work. Nevertheless, the three Sappers in the management team were a major influence over all aspects of the design and construction work. Although I was not part of this team, I observed, at first hand, that they were gaining invaluable experience in an international environment where the main qualities required included technical competence, common sense, attention to detail, patience and a sense of humour. I am certain that Wing Commander Akhurst would agree.—Yours sincerely, David Reid.

Lieutenant Colonel (Retd) G Minderhoud
Royal Netherlands Army (Corps of Engineers)
Amsteilaan 6
5215 GB 's-Hertogenbosch
The Netherlands

The Dykes of Walcheren

Sir,—Major I H Johnson RE describes the BAOR meeting of the Institution at Willich Depot on 30 October 1985 in the June issue of the *Royal Engineers Journal*. In this article he pointed me out as the one who made the presentation possible. This is too much honour. For me it was a pleasure, being commissioned in the Royal Engineers in the British Army on 23 March 1946, when MOD (The Hague) asked me to liaise in the preparation for this meeting. It was good to work together with young Sapper officers of a branch of the British Army where I served myself 40 years ago (I am now 65).

The reconnaissance to the island of Walcheren for two days with Major Johnson and Captain Wade to see the ground and find inhabitants of the island who were present during the bombing was a pleasure in itself.

The presentation with the different speakers was excellent, and the evening afterwards in the WOs and Sgts Mess with so many RE officers was a night to be remembered. There I was presented, on behalf of my Corps, with two mighty 'shoulder pads' representing left and right handed Crouze helmets mounted on wooden backgrounds—the insignia of the Corps of Engineers. This fine present has found a place in the RE Museum in the van Bredezode Kazerne in Vught where the Dutch School of Military Engineering is situated. I had the honour when I left the SME ten years ago as second in command, on retirement to be appointed Curator of the RE Museum.

Altogether, as a retired Engineer, I had some wonderful weeks assisting with this presentation.

May I take the opportunity to ask officers reading this letter, who served with me during my training period in the UK in 1945–6 to seek contact with me. My details are:

No 1 ITC Brentwood (April–May 1945)
No 1 TBRE Clitheroe—142 War Party (May–August 1945)

No 148 Pre OCTU Trg Est Wrotham (August–October 1945)
Basic OCTU Repton/Willington (October 1945–January 1946)
Aldershot
RE OCTU Newark (January–23 March 1946)
(Passing out parade as 2Lt RE 23 March 1946)
SME Ripon (May-August 1946)
HQ NORTHAG (Engr) (1959–61)

Finally, I invite those who are interested to visit the RE Museum when they are on holiday in Holland. Thank you.—Yours sincerely, G Minderhoud.

Captain G C Hartley
1 Main Street
Elloughton
Brough
North Humberside HU15 1JN

MUSEUM OF ARMY TRANSPORT-BEVERLEY

Sir,—I can confirm that the Museum near here really is worth a visit. I served in the Corps only from 1941 to 1946. We have several spare bedrooms and would accommodate readers for a day or two very cheaply, and also show them the area.—Yours sincerely, Gavin Hartley.

* * * * *

Book Reviews

TRENCH MAPS—A COLLECTORS GUIDE VOL I BRITISH REGULAR SERIES 1:10,000 TRENCH MAPS GSGS 3062

PETER CHASSEAUD

(Published by Map Books: Price £6.00 (plus 60p p&p) ISBN 0 9512080 0 4)

TRENCH MAPS is the first of a series of books by Peter Chasseaud covering British maps and survey in the First World War. The result of over seven years exacting private research this volume covers the important 1:10,000 scale series GSGS 3062 maps.

The series was initiated by the GHQ Survey staff in June 1915. By that stage it was apparent that cohesive large scale map coverage of the front line was needed to supplement the recently surveyed and compiled 1:20,000 series and to replace a jumble of variously scaled and sketched trench diagrams. The new series, generically termed Trench Maps, became central to all detailed operational planning, and vital to development of sophisticated artillery techniques.

The especial value of this volume lies in its indexes and definitive listings of sheets, with edition numbers and print dates. Monochrome extracts illustrate the information available from the maps. So far as the reviewer can establish this is the first ever publication enabling identification of sheets for particular locations and the edition relevant to the period of interest. It will greatly facilitate reference and thus access to maps held at the Public Office or in Copyright Libraries.

By the author's own admission there are some gaps, notably in early classified editions, whilst special derivations made for temporary distribution may not have been identified. Also Carto bibliographic information was introduced as research proceeded so maps examined at an early stage are not cartographically described.

