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No. 2

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Established 1875, Incorporated by Royal Charter, 1923)

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Authors alone are responsible for the statements made and the opinions 4,250 expressed in their papers

Editorial

COURAGEOUS, FOOLHARDY OR BLOODYMINDED?

THESE three words are in common use; they are often applied to a single action. One can only suppose that it depends on whether one agrees or disagrees with the action.

For example the actions of a dissident are often described as courageous by supporters, as foolhardy by neutrals and bloodyminded by antagonists. A Protestant who walks into an Irish pub used exclusively by Catholics could be described as bloodyminded, if he then declares in a loud voice that he is a Protestant is he courageous or foolhardy?

One is not over concerned with definition (although one should be), but with the commonly accepted meanings. What does courage imply? An awareness of the risks involved? A premeditated decision? A lack of imagination? A degree of arrogance? Does the inner pleasure resulting from "standing up to be counted" in any way reduce the level of courage required to do so? Does the desire for martyrdom change the circumstances? Are terrorists courageous? Reactions to stress vary; is an action by someone who is frightened more courageous than the same action by one who is not frightened? Can a speech really be described as courageous? Is putting one's head in the mouth of a lion courageous?

Soldiers are called upon to show courage more often than most other members of society. It is logical to suppose that Members might have some views on the subject.

The English language is not a simple one for the communication of specific ideas. Many words have multi meanings – some embarrassingly so! One would however expect that a "higher" computer language would be relatively precise. A computer programme, or suite of programmes, is under development which is designed to translate the languages of ordinary mortals. In an experiment English was translated into German and then back to English. The initial input of "Out of sight, out of mind" gave a final output of "Hidden imbecile". This is reassuring until one remembers that, at best, a computer is a bloodyminded moron!

Centenary Meeting – 27th November 1975

COMMEMORATIVE COPIES

THE Centenary Meeting of the Institution of Royal Engineers was held on 27 November 1975. The *RE Journal* published an introductory article by Brigadier J H S Lacey CBE (Secretary of the Institution 1958–72), the Proceedings of the Meeting and a number of written contributions following the Meeting.

All these articles have been collected and have been bound in an attractive red cover as *Commemorative Copies of the Proceedings and Correspondence Inspired by the Meeting*. With each copy (in a pocket inside the back cover) is a Royal Engineers Special Commemorative Cover, hand stamped No 1487 dated 22 May 1975, the actual Centenary Day. Only one hundred of these Commemorative Copies have been produced, each is signed by the President of the Institution for authenticity. This will enhance the value of each copy.

They will be sold on a "first come first served" basis at £3.00 each. Applications to Secretary, Institution of Royal Engineers.

Military Engineering in South Armagh 1976/77

MAJOR H G R TAGGART RE, OC 9 PARACHUTE SQUADRON RE

SOUTH ARMAGH is one of the few areas where the British Army indulges in intensive tactical operations in a rural environment. The Corps of Royal Engineers is the main ground supporting arm. Their support for the infantry is principally concerned with advice on, and the execution of, search and booby trap clearance operations. However in Crossmaglen a particular military engineering problem existed in early October 1976. There was a "hotch potch" of accommodation and fortifications surrounding the RUC Station. About 150 soldiers were based there and over forty had been killed in the area since the present Northern Ireland crisis began. All transport had been by helicopter since many ambushes had occurred and there was effectively no secure land line of communication.

There had been frequent attacks on the base by a variety of weapons and the last and the most serious attack (23 October 1976) was by a new type of mortar, now named the PIRA (Provisional IRA) Mark 9. This mortar, some 20in long, 6in diameter and weighing 45lb, consisting of a casing made from a carbon dioxide cylinder (normally used for pumping keg beer!) with a tail fin welded on to the base. Considerable damage occurred to the temporary accommodation and there were a few injuries.

It was decided that it would be necessary to provide better protection for the 150 soldiers sharing the grossly overcrowded base. The first requirement was to immediately provide repairs to the damaged accommodation and make it reasonably weatherproof. These repairs were completed in about three weeks. In the meantime planning went ahead on the concept of fitting in a hardened shelter.

From the outset, it was clear that considerable disruption to already almost intolerable living conditions would ensue if any major construction work was attempted within the confines of the RUC barracks land. It was decided to requisition extra land on which to temporarily house some of the company accommodation as well as store the building materials whilst construction of the proposed shelter was executed.

Planning the construction of a concrete shelter where there is no secure land line of communication presented many non-engineering problems such as the need to run several convoys; where to store building supplies; how much effect there would be on the efficiency of the soldiers and marines living in the base and what the psychological influence would be on the local people as well as the PIRA.

In the event, a structural engineer with experience of bomb damage to buildings in Belfast was consulted and presented his concept of design to the CRE. In the interests of speed and simplicity of construction a concrete block wall design with a reinforced concrete floor and roof was accepted. There was to be a sandbagged roof covering with a stand-off screen overhead to detonate or catch mortar bombs. Due to the absence of windows an air-conditioning system would be required.

The detailed design was produced by a team from 62 CRE (Construction), they estimated the total construction time for one shelter to be $17\frac{1}{2}$ weeks and they recommended that the work should be completed by the Squadron. *Execution*

In early December 1976 Commander Land Forces Northern Ireland gave approval for the construction of the first hardened shelter at the same time as the extra land was requisitioned. The main building work was to start on I January 1977. The first convoy with about 500 tons of material and engineer



Photo 1. A general view of the convoy in the waiting area of Newton Hamilton, County Armagh. This area was secured by a force of suppers from 9 Indep Para Sqn (as it was then known) RE. The SSM, with a command vehicle, controlled the movement into and out of the area. The Puma helicopter overhead was used to fly in the picquets and the supper route clearance parties.



Military Engineering in South Armagh 1976-77 (1&2)



"cover from view" screens in the requisitioned land at Crossmaglen in December 1976. Corporal Sangwin, a Class 1 Carpenter and Joiner (facing camera) was in charge of the joinery work. The FSP, huits and corrugated iron were all flown in by RAF Wessex and Pumas in about thirty sorties. The temporary accommodation was necessary in order to rehouse infantry and sappers in order to give working space inside the original base camp.



Proto 4. Captain K P Noth, the Troop Commander responsible for the construction at Crossmaglen, pictured beside the completed temporary accommodation huts in the re-quisitioned land. The mortar protection and the stand-off screens were added to give some protection during the occupation of the huts. Captain North is a graduate in civil engineering from RMCS Shrivenham and was involved during the detailed planning stage of the project and saw the ideas take shape before handing over the project in February 1977. His main comment was "They never taught us this at Shrivenham!"

Military Engineering in South Armagh 1976-77 (3&4)

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plant was to be run in mid December, the temporary camp adjacent to the RUC barracks (on the requisitioned land) was to be completed as soon as possible and a second convoy would be run in mid January 1977. In each case the convoy consisted of four phases:



Photo 5. Working conditions for most of the winter at Crossmaglen were like this.



Photo 6. Corporal L E Gallagher, a Class 1 Electrician, helping to install the electric selferecting site crane at Crossmagien. The crane subsequently proved invaluable due to the restriction on the site of the mottar-proof shelter inside the company base. Corporal Gallagher was the principal electrician on site and, with others carried out many temporary repairs as well as helping to install the power supply to the new shelter.

Military Engineering in South Armagh 1976-77 (5&6)

MILITARY ENGINEERING IN SOUTH ARMAGH 1976/77

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(a) Flying in of infantry picquets. They were provided by the province reserve battalion, 1 Black Watch, who also commanded the overall operation from a joint Tac HQ at Crossmaglen.

(b) Route Clearance by ten sapper search teams.



Photo 7. The site of the shelter at Crossmaglen after the concrete "raft" foundation had been completed. The RUC station is on the right.



Photo 8. Working on the site of the mortar proof shelter. The concrete foundation has already been laid and the concrete block walls are being constructed. Corporal Smith, on the right, a Class I Bricklayer was the chief bricklayer on site and found the work well within his skills. He had a team of about six, most of whom were bricklayers, others were "mates". The bonding of the blocks was particularly critical due to the designer's specifications for strength.

Military Engineering in South Armagh 1976-77 (7&8)

(c) Moving the convoy and unloading by packets.

(d) Extraction by air of picquets on completion of the convoy.

From the joint Tac HQ communications were maintained throughout with the picquet companies, the convoys and the resident units. The route picquets were flown in to pre-selected landing sites and dispersed on foot to their positions along the convoy route. For the first convoy the infantry stayed out the previous night having, with sapper clearance parties and the dogs, cleared and secured the route. The convoy moved in daylight only. On the second convoy the operation was continuous and the convoy ran on into the hours of darkness. The convoy waiting area was controlled by the SSM. (Photo 1.) The two convoys consisted of about fifty and thirty vehicles (many with trailers) respectively. As the guard force was about thirty strong and there were about a hundred drivers, escorts and visitors in the area the SSM's powers of tact and diplomacy were well tested. The critical part of the convoys operations was the unloading of the stores at Crossmaglen. (Photo 2.) On the second run unloading carried on into the night using flood lighting. The portable flood lighting tower with its own generator was underslung from a helicopter and flown in.

It is not the intention in this article to elaborate on the actual construction methods used and problems encountered. A few words however would not be out of place. A Clerk of Works (Construction) from 62 CRE was on site during the project. He was completely integrated into the Squadron (even wearing a red beret) and provided valuable construction expertise to the sapper tradesmen. He did not detract from the supervisory responsibilities of the Troop Commander and Troop Staff Sergeant but acted as a technical adviser. Because of the flood lighting the normal working hours were from 0800 to 2000 hours. Putting on a night shift to speed up the work was not really possible because of the living space restrictions. In addition the "24-hour patrol" members had to get their sleep. The sappers helped with patrols and guards and also had a role in the quick reaction force in the event of attack. All stores, food and visitors arrived by air and even rubbish was flown out for disposal. The 10/7 concrete mixer used weighed 5000lb and a Puma helicopter can just lift it.