The six page preface details the derivation of the various map series covering the British sectors of the Western Front, summarises the development of the RE Survey Staff and organization, and touches on the hazardous process of field survey in the front line. The Grid and reference systems are explained in detail with supporting diagrams.

Although aimed at historians, map curators and map collectors, Trench Maps Volume 1 will prove an invaluable aid to any student of events on the British front or visitors to the ground. Peter Chasseaud has rendered a valuable service. Subsequent volumes on the regular series 1:20,000 and 1:40,000 sheets; on the special sheets; and on the development of field and artillery survey are awaited with keen interest.

GPGR

MARCH TO THE SOUTH ATLANTIC

NICK VAUX

(Published by Buchan & Enright, London: Price £11.50 ISBN 0-907675-56-5)

THIS is Lieutenant Colonel (now Major General) Nick Vaux's account of 42 Commando's part in the South Atlantic Campaign. It is the first account written by a commanding officer and fills an important gap in the historical record of the war. Although written some four years after the event the book gives vivid, graphic descriptions of the terrain, battles and personal experiences.

The early chapters cover the mounting of Operation *CORPORATE*, the voyage South, the retaking of South Georgia and the initial landings at San Carlos. But, well-written as it is, there is little in this part of the book to distinguish this account from numerous others. The book comes to life, however, when 42 Commando are flown forward to seize Mount Kent, in exploitation of aggressive SAS patrol activity.

The delays and frustration caused by the shortage of helicopters and the weather, and the palpable apprehension of launching out from a secure base with scant information about the enemy or the ground, and with very limited support, comes over so clearly: "Almost before we expected it the lurch and bank of the helicopters alerted us that a tactical landing was in progress. The crewman slid back the door to reveal a whirling kaleidoscope of fleeting rocky slopes. As we hammered down in the hover the co-pilot crisply warned me through my headset that the LS was once more under attack, then we were engulfed in the frenzy of disembarkation as the klaxon sounded and the dim exit light changed from red to green." You can almost feel the racing pulses and smell the AVCAT. No exercise this, but the real thing.

For two weeks 42 Commando clung to their positions among the exposed crags of Mount Kent in the most appalling conditions. The reader can feel the privations endured by the Marines (many without even a sleeping bag) and can understand the problems faced by unit and sub-unit commanders in maintaining morale in the face of mounting cold, injuries and dwindling logistic support. Only the fittest mountain and arctic trained troops could have survived. The opportunity to be relieved from this agony was spurned by Vaux, determined to have a crack at the enemy when the time came.

When it did come, and not a day too soon for all concerned, 42 Commando played a crucial role. The battle of Mount Harriet was a model battalion night attack and the lessons are as obvious as they are brilliantly depicted. Detailed, painstaking, dangerous reconnaissance; physical and moral domination of the enemy in the days before the battle; a simple plan understood by all ranks; effective command and control; surprise; fire support; but, above all, leadership, flexibility and determination to win at all costs. The esprit de corps of the Commando is palpable. You can feel the affection and concern of commanders for their subordinates, the anguish when casualties are taken, the humour in adversity, and the triumph of victory.

March to the South Atlantic ranks as one of the best books about the campaign. it is a 'must' for all budding commanding officers, and thoroughly recommended for all others interested in learning more of the principles and practice of leadership in war.

GWF, RM

SIMKIN'S SOLDIERS—VOLUME II THE INFANTRY

COLONEL P S WALTON

(Published by Picton Publishing (Chippenham) Ltd—Price £12.95
ISBN 0-948251-02-6)

COLONEL Walton's Volume II of *Simkin's Soldiers* dealing with the Infantry follows on from his earlier book on the Cavalry. It is based on a selection of works by Richard Simkin, the noted Victorian water colour artist, who portrayed so profusely the uniforms of the British Army of the period. Magnificent though Simkin's prints are, they do not give full information about the uniforms illustrated and Colonel Walton has set himself the task of complementing them with supporting material so that the reader can fully comprehend what soldiers did and wore.

It is a complex subject and he has very wisely been selective in his choice of regiments.

He has taken an interesting cross-section illustrating The Foot Guards, some of the old county regiments, Fusiliers, Light Infantry and Scottish regiments. His book gives a clear insight into the british military scene circa 1890 and makes fascinating reading. Much care and detailed research has gone into the presentation. It is a valuable mine of information both for the tyro and the experienced student of military affairs.

CPC

(Colonel Walton is planning a third volume to cover the Royal Engineers and Departmental Corps—Editor)

TAMING THE LANDMINE
PETER STIFF

(Galago Publishing (Pty) Ltd 1986: Price £19.50 ISBN 0-9470-2004-7)

HERE is a welcome addition to the limited amount of published material on that crucial topic for combat engineers—minewarfare. Peter Stiff has prepared a profusely illustrated book, aimed particularly at the lessons learned during the low level operations in Rhodesia and South Africa.

After a brief introduction on the origins of minewarfare and the development of mines through the Second World War, he briefly describes some modern-day countermeasures before turning to the bush war in Rhodesia and the conflict in South Africa. What follows is a chronology of these campaigns accompanied by an explanation of the development of mine-resistant vehicles. By adopting such vehicles in large numbers, apparently he considers that the mine was tamed in South Africa.

There are excellent photographs throughout, which provide much scope for reflection. Few of us have had the misfortune to face the effects of mine detonations, yet these photographs provide sobering insight into the consequences. It would be wrong for British soldiers, of any arm, to neglect this book as not being relevant, for there are many lessons to be learned from the bitter experiences of the Rhodesian Engineers and the South African Defence Forces. After some success at improvisation in preparing existing vehicles to be mine-resistant, they eventually realised that crew and cargo protection was best provided by vehicles specifically designed to counter the blast of a mine. With the proliferation of scatterable and remotely delivered mines, a question to be asked now is whether sufficient emphasis is placed on mine-resistance in the design of NATO vehicles. This book offers several ideas on how this could be achieved.

It is unfortunate that the publisher decided to mix the text, the illustrations and their accompanying description in such a way as to confuse the reader. Equally, the author has placed too much emphasis on vehicle development at the expense of other counter-measures, mines, guerrilla mining tactics and security force procedures. Despite these criticisms, *Taming the Landmine* is well worth the attention of every Sapper.

CEES

A GOOD DUSTING
THE SUDAN CAMPAIGNS 1883–1899
HENRY KEOWN-BOYD

(Published by Secker and Warburg Ltd—Price £16.00 ISBN 436-23288-X)

THIS is a splendid book, lavishly illustrated, well researched and written with tremendous dash. The history of the events leading up to the campaigns of 1883–99 are lucidly described. The peripheral skirmishing between the Dhervishes and the Abyssinians and the entry of the Italians into Eritrea, which culminated in the disaster at Adowa, are explained with clarity, and act as a setting into which the campaigns of Wolseley and Kitchener can be fitted. The author has much knowledge of and affection for the Sudanese.

Both these expeditions included many 'personalities' who added colour to an already colourful scene, and the author has used their experiences and their letters to great advantage, taking material ranging from the comments of Major the Hon Edward Montague-Stuart Wortley (Wortles) who survived both campaigns with wit and sangfroid to the less reliable letters of Private Frank Ferguson of the 20th Hussars to his parents. The whole scene is brought vividly to life as is the bravery and endurance of the British, Egyptian and Sudanese soldiers.

The story of the two expeditions and the savage battles against a fanatically brave enemy is extremely well told. However the author is unfair to Wolseley whom he dismisses as 'shrill and bitchy'. Of the two expeditions Wolseley's was by far the greater in concept, in effort and in execution. He fought against time, and his army was totally unacclimatized to a climate which was even more savage than the foe. His government was, at best, half-hearted in its support. His C-in-C, the Duke of Cambridge, disliked him personally and his methods more. Redvers Buller, his chosen Chief of Staff, let him down badly both in his failure to purchase enough decent camels and, more seriously, in not providing sufficient fuel for the steamers ferrying supplies from the depots to the whalers. The delay in the delivery of fuel, Wolesley calculated, put the whole expedition back by three weeks. It was the first time in a long and brilliant career that he had not accompanied his troops into action, being forced to remain at Korti at the end of a telegraph line. Wolesley provided for his sick and wounded. He failed to rescue Gordon.

Would Kitchener's campaign have succeeded without the lessons learned from the earlier expedition? It probably would. He had thirteen years to train and prepare his army. His Egyptian and Sudanese soldiers were more accustomed to the heat. His camel corps knew everything about the care of their camels. He had no Gordon to rescue. Ambition and economy drove him, and his army had to follow. At the great battle of Omdurman the Dhervishes received their 'good dusting'.

At the end of the book the author follows the fortunes of some of the characters who took part in the campaigns. It is not displeasing to learn that the incorrigible Osman Digna survived to make the pilgrimage to Mecca in 1924.