Construction work started as planned and was greatly eased by the use of a self-erecting crane hired by HQRE Northern Ireland. The electrically driven, remotely controlled from ground level, crane had a 750kg lift capacity at 20m radius and was 20m high. It proved invaluable on such a limited site. It speeded up the task and cancelled out the delays imposed by alternating periods of bad frost and heavy rainfall on site and accounted for the project being about two weeks ahead of planned schedule on completion of the tour. About 900 tons of stores had been moved by vehicle and about 100 by helicopter since the project began.

Reflections

The task presented the squadron with many varied problems not only of construction but of tactics and logistics. The construction skills required occupied nearly all the specialist tradesmen. The squadron plant, search teams, resources, communications and transport were all stretched on several occasions as a result of the convoy operations.

There is always an argument between "combat" engineers and "construction" engineers and the pages of the *RE Journal* have carried both sides of it over the past year or so. The building of the fortifications at Crossmaglen must surely illustrate the importance of a well balanced unit which can combine the soldierly skills required on the battle field (route clearance, defence, communications, convoy discipline and movement by helicopter), with the engineering expertise required to carry out tasks which we normally now associate with the Property Services Agency of the Department of Environment.

There is a tendency to define "combat engineering" as those activities which are practised at length and rehearsed in detail in order, for example, to produce medium girder bridge crossings or lay minefields. Quite often, by implication, there is no flexibility of action and soldiers assemble "meccano-set" type equipment which does not require any real engineering skill on their part, although considerable skill is required of the designers. The Crossmaglen operation, as it is felt our successors will have also found out, has been an excellent vindication of the Corps' policy of training sappers as soldiers first then developing them as artisans. Both skills are equally important otherwise we would simply either be infantrymen or civilian contractors. The military engineer was created for one purpose only, that is to apply his engineering skills on the battle field in order to support the infantry. If those skills require him to build a shelter from concrete and install central heating and air-conditioning, for example, then he cannot baulk at the task and say he is a "combat engineer" and that such work is really someone elses job.

One Sapper's View of the First World War

These edited extracts from "I Must Build," the Memoirs of Sir Robert Owen Lloyd, OBE, FIOB are reprinted by kind permission of the Directors of Sir Robert Lloyd and Company Ltd, Building and Civil Engineering Contractors of Mersevside.

Sir Robert was one of the great builders of the twentieth century, one of the few who started their own businesses and led them to national, and in some cases, international fame.

In his Memoirs Sir Robert writes of his experiences, the extracts concentrate mainly on tunnelling and have been edited to maintain continuity.

IN 1914, that eventful year when the nation became involved in what is now known as the First World War, I was nearing my twenty first birthday and, in common with most other boys throughout the length and breadth of the country, felt a great urgency to join the Forces. I tried to do so in the few months remaining in 1914 without success as the work I was doing (Leyland Motors), for twenty five shillings per week plus overtime, was of national importance. However I got permission to join the Forces at the end of 1914 and found myself in Brompton Barracks, Chatham, early in 1915 and thereupon entered upon a new phase of life and endeavour.

There were powerful forces at work in our newspapers preaching a nationalism that burned with fire and zeal and, as young soldiers, we were straining at the leash to get ourselves through the very quick course of military engineering and ordinary soldiering, square-bashing and the like. There was no time to go sick and our training days started at seven in the morning and usually finished late at night. Our field works course at Upnor and our pontoon work on the Medway were really exciting times for me. There was much to remind us that our country was at war in the centre at Chatham. Most mornings there would be a blimp airship flying over the parade ground, and we passed through the Naval Dockyard to go to our field works courses and pontoon work. Part of our time was spent under canvas prior to leaving for France. Another thrilling part of training I enjoyed — I remember going for a few days to Shornemede Fort, a rifle range near Gravesend. I qualified as a crack shot and rather fancied myself with a rifle.

The day soon came for us to entrain and ship to France which we did towards the middle of April 1915. The first armies we had in France had taken a beating on the retirement from Mons and were sadly in need of reinforcement. The Royal Engineers in the party were shipped from Southampton across to Calais and we sailed up the River Seine to Rouen. Here was the camp for the Royal Engineers reinforcements. A couple of days later and I was in a small contingent off to join the 59th Field Company in the 4th Division. We were then taking over from the French in the Somme area. The company headquarters were in Meaulte.

There was no time for any company programme and on my first day in the unit I was posted to a section which went up the line the same night. This was quiet by the standards we had to endure later on. Our work was repairing the front line trenches and making them habitable. These had just been taken over from the French infantry by our holding forces in the 4th Division. We had of course received a wonderful training in Chatham to qualify us for the work in hand, but the trenches had been held for some months and were naturally littered with trash in "No Mans Land". Empty bully tins and jam tins in abundance made it difficult to work on the barbed wire at night without drawing the attention of the enemy who was only some ninety yards distant beyond the trenches.

There were also hordes of rats foraging amongst the tins which added no particular joy to our trying to remain quiet; an hour in "No Mans Land" seemed a day in any other place. There was spasmodic rifle and machine-gun fire passing around us practically all the time we were out. Our casualties were high for the number of men employed on the work. Heavy mortar fire was constantly being used against our protective wire, so frequent repairs had to be carried out. In the early days of trench warfare it was the duty of Royal Engineers not only to supervise this work but to carry it out. A little later on, this was changed owing to heavy casualties in the Royal Engineers and the infantry had to repair their own wire.

I had not been with 59th Field Company long, before I received a leg wound which happily did not do much damage but put me out of action for a few days in the field dressing station. During this time I received instructions to report to Major E V C Wellesley who was the new commander of the 178th Tunnelling Company which was being formed in the same village as the Field Company had for its headquarters.

We were moved back to the village of Corbie to complete our build up of personnel who were being sent to us from the base and other units in the front line; at that time it was in front of Fricourt which was on the right of Albert. This was the line of trenches where the French armies stopped the German armies in the retreat from Mons. There was no shelling in this village and air attacks had not started on ground troops at this stage. After a week or two we completed our complement of personnel, equipment and transport and moved back into Meaulte to take over the tunnelling activities from the French sappers who were still carrying on with their work along with the British infantry holding the line.

The Director of Mines was Colonel Norton-Griffiths, who was a great tunnel man prior to the war, a practical man in the art of tunnelling, and he used to visit and advise all the tunnelling companies on the front. It was soon decided that the size of our fighting galleries, and indeed the shafts which had been sunk by the French, were not suitable for us, so we had to start from scratch by sinking shafts at an angle of 60° down about 112ft where a main gallery was made at the bottom of the shafts connecting them all together. The front we operated on was, as far as I remember, 500 to 700yds and we worked at various times from 5ft 6in shafts from which were driven the fighting galleries. The Boche were carrying out operations similar to ours and very occasionally we broke into each others workings. When this happened we usually made a hurried retreat in the other direction, as breakthroughs into each others workings had to be avoided at all costs, fighting at these low levels was hazardous and expensive in life. We struggled on for many months and occasionally blew charges of varying sizes, ten to twenty tons of explosives being used to avoid disturbing the surface between the two trenches. This operation was called "blowing camouflet" had the effect of slowing down the operations of the enemy, and also our own operations to some extent, as the ground which had been fractured by these underground explosions was difficult to work. The exercise was carried out chiefly as a slowing down operation but also to catch the enemy tunnellers who were at work when the discharge was made.

We had many problems because so much of the work had to be carried out by hand in the hard headings that we were working in, the ground being solid chalk and very hard to cut. To cut a foot of fighting gallery in one hour was our target, with two miners at the face and infantry carrying away (in sandbags). the excavated material. A few months after we had started our operations we did have the assistance of compressed air using wombat drills with which we drilled holes in the face and fired small shots. This technique of course had its disadvantages because it directed the attention of the enemy listening posts and they were better able to locate the direction of our fighting galleries, but nevertheless we carried on with this system for some time. We generated our compressed air in a big dug-out that we made eight or nine hundred yards from our front line trench and carried the air in 2in pipes in a shallow trench, over the top. This of course, had grave disadvantages, one being the damage caused by heavy mortar bombs of varying types fired by the enemy over the front line trenches, many of these overshot and occasionally fell on our air mains. Another disadvantage was the exhaust from our petrol engines driving the compressors. We carried them some distance down short tunnels from the compressor dug-out, but on many mornings one could see the blue haze of the exhaust over the ground and this attracted much shell fire. In fact our generating station was never hit as it was carefully camouflaged. Near to the front line, we could protect the air lines by debris from the mines and sandbags. The debris areas became little hills at the back of our trenches and a similar situation was of course in existence behind the enemy lines. After a month or two of excavating we gave up the attempt to camouflage the debris as this was largely chalk and quite obvious to the enemy. The first eight or ten feet of this area on the Somme was black soil and it was quite obvious that some deep excavation was in hand when deposited chalk could be observed on the surface in aircraft pictures.

Two great problems we had in tunnels were water and the absence of electricity for lighting. We had compressed air pumps which were not very effective and the effluent we had to pump was like thick whitewash. Since we were working at about 112ft the hand pumps were not sufficiently strong to throw this effluent on to the surface and away. Pumping chambers had to be built into the sides of our shafts and frequently we had infantrymen working hand pumps lifting it from one level to the next. A shocking job indeed, coupled with hard work. The personnel of our company were for the most part coal miners recruited at home at high rates of pay compared with ourselves. We got 2 shillings a day and they were getting 6 shillings a day with appropriately higher pay for NCOs and Officers.