AC

BOMBS AND BOOBY TRAPS
CAPTAIN H J HUNT MBE

(Published by Picton Publishing (Chippenham) Ltd—Price £12.95
ISBN 094-8251-190)

THIS book as described on the dust cover relates the experiences of an individual RE bomb disposal officer during the hectic years of World War Two. As such it makes interesting and at times exciting reading. It contains very little of a technical nature relating to bomb fuzes or the means of disposing of them, instead it concentrates upon the personal aspects of the work.

To the historian minor errors of fact tend to irritate but to the layman the book is well worth reading. As written, the main text has no pretentions to be either a history or a reference book. However the editors have attempted to give it the authority of a reference book by adding an Appendix which repeats the standardised history of the formation and organisation of RE bomb disposal units during the war and adds a list of RE bomb disposal George Cross and George Medal winners. Unfortunately these lists are far from accurate, this reviewer noted the omission of three RE bomb disposal George Crosses and twenty George Medals awarded to members of RE bomb disposal units, including two well known holders of the George Medal and bar. A more useful addition to the book would have been an index of the main text which is full of names, places and units.

This pretentiousness however, is not the fault of the author who died in January 1977. His reminiscences in the first 119 pages of the book are well worth reading as a personal view of the dangerous, courageous and at times amusing incidents of the men of the RE bomb disposal units. Captain Hunt tells it as it was, a dirty and dangerous job with no room for mock heroics.

ASH

FINDING WATER
RICK BRASSINGTON

THE publisher of this book, reviewed in the March 1987 *Journal*, was shown incorrectly. This book is published by Rookery Books, 12 Culcheth Hall Drive, Culcheth, Warrington, Cheshire, WA3 4PS at £7.95. Anyone wishing to buy a copy should write to Rookery Books at the address given here.

Journal Awards

The following awards for articles in the 1986 *RE Journal* have been made.

The Montgomerie Prize for the outstanding article on a professional subject, by an officer not above the rank of Lt Col, was awarded to Maj D M Webb MBE and Capt P D Cook for their article "Earthquake Relief in Mexico City", (£50)

The Arthur Jolliott Garrett Prize for the outstanding article on the technical aspects of logistic engineering or survey, by an officer not above the rank of Lt Col, was awarded to Maj H M Hoey for his article "Mount Pleasant Airport Construction", (£75)

The Best Article of the Year Award 1986 was awarded to Brig A E M Walter for his article "A Harbour goes to France", (£100)

AWARDS FOR DECEMBER 1986 JOURNAL

MERIT awards for the December 1986 *Journal* are as follows:

"Earthquake Relief in Mexico City" by Maj D M Webb MBE, and Capt P D Cook, £50
"A Worm's Eye View" by R J P Cowan OBE, ERD, £50
"Are We Playing at Being a Technical Corps?" by Maj M S Campbell, £20
"Are We in Control for the 90s?" by Capt (GE(M)) H J Mitchell, £10