My job during these operations was to supervise the timber that was used for propping the sides of the fighting galleries and shafts. This was necessary not only to keep up the roof so this would stand on its own, but to offer some protection when we got a blast from the enemy's camouflet explosions. Indeed in some of our fighting galleries we had put in additional diagonal pieces to resist these pressures. (If, of course, they were near to the explosions they did not prevent the galleries from being blown away, we would sometimes lose 50ft of galleries.) They did protect the fighting galleries to some extent and the personnel could get out and so avoid casualties from after-damp (carbon monoxide) which quickly followed explosions. We suffered two kinds of casualties in our company and I may say our casualties were extremely heavy. One was complete exhaustion from the operations of hard-head driving in tunnels by hand for the most part, and the other was from after-damp or carbon monoxide. To help in reducing these casualties we had bottles of oxygen at the bottom of all our shafts and if men working down below could get to these points and discharge the oxygen into mouth pieces provided, they could be kept alive until assistance came from the rescue gangs we always had waiting in a dug-out above for such emergencies. These men were provided with proto sets, about 90lb weight, which were in effect a self-breathing apparatus which could provide air for the operator for periods up to one hour.

I have mentioned this tunnelling business in some detail because it was an operation not previously carried out in any war on the same scale as it was in the first two years of the 1914 War. It was a most foolish conception of fighting or holding the line, but when the enemy started, our side had to follow suit. It was a gigantic public works operation with the most inferior and inadequate tools and tackle and carrying with it tremendous disadvantages. On the other hand the operation being conducted on the surface from trenches was also an extensive holding operation as each side produced bigger and better trench mortars, projectiles of all descriptions and weights which were constantly employed against the trench works, the trenches being inadequately protected against easy entry from the enemy lines by thousands of tons of barbed wire. This was constantly holed and destroyed by large mortars and then repaired in a haphazard way. As time went on it became a terrible tangle of weeds and grass and barbed wire, coupled with thousands of empty food cans of all descriptions, bringing in their trail armies of rats which made the life of the soldier very miserable. The rats had their runs in the roofs of dug-outs and behind the trench revetment which was timber shored or had sandbagged walls as protection against shrapnel only.

The lighting we used in the underground was wax candles of four, six and eight hours duration. We used to tell the time down below by the length of the candle we had left and we always took care to see that our candles were protected from draughts, particularly from the compressed air which was blown down to the head of our tunnel to improve ventilation as far as possible. But the air was generally bad and reduced the efficiency of the men working in these conditions. On occasions we were called out of the mines when heavy bombardment gave the impression that overland attacks were imminent. We had to assist the infantry who were thinly spread in our trenches and do what we could in trench fighting to repel infantry attacks. We used to work eight hours on and eight hours off for perhaps ten days, after which we went back to Meaulte, our headquarters, approximately three miles behind the front line, for a rest period. We were not relieved by any other tunnelling company at all during the many months we were engaged on tunnelling from May 1915 until July 1916 when the battle of the Somme commenced. By this time we had all our fighting galleries charged with sufficient explosive to blow craters in the outside surface, these charges were in the region of 100 tons each and left enormous craters when the explosive had done its work.

In the tunnelling companies we threw up our hats when that tunnelling work came to an end. For many weeks afterwards we were engaged in burying the dead from the first battle of the Somme and salvaging materials where this could be done quickly. Then as the infantry fought their way beyond Fricourt, we were engaged in sinking wells to get pure water for the vast armies of men fighting in the field and, equally important, for the considerable number of mules that formed the basis of all our army transport. There were many lorries of course used to bring up arms and supplies, but the light artillery and many infantry units had their own mule transport.

The Battle of the Somme continued until the end of the year 1916. Many famous bitter battles were fought by various units and the ground from Fricourt to Le Transloy in early 1916 was won at enormous cost in lives and supplies. Small French villages became famous overnight during this time: Pozieres; Longueval; Montaban; Flers; Thiepval; Beaumont Hamel and so on to the outskirts of Bapaume. There was literally not a blade of grass to be seen and burnt surfaces of the ground abounded everywhere. The third class roads we had for transport were in very bad condition. The Somme mud will always be remembered by those who fought in this region in 1916 and 1917.

After Christmas 1916 we had a long frost which literally made the obtaining of a gallon of water a major operation. The ground was so thickly populated with troops, horses and mules that water was an essential war weapon and we were engaged in sinking wells as often as we could to obtain clean water suitable for our purposes. Since we were in an advancing force we had to commence these operations almost in the front line so that when we reached water the wells would not be too far behind the line when they were finished. We got water at about thirty feet at Fricourt but as we advanced towards Bapaume on rising ground the water level remained the same and we were sinking some of our wells as deep as 150ft which took some time, although we worked night and day in shifts on the operations, we went through chalk and gypsum before we came across the water bearing stratas.

Another operation that we were engaged on in one of the battles was pipe pushing as the trenches were rather shallow. With the assistance of hydraulic pumps 2in wrought iron pipes with screw joints were pushed out from our trench until the pressure became so great that our pumps would take no more. We had one or two that stood out over the Bosche trenches like flagpole masts. However once the pipes were charged with ammonal cannisters, we waited for the correct opportunity to blow what was literally a communication trench from our front line trench to the enemy or as near as we could get. These were exploded immediately before our infantry went over in a bayonet attack and as the debris subsided, so these trenches were used for bringing back the wounded and to take up rations and stores to the advanced infantry. We had many casualties and many difficulties with underground obstruction, but it was a very successful operation.

One could write much more on the colossal difficulties of victualling an army in the field, as at the Battle of the Somme, and the terrible cost as transport had to make its way over broken roads and badly drained ground which very soon became a quagmire, particularly in the rainy season. In the preparation for the battle of Cambrai we were favoured with many days of light mist and the preparation went ahead at an enormous rate. The main line wide-gauge railways were brought up to the rear of Gonnelieu which was an enormous advantage for supplies of materials and equipment. As the advance opened it hinged on its right at Gonnelieu and went right across the front for many miles. The advance was carried out by infantry and some tanks. Whereas in the battle of the Somme we used to fight for days on end to gain 500yds, this battle gave the army four or five miles of advance in open country in a couple of days. All the troops engaged in this operation were very heartened as our casualties were light and the Bosche suffered heavily, many thousands of prisoners being taken. But alas, after about two months of digging in and advancing in 1917, we met greater resistance and the line again became static. We continued to billet in Gonnelieu for a few months and many of our company were using a tunnel we had constructed some months before for the purpose of getting ammo and supplies to the front line. It made an ideal dug-out for protection against light bombing and aeroplane attack and above all else, as winter was coming on, it was warm.

One fine morning there was a great commotion outside of low flying aircraft and retiring troops. It was very quickly realized that the enemy had launched a fairly big attack on our front, some eight or ten miles in width and indeed he broke through at this point. We retired along with the general body of troops, and German infantry were coming through very fast. Unfortunately we decided to retire over a cross country route which was broken ground and masses of barbed wire. We did this to keep away from the sunken roads which were heavily under fire from the Boche. This operation did not turn out too successful for myself as my respirator was torn by the barbed wire and very soon I was out of action by gas which the enemy were showering in the form of shells. I woke up that night many miles behind the line and was later conveyed to the French town of Gondrecourt, blinded and severely burned. Being out of the battle for some months I knew little of the details except that our Army Corps stemmed the advance of the Boche. The line became static, although in the attack we lost thousands of prisoners to the Boche and it gave him the line that he later used as a spring board for his last great advance on Paris via Albert. During the months I was away from the front line the Boche had many divisions that became surplus after the collapse of the Russian effort in the War and these were arrayed along the battle front on which I had been working for so many months.

After a few months in hospital I returned to my unit who were engaged in terrific training to resist the expected Boche attack. Some units were destined to be sacrificed. Alas others had to fight a rearguard action. I was fortunate in being with units whose orders were to retire, fighting rearguard actions as we went. After about five or six days of retirement we eventually held the ground that we had been fighting on in the early days of the War, namely the Albert-Bruay line and it was hereabouts that the force of the German attack slackened, his lines of communication lengthened and we were able to dig in and prepare for the next and final advance which ended the War.

In the final thrust into enemy held country which ended the War we advanced through in the Somme area right through to Cambrai moving forward mostly, suffering setbacks with enemy pockets of resistance until 1918 and on the final day, 11 November, we were engaged on booby trap hunting, in an advanced position with the infantry and light artillery. This was indeed a nasty job, and we had little idea that there were any negotiations proceeding for an armistice but when it did come, the news breaking with us at 11 am, the reader can imagine the great celebrations that took place amongst everyone connected with this terrible War. The army really had a party on that day after 11 am. We did not see much other than the labels on the bottles we were able to acquire!!

We were very soon organized into a company for bridge building as the Boche in his retirement had felled all the bridges on important roads and railways and there was much to be done to allow the French people to return to their homes and carry on in some kind of orderly fashion. Their country was broken and in many places completely destroyed, but the spirit of the people was far from broken.

About this time a threatening wave of illness overtook the army and the French people in thousands. If my memory serves me right this was a virulent form of influenza and people who contracted this disease lived less than a week. Apparently the medical profession could do little about it and I regret that some of my old friends whom I had with me all through the War were stricken down with this loathsome disease after long and gallant service in the forces. I knew of no-one who survived this disease at the time. I also remember that we were advised to drink rum in small quantities if we could get it and indeed a rum ration was started by the army.

Early in January 1919 I received a letter from my old firm, Leyland Motors, with a request to the army authorities to release me for special duties in civilian life. So I was sent down to the base and went through the process of demobilization, which took about four days. I was then able to start life afresh, very much wiser for the experience.

Bermuda

CAPTAIN C E E SLOAN, RE, B Eng (Hons)

THE initial discovery of Bermuda in 1503 was made not by an English adventurer, but by a Spanish mariner Juan de Bermudez. The Spaniards never settled in

BERMUDA

Bermuda, nor did others wish to, because of the treacherous reefs and hurricanes of the area which led to the island being called the Isle of Devils. However, in 1609, an English ship was driven onto the northern coast of Bermuda. This ship, the *Sea Venture*, was commanded by Admiral Sir George Somers. Surprised by the abundance of fish, birds, turtles, fruit and cedar trees on the Isle of Devils, Sir George, and many of his crew, returned to Bermuda after having successfully built another ship to complete their original voyage. More English settlers arrived in 1612 and the original capital, St George, was founded.

DEFENCE OF THE COLONY

The oldest forts around Bermuda were originally built to defend the blossoming colony. Because of its position 500 miles east of Carolina, Bermuda eventually became the home of the British North America and West Indies Squadron. This naval force was able to command the Atlantic approaches to the eastern seaboard of America and to the West Indies. The importance of the dockyard built on Ireland Island therefore increased, until, by 1793, Whitehall was able to say that the aim of all fortifications on Bermuda must be to deny access to the dockyard. In that year Captain Andrew Durnford of the Royal Sappers and Miners was instructed to begin a survey of all defence works on Bermuda. His task was to ensure that such fortifications met the government requirement to safeguard the naval installation and not necessarily the colonial settlement. It is suspected that this enterprising officer may not have kept fully to his brief, for Durnford eventually became Mayor of St George. His portrait still hangs in the original Town Hall on King's Square, St George.

It would appear that over half a century passed before the War Office once more became concerned over the security of the naval facilities. In 1865 the possibility of outright conflict with the United States was high and the American Admiral Wilkes had already attempted a naval blockade of the Bermuda Islands. The Deputy Director of Fortifications, Colonel W Drummond Jervois, was therefore sent to assess the defences of Canada, Jamaica and Bermuda. Jervois submitted a convincing report to his superiors calling for enormous expenditure upon fortifications, especially in Bermuda. The allocation of funds revealed Whitehall's intention to turn Bermuda into a fortified "Bulwark of the Empire", second in magnitude only to Gibraltar. The eventual cost of constructing harbour forts and coastal batteries was £435,000. A high price, but even so this sum did not include the cost of armament, the building of warehouses, barracks and wharves or maintenance of the garrison. Fortunately for the tiny colony of Bermuda all charges were met by the Treasury in London.

BRICKS AND MORTAR

Real efforts to strengthen the island's defences began in 1867 when Major General Frederick E Chapman became Governor and Commander-in-Chief. Governor Chapman was a distinguished Royal Engineer who used his experience and knowledge to give the initial impetus to the fortification project. Supported by General Burgoyne, then Inspector General of Fortification, Chapman's detailed plans for the island were accepted in Whitehall. During 1868 a second company of Royal Engineers was despatched to Bermuda in order to increase the strength of the Garrison to one battalion of infantry, two companies of Royal Garrison Artillery and two of Royal Engineers.

Even with the Sapper reinforcements, lack of manpower was one of the more serious problems facing Chapman. The small colony had little labour to spare for constructing fortifications and those convicts who were available were fully employed on developing the dockyard itself. Consequently all garrison units were employed in defence works. The work was extremely hard and not made easier by the humidity and blinding sun of Bermuda. To compensate for the conditions, the unpleasant diet of salt meats and the ever-present threat of dysentery or typhoid fever, soldiers received working pay. This supplement almost



doubled what they would otherwise receive. Naturally, the extra rum purchased with the pay did not assist officers in the maintenance of discipline on the lonely, sub-tropical island. Indeed, the Officer Commanding Troops found it necessary to comment in his annual report that he could only account for the increase in crime (drunkenness) in the garrison as follows:



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- (1) The men having earned a large amount of working pay
- (2) The disappointment caused by the relief of units being delayed by six months or more
- (3) An increase in the strength of Royal Engineers

The last indictment is an even greater blow to the pride when it is realized that the report writer was, in addition to being OC Troops, also the resident CRE!

To add to Chapman's difficulties all stores for the fortifications had to be brought to the colony, Local, Bermuda, limestone was available but could only be used for minor buildings such as store-rooms and barrack blocks. Rock was imported from Great Britain and Canada. Bricks, timber, nails and cement were shipped to the harbours of St George and Hamilton, where they were stored in military warehouses. On Water Street, St George, one such Royal Engineer warehouse still stands, now successfully converted into an attractive carriage museum and restaurant. Using the imported stores the garrison started work along the whole length of the colony. Under the direction of Lieutenant Colonel C B V N Nugent, 18 and 29 Companies, Royal Engineers, began construction of Forts Prospect, Hamilton and Langton. Selected tradesmen from both companies were attached to infantry and artillery companies to supervise renovation work on existing forts such as Fort St Catherine and Fort Cunningham. One company of 61st Foot was billeted in Warwick Camp, the present home of the Bermuda Regiment and where the advance element of the Spearhead Battalion was stationed during the riots in December 1977. The company of 61st Foot were tasked with building a rifle range on the South Shore. The overgrown butts and firing points are still visible among the sands which are now the favourite bathing spots of both residents and tourists.

IMPREGNABLE FORTRESS

Chapman remained as Governor of Bermuda until 1870 when he returned to London as (Major General Sir John William) Gordon's successor in the post of Inspector-General of Fortifications. General Lefroy, an artilleryman, replaced Chapman. Between 1871 and 1877, with Lefroy in Bermuda and Chapman in London, but still very interested in Bermudan affairs, work continued on the improvement programme which had started during Chapman's Governorship. Work on Forts Prospect, Hamilton, Langton, Scaur, Victoria and Albert had begun. Fort Cunningham was being rebuilt and Forts St Catherine and George were in the process of renovation. Equally, the dockyard was under constant improvement. Despite this determined activity, the fortification of Bermuda was by no means complete. When Lieutenant General Robert M Laffan was made Governor in 1877, there were another ten years of construction ahead. Unfortunately, that great Sapper would not see the end of the programme. He applied himself so industriously to the problems of the colony that his health was undermined and he died in Bermuda in 1882.

Another Royal Engineer was to enjoy the satisfaction of seeing the completion of the rebuild and re-arming of Bermuda's defence works. Major General T L Gallwey served as Governor from 1882-1888. Towards the end of his tenure the United States was no longer considered a potential threat, and in Great Britain there was a desire to economize by reducing garrisons abroad. This was also the beginning of the era of "Blue Water" defence. The suggestion being that the interests of the Empire were best served by holding a strong Royal Navy in continual readiness for action world-wide, rather than garrisoning countless fortresses with expensive and ill-employed troops. This concept was becoming popular and the War Office were able to say, in 1888, that the fortification of Bermuda was so complete that it could not be improved, not could any enemy hope to breach the defences. Work stopped on the impressive line of forts and batteries.

The major period of military construction in Bermuda was over. Further improvements to the defences did occur, mainly during World War II, but not



Photo 2. Fort Scaur commands the eastern and land approaches to the dockyard.

to compare with the extent of fortification completed between 1865 and 1888. Many of these coastal forts are still in excellent condition and provide interesting places to visit for Bermuda's tourists. Notable amongst the sites are Fort St Catherine, close to where Admiral Somers was ship-wrecked, and Fort Hamilton, overlooking the present capital of the same name.

Although the zenith of Sapper involvement in Bermuda was past, Lieutenant A J Savage was able to make a notable contribution to the colony in 1898. With the aid of a small working party, Lieutenant Savage surveyed the fifteen mile long chain of 140 islands which form Bermuda. A map was produced in 1901 from his drawings and data. This map was so accurate that it was never challenged and was used for over sixty years by the Public Works Department in the conduct of its affairs. The map was eventually superseded by an Ordnance Survey map based upon aerial photography.

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BERMUDA

BERMUDA TODAY

Tourism is now the major industry of the Bermuda Islands. Lying over 3000 miles from England, but less than 800 miles from New York it is not surprising that the greatest number of Bermuda's visitors are from the American continent. To the average tourist there is little indication of the extent of Sapper involvement in the history of one of Britain's oldest colonies. Accepted, the Royal Engineers are given favourable mention at the Maritime Museum where the



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exhibits are presented in the Queen's Exhibition Hall. This building was once a gunpowder magazine, constructed under Royal Engineer supervision, and has a magnificent groyne-vaulted brick ceiling. The original, non-sparking bitumen floor can also be seen, marked in places with the impressions of heavy powder casks. A walk through the older cemeteries also reveals the past presence of Sappers on the island. A particularly sad memorial, although grand in appearance, lists those non-commissioned officers and men of 4 Company, Royal Sappers and Miners, who died of typhoid fever in the first half of the nineteenth century. However, to obtain even the briefest of outlines on Royal Engineer activity in Bermuda, it is necessary to visit Bermuda Library. This shares a fine colonial building with the Historical Society Museum in exotic Par-La-Ville Gardens, Hamilton. The building was initially the home of W B Perot, whom philatelists will know as being the postmaster who made Bermuda's first postage stamps. Regrettably the library military archives have been returned to England. Nevertheless, much of the information offered above was found without great effort in the quiet reference room. Bermuda today is a bustling tourist centre with every modern distraction a holiday-maker requires. Yet there are many reminders of its interesting history to be seen and Royal Engineers have been closely associated with important periods of that history. For Sappers fortunate enough to visit Bermuda in the future, perhaps this short article will assist them in further enjoying the experience by revealing some little known ties which they could pursue in moments of quiet or leisure.

Siege Exercise at Chatham 1907

BRIGADIER J R E HAMILTON-BAILLIE, MC, MA, C Eng, MICE

IN the December 1977 issue of the *Journal*, Colonel Clifford, in his article on the "Early History of Sapper Tunnelling", made a brief mention on page 271 of mining trials at Chatham in 1907. The Medway Military Research Group recently discovered in the Institution Library a printed and bound copy of a report (1) on these Siege Exercises. The printing and binding, typical of those more lavish and unhurried days, have been rewarded by the survival of this interesting document.