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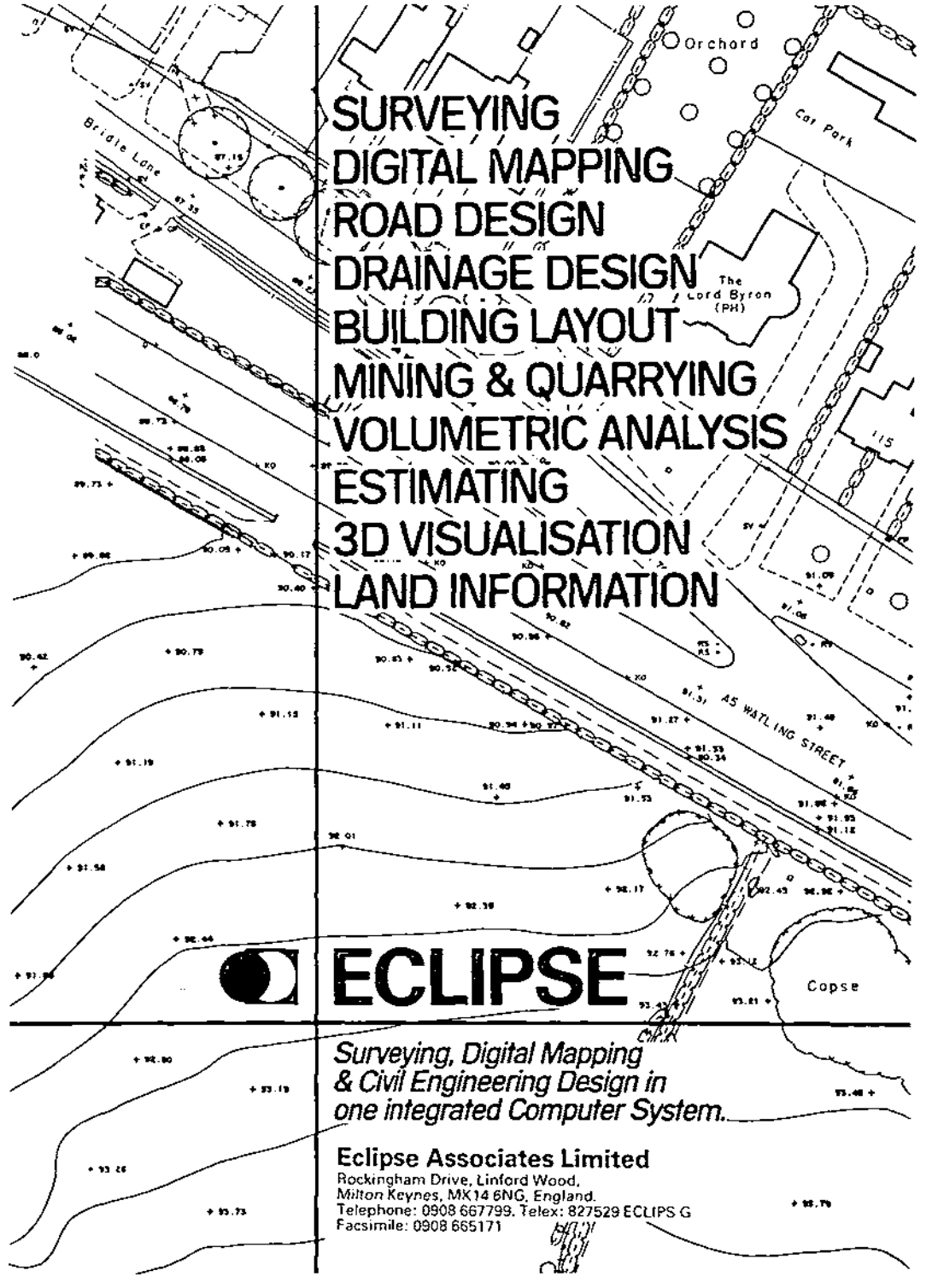
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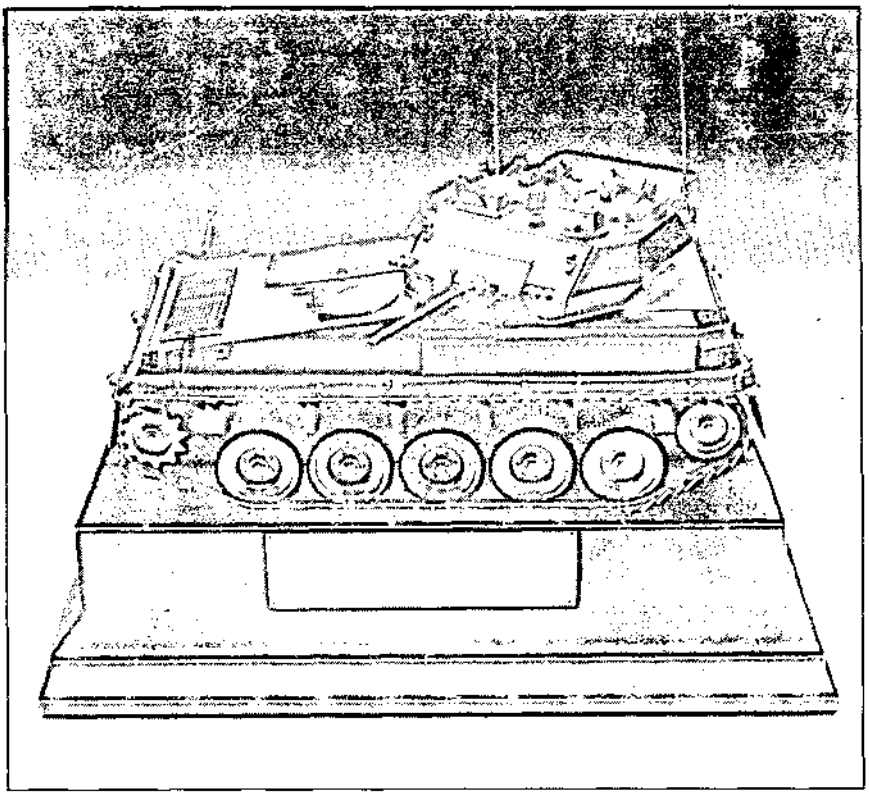

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