The Girdle Forts at Chatham have been described in a number of articles (2) (3) (4). Briefly however their history is that, though proposed by the Royal Commission of 1860, for lack of money work on them did not start until the seventies and continued intermittently until the end of the century. As a result the forts were varied in type and, by the time they were finished, almost obsolete. The five major forts were on the chalk ridge to the south of Chatham, and, from right to left, were Borstal, Bridgewoods, Horsted, Luton and Darland.

The exercises were inspired by the Russian defence of Port Arthur, where forts very similar to those at Chatham held out for seven months in 1904-5 against 50,000 Japanese. At first the Japanese assaulted with their usual bravery, but were mown down by fire from the Russian caponiers and counterscarp galleries. They were forced to undertake formal siege operations such as would have been approved of by Vauban, and finally took two key forts after tunnelling beneath them and exploding mines.

As a result the British Army decided to brush up their knowledge of siege operations and write a new manual on the subject. Manoeuvres against the Chatham Great Lines had been held in 1876 but the army had had no operational experience of sieges since the Crimea. The first step was to hold new exercises, for which the outer defences of Chatham were selected. The first was what they called a *Staff Ride*, and which in more modern times would have been called more prosaically a *Tactical Exercise Without Troops*. Though the last of the Forts had been completed only eight years before, these were already outdated, as the increased range of guns meant that they were too close to the dockyard they were built to defend. This was overcome by assuming the forts to be twice their real distance from Chatham. The setting was also made more acceptable to the "Blue Water School", who relied on the supremacy of the Royal Navy, by assuming that England was joined to the continent by a neck of land near Dover. The Staff Ride recommended attacks on Darland and Luton, but for the next stage which was to be actual attacks by troops, Luton and Bridgewoods had to be selected, to keep the works on War Department land and avoid houses and public roads – exercise restrictions with a familiar ring to modern ears!

The attacking "Blue" forces consisted of two Companies of Royal Garrison Artillery, two and a half Fortress Companies, with a Balloon Company Detachment and Searchlight Detachment, Royal Engineers (20,34 and half 42 Fortress Coy RE, Det 1st Searchlight Coy RE, Det Balloon Coy, RE), half a regular infantry battalion and, for the assault only, a Volunteer Infantry Brigade, a total of 2528 officers and men. The "Red" defenders had about the same strength in regular troops, (21, 39 and half 42 Fortress Coy RE) but only two RE Companies from the Volunteers (1 Cheshire and 1 Flintshire RE Volunteers).

The real exercise started at a stage in the attack where the last "parallel" or infantry trench had been reached at about eighty yards from the forts. The approach to this position by "saps" leading forward from parallels further away was assumed to have been completed, but this "last infantry position" was actually dug. The defenders at the same time constructed machine-gun positions, overhead cover for riflemen, etc on the ramparts of the fort, and also built some improvised field defences in the intervals between the forts. These were substantial works, and the remains of some can still be seen on the right flank of Fort Bridgewoods. The artillery on both sides constructed batteries for heavy guns, though in most places they seem never to have got the guns to emplace in them. They must have had a comparatively dull time.

The balloon was with the Attack throughout and made observations at ranges of 6000 to 300 yards. The new works made by the Defence were located. It could have been used to observe artillery fire, but it was thought it would itself have been vulnerable to artillery. It was tried at night and could not be seen by the Defence at 500 yards, but little more could be seen from it than from the advanced trenches. A "free run" was not tried because of unfavourable weather. The searchlights were with the attack except on one night, when they were tried out illuminating the ground in front of the forts and another, when three 30cm projectors were used by the Defence and three 90cm and one 60cm by the Attack, at a range of 1500 to 1700 yards. These were found to be very effective in dazzling the defenders even when the latter had the smaller lights; a use for searchlights that was again found to be valuable in World War Two.

The attacks proper started at the beginning of July and from then on the main operations were mining by the sappers of the Attack and countermining to try and intercept them by the Defence. Both mines and countermines were tunnelled in the chalk four or five feet high and two feet wide. Apart from a little timber at the shafts and entrances they were unlined, as the chalk stood safely without support. Plans of the attacks taken from the report are at Figures 1 and 2.

To start with the attacks on both Fort Luton and Bridgewoods followed the same pattern. A "mine trench" was dug about forty yards from the face of the fort to be attacked, and connected to the "last infantry position" by saps. In the mine trench four shafts were sunk and horizontal galleries started towards the fort. Meanwhile the defenders sank shafts in the fort ditches (again four each), and tunnelled outwards. These countermines branched left and right





Figure 1

after about forty-five feet, the branches eventually meeting to form a continuous "envelope" or gallery in front of the fort ditch. The defenders listened for the sound of the attackers picks, and when they thought they had detected it, branched from the envelope towards it. When they calculated they were near enough they claimed to the Directing Staff to explode a suitable charge, say 30 lbs of gunpowder. The Directing Staff who of course had plans of the galleries of both sides either accepted this as imaginary, awarding either "no effect" or so many hours delay to the gallery attacked, or alternatively allowed the charge to be placed and fired in reality; in this event they naturally warned the other side so that their tunnellers were withdrawn to safety. The charges fired were calculated as camouflets, ie to blow in the hostile gallery but not to break surface. After about three weeks the attackers were about twenty yards from the fort ditches. They then exploded four mines in front of each fort, large enough to form craters. The craters were occupied by assault parties of sappers and infantry, and subsequently connected by a trench constructed by sapping.

The Attack now took different forms at Luton and Bridgewoods. At Luton, after a new shaft at the crater trench had met a defensive gallery, approaches were made by "blinded sap", ie shallow cut and cover tunnels, with three feet of overhead protection. The Defence evidently considered this unfair, and their claim that the blinded sap, though only advanced at night, could have been stopped by guns, mortars, or grenades was accepted by the Directing Staff in the final summing up. At the time however they could only start new countermines at a higher level than before. To do this the concrete counterscarp revetment was cut through with explosive ten feet from the bottom, and galleries driven forward from there. With considerable help from the Directing Staff two of the attackers covered saps advanced, one branching into three and the other into two before reaching the top of the counterscarp at five points equally spaced twenty feet apart. Here eighteen foot deep shafts were dug and charges each of 225lb of gunpowder placed a few feet behind the concrete revetment. These were exploded simultaneously on 2 August (see photograph 1). The counterscarp revetment was destroyed and enough spoil thrown into the ditch and piled against the scarp to make a "practicable breach" (see photograph 2). This was later assaulted by the volunteers. The defence claimed that this would have been repulsed by rifle and machine gun fire from the parapet, and from temporary caponiers that they had built in the ditch during the attack. The Directing Staff gave no ruling on this. The use of caponiers is interesting, as ditch flanking arrangements such as these had gone out of favour during the last years of the construction of the Chatham Forts.

Colonel Sydenham Clarke had convinced everyone that frontal magazine rifle and machine gun fire could stop any unprotected assault on a prepared position. The Great War was to show that he was right. However counterscarp galleries and caponiers had been used with success at Port Arthur, so were perhaps temporarily back in fashion. Finally the Defence were allowed to blow some counter mines that the Directing Staff had earlier disallowed.



Figure 2



noto 1. Luton Fort. The explosion.

At Bridgewoods the advance from the crater trench was made in a more orthodox fashion by low level galleries. Attack and Defence galleries twice broke into each other, and the Directing Staff had to adjudicate on the outcome. However by 2 August four attack mines had been laid, one of four charges of 201b of tonite in contact with the inside of the counterscarp wall and three, each of one 201b charge of tonite against the back wall of the counterscarp gallery. The charges were fired together, blowing a fairly large hole in the



Siege Exercise at Chatham 1907 (1 & 2)



Photo 3. Bridgewoods Fort. The damage.

counterscarp (see photograph 3), and small holes into the gallery whose wall proved to be 2ft 6 in thick, not four feet as expected. The attackers claimed they would have occupied the gallery and would have been able to mine or sap across the ditch preparatory to blowing down the scarp. The Defence, of course, claimed they would have been able to prevent it, and mounted a machine gan in the long passage leading back into the fort from the gallery. Again no ruling was made. The Defence here, as at Luton, were allowed to blow some countermines on the next day.

This was the end of the mining stage of the exercise. The infantry assaults, on Luton and on some of the field works, took place during the next few days, and operations ended on 10 August, except for those employed in clearing up-

The conclusions were that the exercise had been valuable, that good lessons had been learned, and that it ought to be repeated. It apparently never was, but perhaps some of the lessons were applied a few years later in the extensive mine warfare on the Western Front, culminating in the attack on Messines Ridge where 1,000,000lb of ammonal were fired.

The forts themselves were carefully repaired and little sign of the damage can now be seen, though the shaft of a countermine remains in Bridgewoods ditch.

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Siege Exercise at Chatham 1907 (3)

Cyprus Sappers Trek the Troodos Trail

MAJOR J M BICKFORD, RE, B Sc, C Eng, MICE

THE first route from Limassol to Troodos, constructed by Sappers in 1879, was re-trodden by members of 62 Cyprus Support Squadron RE last September. Details of the route came to light when Major Arthur French (1 R Irish) visited the Squadron one morning in early April 1977. He had just arrived with his battalion on a six month tour. He showed me a ninety-eight year old Engineer Completion Report written by his great grandfather, Major J H Maitland RE, dated 14 July 1879. The script of the report was historically interesting and described construction problems in fascinating detail. Maps of the alignment were so accurately drawn, with detailed shadowing showing all ground features, that I was able to transcribe it onto the current 1:50,000 scale series. Much of the route turned out to form the alignment of present day roads (see sketch map) but following it where it meandered through mountainside seemed likely to prove a map-reading challenge.

To commemorate the construction, I arranged for the British element of the Squadron to walk the route during their annual training camp. So between 12 and 19 September thirty six men in four Sections participated. They started with one foot in the water at Limassol seafront and walked the first day to a point just north of Dhoros. All requirements for the march and the overnight stop were carried. On the second day the parties climbed the steep slopes to Troodos and continued on to the top of Mt Olympus (1,952m), the highest point in Cyprus.

My purpose in this article is not so much to publicize the Squadron's trek as to re-tell the story of the road construction. So back we go in time to June 1878 when Great Britain took over the administration of Cyprus from Turkey on the condition that Britain would assist Turkey in the event of her being attacked by Russia. A small British Garrison was established and the 1st Battalion the Royal Sussex Regiment, together with Royal Engineers, Ordnance Store Corps, Medical Staff Corps, Commissariat and Transport Corps were the first troops on the island. Their camp was established at Polemedhia, three miles north of Limassol.

Major Maitland's report tells how in the autumn of 1878, a Lieut Colonel made an extensive reconnaissance of various sites for summer quarters for the troops and in mid-December reported strongly in favour of the slopes of Troodos to the north of Platres. The Governor General endorsed the proposition, which included the formation of a depot at Limassol and the construction of a road from the coast to the proposed cantonment. Consequently Headquarters 31st Company Royal Engineers moved from Mathiati to Limassol via Larnaca over Christmas 1878 and took over hired houses in the town. On 14 January 1879 Major Maitland put forward his proposals for the alignment of the road. During fourteen days of reconnoitring he had had to examine four possible main routes with six to eight variations in each. There was no time to make a survey of the country and decisions had to be based upon field sketches. The line eventually chosen was the one which presented fewest serious engineering problems.

It is of interest to note from other records that in September 1878 Field Marshal Lord Kitchener, then a young officer, arrived to plan a survey of the island. He departed, still at the planning stage, in mid 1879 but returned a year later. Then from his bungalow (which still stands) in Polemidhia Camp he organized the survey of the first "1 inch" map of Cyprus.

The proposed road alignment was divided into three Sections each about ten miles long. Each Section was placed entirely in the charge of a Sapper Lieutenant. The thirty four mile road extended only to Platres; from there on all supplies had to be carried by mule along a special track constructed from Platres



to Troodos. The estimated cost of £350 per mile proved to be accurate in the event; the actual cost was £11,900 including bridges. Work started on all Sections in late January/early February 1879. A detachment of Sappers was appointed to each Section and up to 6,000 local labourers were engaged to undertake the bulk of the task.

"Work being once begun was quickly pressed on, and as workmen came in new gangs were formed until there were fifteen parties working at different portions of the road. Native overseers were appointed to every twenty five workmen, and over each gang of 150 or so a non-commissioned officer or sapper, Royal Engineers, had charge; as far as possible the gangs were kept apart by villages or nationalities, and no overseer (unless he showed unusual promise) was appointed unless he brought twenty five men to work under him".

Money worries as usual

"During the progress of the works there were no fewer than eight distinct attempts on the part of the work people, to impose their own terms as to wages, length of working hours, etc, which required a good deal of tact and management.

"At the very commencement, at 1 shilling a day first being called for, many workmen came for employment, but all refused steadily to work under 2 shillings a day.

"In this way they were somewhat supported by the municipality of Limassol, who were employing labourers at 10 piastres, (1s 8d) and who had fixed that as a fair wage for a lighter day's work than was required on the road. At the advice of Signor Bistache, a body of about seventy labourers were brought over from Mathiati, where they had been employed in road-making before, who began quietly to work at 1s a-day; and immediately (care having been taken that they were not molested) the rates of wages fell throughout the district, and as many labourers as were required could be got for 1s a-day."

"In the latest instance, a large gang stopped work and sat down without orders. On being told to go on working, all complied except two, who attempted to make the others leave their work, and resisted the attempts of a corporal and sapper RE to remove them. There was a party of sappers working at a bridge near who came to assist, when the whole gang assumed the offensive, in support of their countrymen, and the situation began to look awkward, there being nearly 200 men, armed with their knives and with pickaxes, against six Royal Engineers, a long way from help, when the corporal told them he would stop all their working pay. This at once introduced a new line of thought, and the whole gang proceeded up to the headquarters of the company, to appeal against their pay being stopped, and forgot the original dispute.

"On arriving at the camp, the ringleaders were at once put under charge of a guard, and, the case having been investigated, were sent into Limassol for the Commissioner to punish, and the remainder of the gang were told their services would not be further required. They had managed to make the time of their *emeute* (riot) coincide with a monetary necessity for reducing the parties".

"Many of the tools left in the 'Indian Park' by the sappers and miners turned out to be very bad; the pickaxes worst of all, the heads being of bad metal, which twisted into all conceivable shapes, while the helves broke off straight across, as if the teak had no fibre at all. The hard work, road making at Mathiati, had played havoc among the wheel-barrows; and when the number required for works at Larnaca had been deducted from the effective wheel-barrows left, it was found, about the 8th of February, when the work on the road had already been commenced in several places, that we had a proportion of one barrow to every two miles of road. The unusual course had to be adopted of giving a large order for wheel-barrows to a local merchant, who manufactured them in a very short time...."

"They were very bad wheel-barrows, as might have been expected, but they were cheap, and they served their purpose; and with them the road has been made. Without them (and no others were procurable) this would have been impossible".

Time and cost prevented the completion to permanent standards of many bridges. Abutments were properly finished but piers were carried up to the springing of arches to be placed at a later date. In the meanwhile timber trestles and beams were used instead. Quarries had to be opened near the principal bridges, but in Section 2, where most masonry was required, all stone had to be carried about four miles on mules and donkeys.

Good cement was to be had at 15/-a barrel but its transport was a difficulty. No camels could traverse the country at first and no smaller animal could carry the barrels. Two barrels were too heavy for a camel so all the barrels had to be opened and the cement sent up in sandbags.

"The lime throughout has been of bad quality, but chiefly from being badly burnt. There being no demand for lime before the 'occupation', the supply has been from hand to mouth, and there have been many delays for want of lime. The Commissioner of Limassol having contracted for a large supply of lime, which he afterwards found he did not require, the whole of it was bought from him on condition that it was ready for issue as required; but much of this lime when bought was unburnt, and further, the price of lime having more than doubled in consequence of the stoppage of wood cutting, etc, the contractor preferred to supply the general market at the increased rate to supplying us at the contract price; the lime on hand soon came to an end, and we have been obliged to obtain lime from the other side of the island, and to charge the difference in price to the municipality of Limassol. This caused a long delay, however, in the works of No 2 Section".

Animals play their part

Creosoted "sleepers" (beams) had been sent from England for the construction of huts at Troodos but were not required for this since there were thousands of trees lying already felled in the area. Instead the sleepers were used extensively as beams for the smaller bridges and piers for the larger ones.

"Their transport was a great difficulty, as two of them - one on each side made too heavy a load for an ordinary mule. Company Sergeant Major Drew, however, devised a sort of cradie, with which one of these sleepers was supported longitudinally over the mule's back, which answered admirably; and many hundreds of these sleepers were thus conveyed up country. Both the muleteers and their mules very much disliked the carrying of these sleepers, which they appeared to consider unnatural, as being unlike anything they had ever seen before. On one occasion two mules were met on the road, one carrying the immense load of two sleepers, one on each side, the other carrying the two cradles in the same way.

"As the road progressed out from Limassol the heavy beams for the nearer bridge were conveyed on devil carts, drawn by the Company mules, and great praise is due to the drivers and to Sergeant Scott for the patience and care with which they performed this difficult duty.

"On Sections 2 and 3, where it was obvious that these beams from the coast could not be brought up until the intermediate bridges were completed, similar beams had to be requisitioned.

"In every village some were lying, and when they found they had to give them and that they were paid a fair price for them, the natives were quite pleased with the transaction and themselves assisted to move the beams down to the bridges. Their mode of using oxen (one pair only) to drag 13 inch square beams, of 30 feet long, is very simple and ingenious. The oxen were led over one end of the beam and a purchase of rope or withles is fastened as tight as possible from the yoke to the beam. The oxen are then driven forward and the purchase, which before was perpendicular, becomes slanting, and having before been perfectly tight, lifts the end of the beam ever so little, and the weight of the oxen drags the whole mass slowly but steadily along. With several relays of pairs of oxen to relieve one another, the large beams were brought over very rough ground, up hill as well as down, to the places required". *Many hands make light work*

Both military and native work forces were employed along the route and the report has various comments to make about each;

"The services of the Royal Engineers have been chiefly used in superintending natives, and making bridges, and at first, before the line parties and natives could be trusted, to handle the jumpers, in blasting rock. In each capacity they have done most excellent work.

"The infantry working parties were not sent until nearly a month after the date on which they had been asked for, and when they came they had only a total strength of 200 instead of, as demanded, a strength sufficient to provide

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a working party of 200. The number on the works was therefore only about 140 after the 200 was reduced by guard, duty men, sick, and prisoners. In making their way %hrough heavy cuttings of hard rock, the men of the 20th proved most valuable, and altogether worked well, and did very good work.

"In view of the very large amount of labour required to construct such a road as that spoken of in two months, an attempt was made to import Arab or Druse labourers from the Lebanons. Only one batch, however, of about fifty had arrived, when a panic about 'the plague' caused a quarantine to be put on Syria, and no more of these workmen could be brought across."

The proportion of Turks to Greeks employed on the road never exceeded one to ten. When at work the Turks worked harder but they stopped more often to smoke. They were also more difficult to keep under discipline.

"By far the greater part of the work force were (Greek) Cypriots who did a 9½ to 11 hour day's work for 1/-. They are lazy workmen and require constant supervision, and it was very difficult to make them understand the work they were doing; if ever they got a chance of starting a bit of road to go up or down a steep hill, instead of along the contour, or of taking it in a line that must inevitably end in a tunnel, they invariably did it, and the patience of the officers and men who had to superintend the long line of road was often tried to the uttermost. Every feast day and every Saint's day is with them a holiday, and at Easter they stopped work altogether for nearly a fortnight.

"Great numbers of women were employed on the works, chiefly at first in fetching stones for ballast and placing them by the proposed track. Soon, however, it was found that they could pack the ballast better than the men, so this and the breaking of the stones for metal were added to their employment. Later on many women were employed as ordinary labourers, with pick and shovel, and after learning their use, being quite as strong as the men, less lazy, and paid at a lower rate, they made themselves very useful.

"The Turkish women, as a rule, only brought up stones in paniers, or on boards, arranged on each side of donkeys. At one place, however, a gang from Seleikon was employed at breaking stones, which they did in a futile way, with



Cyprus Sappers trek the Troodos Trail (1)

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one hand, while with the other they held their veils over their faces — this was while their husbands were near; but Lieutenant Bagnold requiring to form a new gang, sent the husbands to work about two miles away; very soon the yashmaks were abandoned, and the women, squatting on the ground, hammered away with both hands in all their native ugliness.

"Children, both boys and girls, up to a certain size, were used to collect stones for metal, and bring them in baskets. Very good results were obtained from the employment of these little creatures, who worked with a will, and often used to run back to the place they were getting the stones from after emptying their baskets. "After some heavy rains at the beginning of March, the season for pruning

"After some heavy rains at the beginning of March, the season for pruning the vines arrived, and great numbers of the workmen said they were going to leave road making for this purpose. It being of great importance to get the work done quickly, application was made to the Commissioner of the district to put in force an ordinance by which any adult Cypriot male can be required to perform thirty days' labour per year on Government works, to the extent of providing 300 labourers on Sections 1 and 2 of road. This was done by sending Zaptiehs into the distant villages, and ordering in a proportion of the inhabitants from each. These enforced labourers came most willingly, and worked well. Many of them said they would have come before had they known that 1s a-day was t. be had for wages, or that Government works were going on. Not a single complaint was heard as to ill-usage.

"Although ordered in to work they were allowed to go away when they pleased, and when they were all dismissed, as after about a fortnight they were, by order of His Excellency the Governor-in-Chief, they sat by the road side and clamoured for employment."

The report goes on to describe the road in detail and explains engineering problems encountered en-route such as landslips, crumbling cliffs, lack of money and damage to the road by mules.

"The manner in which mules follow one another in identically the same track is absolutely destructive to a road, and forms a channel for water to pour along, which will destroy any road in a single winter. In all the steep parts of the road a mule track has accordingly been made, which crosses the zig zags by



Cyprus Sappers trek the Troodos Trail (2)

the shortest possible line of ascent... The only good road I know of in the Levant is that from Beyrouth to Damascus. On that there is a prohibitive tariff put on mules, viz, 3 piastres a mile, so that the mules use a track of their own alongside of the road."

Finally the report warns of work to be completed before winter. In particular a bridge over a deep gorge near the start of Section 2 needed to be stayed with chains on both sides since the trestles were extremely tall and the position of the bridge was exposed to strong gusts of wind blowing up the gully.

The descendant ascends

On 16/17 September 1977 Major French and I walked the route with one of the Sections. My only regret about the occasion was that the road had not been built two years earlier than it was, making 1977 the centenary. However the historic event of the Project Officer's grandson accompanying us was sufficient compensation.

For much of the alignment the tarmac of present-day roads had been laid directly upon the old cobbles. Away from the roads however, the old construction winds unaltered through a rough countryside of vineyards and ravines, little touched by modern progress. All four Sections had a different tale to tell of the steep mountainside between Platres and Troodos. My Section lost the track above the beautiful Caledonia Falls and had a very strenuous experience scaling an unstable 80m scree slope.

After reaching the summit of Mt Olympus we finished off the trek by visiting Troodos Military Cemetery. Here the earliest graves are of five Royal Engineers who died the year the road was built; sad for them that they never saw their splendid achievement put to use.

The Chieftain Bridge Layer

MAJOR M A NAPIER, M Sc, C Eng. FICE, MI Mech E and T S PARRAMORE, C Eng, MI Mech E

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M A Napier M Sc, C Eng, FICE, MI Mech E was educated at Canton High School and University College, Cardiff. After service in the Royal Engineers and at AWRE Aldermaston he was appointed to MEXE Christchurch (MVEE) in 1955, being between 1963 and 1970 the Mechanical Bridging Group Leader. He has subsequently been Assistant Director Defence Quality Assurance Board Executive and currently is Director Quality Assurance (Fighting Vehicles and Engineer Equipment) Royal Arsenal, Woolwich.

T S Parramore C Eng, MI Mech E served a student apprenticeship in aeronautical engineering at Short Bros, Rochester, followed by a period in the Research Department. After three years with the De Havilland Aircraft Co, employed on structural research, he joined MEXE Christchurch (now MVEE) in 1950, where he was engaged in the design of a wide range of military engineering equipment and was responsible for the concept study of the Chieftain bridge layer. Following a period of six years in work concerned with lightweight power generators, he returned to his present branch, and is now Group Leader responsible for the design and development of assault bridging, including the Chieftain AVLB.

The article describes specialized equipment developed for battlefield conditions and requiring the marriage of mechanics, materials science, the design of structures and advanced design of hydraulic systems to mention but four of the major disciplines involved. Each branch of engineering was asked to give of its ultimate and, in at least one case, the designers had to search abroad for their requirements. The result is a highly-specialized machine/structure for the rapid bridging of obstacles up to 75ft (22.8m) and capable of carrying vehicles of up to 60 ton in weight.

THE specialized requirements of the Army often constitute a considerable challenge to engineering design and result in interesting developments. High mobility is essential in modern warfare and demands that heavy vehicles should be able to cross rivers and ravines without delay. One means to this end is the tank-launched bridge shown in Fig 1.

This bridge can take vehicles of up to 60 ton over a clear span of 75ft (22.8m) and is carried and laid by a Chieftain tank without its gun turret but fitted with a hydraulic launching mechanism. The three-man crew has the same protection as that provided by an ordinary tank. The bridge, the overall length of which is 80ft (24.4m) is hinged at the centre and folded during transport to reduce its stowed length to a little over half. When the tank arrives at the site, the bridge can be lowered into position, as shown in Fig 2, by a series of hydraulic cylinders controlled from within the tank.

For smaller gaps a bridge of 44ft (13.4m) length has been designed that can be carried in one unhinged length and launched in a similar manner.

OPERATION

The bridge is launched in three stages, each of which can be controlled by either the driver or commander. Hydraulic power to the five cylinders in the launching mechanism is provided by a pump run off the main engine.

The bridge is normally carried horizontally above the tank where it is firmly clamped to prevent movement. Once the clamps have been mechanically removed, the launching sequence (Fig 3) begins with operation of the Stage 1 cylinders that pivot the folded bridge about the forward part of the hull casting. This continues until the launching pad meets the ground or the cylinders reach the end of their stroke, when the folded bridge will be at about 30° to the horizontal.

The Stage 2 cylinders are then operated, tilting the launching pad on the ground until it is approximately level. The bridge is unfolded by means of tension rods connected at one end to the launching frame and at the other to quadrants which are pinned to the far half of the bridge. As the bridge is lowered, the rods rotate the far half to the horizontal.

When the Stage 2 cylinders have reached the end of their stroke, the single Stage 3 cylinder is actuated, lowering the bridge until the end reaches the far bank. At this point the rods will slacken and, on further lowering, the bridge



The Chieftain Bridge Layer (1)



The Chieftain Bridge Layer (2 & 3)
becomes a rigid structure as the top chords butt together at its centre joint. The rods will then be quite free and can be detached from the launching structure, using the remotely operated release mechanism. By reversing the tank, the launching structure is removed from the bridge and the tank may retract all its cylinders and proceed to a rear area to pick up another bridge.

The bridge can be recovered from either end but this requires the emergence of the crew from the tank to recouple the launching rods, dig out embedded ends of the bridge when necessary and guide the launching arm probe into the lifting beam. This beam is pivoted at each end on spherical bearings, to allow the probe to enter with the launching arm at varying elevations. A conical hole is provided in this beam to simplify the probe's entry. After the launching rods are reconnected manually, the launching sequence is reversed, folding the bridge back to its horizontal position on the tank.

MATERIAL

The 80ft (24.4m) bridge had to be designed within a weight limit of 12 ton and a folded height of 6ft (1.8m) in order to achieve acceptable mobility for the launching vehicle. This demanded a material with a high strength/weight ratio, high modulus (for acceptable central deflection, particularly under eccentric loading) but with adequate ductility throughout the climatic temperature range, good weldability and low distortion. The launching structure itself (Fig 4) also needs a high strength/weight ratio.

The chosen material was a strong, 18 per cent nickel-alloy maraging steel developed by the International Nickel Co with a nominal 0.2 per cent proof stress of 90 ton/in² (1390MN/m²) yet possessing high toughness and impact resistance. Three main grades of maraging steel were available, containing 18, 20 and 25 per cent nickel, respectively. The first of these was considered the most attractive because it was easiest to work in. It may be subdivided into three sub-grades, each containing 8 slightly different percentages of the other alloying elements, Co, Mo, Ti, Al, etc, giving 0.2 per cent nominal proof stresses of 90, 110 and 125 ton/in² (1390, 1699 and 1931MN/m²) respectively.

Since the first of these is the most ductile and produced by melting in air, it was considered to be the most suitable. The annealed structure is essentially a carbon-free iron-nickel martensite. Unlike the hard, brittle martensite of conventional low-alloy steels, it is soft, readily machined and formed.

The as-rolled material is martensitic at room temperature but reverts completely to austenite on heating to 850°C. On cooling the material transforms back to martensite and requires only a simple maraging treatment (typically 3



The Chieftain Bridge Layer (4)

hours at 480°C) to develop its properties. During this heat treatment no austenitic reversion occurs but instead the martensite is strengthened by precipitation and matrix reordering.

The dimensional stability during maraging is exceptionally good, so that the complete structure can be welded together without pre-heating and then placed in a furnace at 480°C in order to develop the full properties in the weld metal and restore the strength of the heat-affected zone, without fear of distortion.

There were some difficulties in the supply of this material early in the development phase, as it had not been previously made in the UK in any quantity. However, the British Steel Corporation is now producing all the material required for the production contracts. Apart from the hinge fittings and scissoring mechanism, the bridge structure, including girder webs and flanges, is made entirely of rolled plate, hot formed where necessary to make the angle sections. This is possibly the first application of rolled plate in this material.

Certain pin joints on the launching mechanism of the vehicle were designed for bearing stresses considerably higher than those normally recommended for moving joints. Since design to a more normal bearing stress would impose severe weight and size penalties, a series of "ad hoc" tests were initiated to evaluate maraging steel under high bearing stress. Considerable improvement in life was achieved by nitriding the pins.

Originally the forgings for jaw blocks etc were air melted sections, like the plate, but a study of the fracture mechanics of this material under plane-strain conditions indicated that the critical defect size was only about 3/16in (4.72mm). Even with the most rigid radiographic inspection of the welds in the highly-stressed areas, such small defects could be difficult to identify. By using double-vacuum melted material under plane-strain conditions the critical crack size was increased to about 3in. This process has therefore been specified for all production forgings.

No special corrosion protection, other than normal three-layer painting, has been found necessary for this type of steel.

STRUCTURAL DESIGN

The proof stress of 18 per cent Ni-alloy maraging steel is 90 ton/in² (1390MN/m²) and therefore too close for comfort to the UTS of 110 ton/in² (1698MN/m²). However, the criterion for design was the permissible stress under the working load for the required fatigue life of 10,000 full-load vehicles crossings at maximum span. From the SN curves for the material this stress was established as 48 ton/in² (741MN/m²) which then gave a maximum static stress under the proof overload conditions of 72 ton/in² (1112MN/²). The fatigue life has been verified by full-scale laboratory tests on a production bridge.

The construction is all-welded with a basic girder section consisting of a 3/16 in (4.72mm) thick web with top and bottom chords welded up from folded sections. The top chord is of hollow rectangular section to resist lateral buckling and the lower tension chord is of hollow triangular shape to shed dirt and mud. All the stiffeners are on the inside face of the web to keep a clear outer profile, U sections being used under the cross girders and plain stiffeners in between.

The hinge forgings are attached by means of slots that accept the web plate and have fillet welds on either side. The forgings are scarfed onto the chord sections with further fillet welds. All welding is by the MIG process, using a 1/32in (0.80mm) or 3/64in (1.20mm) filler wire of similar composition to the parent metal.

The decking is constructed from longitudinal stringers consisting of extrusions in a strong aluminium-zinc-magnesium alloy, welded together longitudinally and bolted down to the cross girders. Raised ribs on the upper surface of the extrusions are intermittently machined away in castellated fashion to form a good gripping surface for wheeled and tracked vehicles. THE CHIEFTAIN BRIDGE LAYER

The two tracks of the bridge are interconnected by bracing frames and lifting beams (Figs 5(a), 5(b) and 6) pin-pointed to provide limited articulation so as to accommodate 'uneven bank seats without imposing undue strain on the structure. This limited articulation is achieved without positive stops but progressive stiffness is provided by making the centres of rotation of the bracing



The Chieftain Bridge Layer (5)

frame near the centre of the bridge different from those for the lifting beam. In this way one track can only move relative to the other by twisting and its torsional stiffness gives the right order of load transfer across the girders for eccentric loading and/or uneven bank seats.

The 44ft (13.4m) bridge is capable of spanning clear gaps up to 40ft (12.2m). Its construction is similar to the longer bridge but, as there was no weight problem, it was designed in a medium-strength structural steel to BS 4360 grade, 55E, which gives an overall weight of $8\frac{1}{2}$ ton (8700kg).

The launching structure is fabricated from maraging steel, the main structural members being of rectangular hollow section. Because they are difficult to obtain they were made by welding four plates together at the edges.

In the event of damage it is possible to repair the structure by welding. A local ageing treatment is then required to bring the repaired areas back up to strength. It was therefore essential to find some means by which these welded repairs could be managed in the field, without having to transport any section back to a large furnace. This has been achieved by employing portable electric heating elements which are strapped to the affected area, covered with thermal lagging, and powered by a low-voltage transformer.

THE HYDRAULIC SYSTEM

Calculations indicated that the optimum system pressure should be 4000lbf/in^2 (276bar). The maximum static thrust required from each of the Stage 1 cylinders is 28.3 ton, from the Stage 2, 59.3 ton, and the pull required in the third stage is 168 ton.

A variable-displacement axial piston pump is used, the variable angle of the swashplate being controlled by a constant pressure servo. This pump has a delivery of 22.5gal/min (120 l/min) at its max rated speed of 3750rev/min, which is equivalent to 53hp at the rated pressure. It is driven from the tank's main engine through a step up gearbox, which also drives a centrifugal boost pump.

A small standby pump is fitted, driven by a 24V electric motor, and there is also a high-pressure hand operated pump for emergency use, as shown in Fig 7.

The flow rate of the main pump was chosen for the desired stroking speed of the largest ram. When the flow required is reduced, the pump delivery is automatically adjusted, so that there is no unnecessary circulation of oil, which eliminates the need for heat exchangers. The system is protected by a separate relief valve, set at $50001bf/in^2$ (345bar) and built into a single body with two non-return valves, as shown in Fig 7.

To protect the fine clearances in components of the hydraulic circuit from damage by debris, a full flow high pressure filter is fitted on the pump outlet and low pressure filters in the return lines to the reservoir. The standby electric pump or hand pump is used for filling the reservoir through these main return line filters to ensure that only clean oil enters the system.

The type of swashplate pump used in this system is very sensitive to damage by cavitation, and it is necessary to ensure that the back pressure at the pump outlet is maintained above 1500lbs/in² even under conditions of a following load on a ram, when the pump load could drop to virtually zero. For this reason a special pressure maintaining valve is fitted in the pump delivery to the selector valves.

The pump feeds three manifold mounted selector valves that control the motions of the hydraulic cylinders. These valves are operated by pilot pressure controlled by solenoid valves, actuated by switches on the control panel. These pilot valves can also be operated manually in the event of electrical failure. Each selector valve is spring loaded to the central neutral position, and with the solenoids de-energised the pilot lines are connected to the reservoir and the pressure lines shut off, preventing any ram movement.



Fig 6. Tension in trackway when articulated.

The hydraulic cylinders have to accommodate reversal of load during the launch cycle so that a following load occurs, that is the load acting in the same direction as the travel of the ram. Under these circumstances the high pressure has to be developed on the exhaust side of the piston, the pump supply merely keeping the other side of the piston from cavitating. The maximum speed of the ram is limited under these conditions by a restrictor in the exhaust line, but under conditions of reduced pump speed (and hence delivery) no speed control would be possible, the pressure maintaining valve would merely protect the pump and cavitation could occur in the cylinder.

To prevent this happening speed control valves are fitted to the manifold block on the output side of the selector valves. These ensure that a ram cannot move until a pre-set pressure is generated on the "following" side of the piston.

This gives full speed control of the rams proportional to engine and pump speed, with a significant operational advantage as the speed of launch is under the control of the crew, who can inch the bridge into position when necessary.

In order to protect the rams from surge pressures and oil expansion, which could overload them when at the end of their travel, a relief valve operating at a differential pressure of 4200lbf/in^2 (290bar) is fitted in each piston head, which opens to allow oil to pass from the rod to the head side of the piston.

On the Stage 3 cylinder the compression loads only require a pressure of $16501bf/in^2$ on the piston head side whilst the tension loads require $40001bf/in^2$ on the rod side. Therefore, in order to avoid any risk of overloading the piston



The Chieftain Bridge Layer (7)

rod in compression, a pressure-reducing valve, combined with a non-return valve and restrictor, is fitted to the cylinder end-cap to permit controlled flow back to the reservoir.

When the bridge is in the travelling position, the Stage 2 and 3 cylinders are fairly well protected from damage by shrapnel, small arms fire and so on, and all the external hydraulic pipes are fitted with armoured shields. The Stage 1 cylinders are left relatively exposed because the fairly obvious alternative of burying them within the tank hull introduced problems with regard to space and cooling for the crew.

Rough Night at Junction Station

G P MANNING, M Eng, C Eng, FICE

THE accounts of individuals and those of official histories often differ in more than detail. This article makes the point as well as relating an interesting story. The passages shown in italics in the Official History indicate the main difference.

Extract from the Official History of the War – Military Operations Egypt and Palestine, Volume 2, pps 162-163, referring to 13 November 1917 (authors asides in brackets):

"Though it was now nearly night and the second phase had not been completed, Major General Palin, (GOC 75th Division), having heard of the capture of Qatra by the 52nd Division, decided to attempt to carry out the third, and sent an order to the 234th Brigade (Br-General F J Anley) to advance on Junction Station, (see map).

"Two battalions of this brigade were now at or near Mesmiye el Gharbiye, the other two with brigade headquarters at Qastine. It took the brigade some time to concentrate at Mesmiye el Gharbiye and refill water-bottles, but the advanced guard, the 123rd Outram's Rifles, moved out at 10.25pm, directly after Br-General Anley's conference was over. The brigadier felt himself handicapped in advancing to an objective so far behind the enemy's present line by his lack of knowledge of the country surrounding the station, and decided, in view of the wording of his order - to 'make for' it - that he would try to capture it by surprise before daylight, but if surprise was impossible would not attack in the darkness. (New moon on 14 November 1917). He also decided to go through the 233rd Brigade on the main road rather than the 232nd in the broken country on the left. His instructions to Lieut-Colonel G R Cassels, commanding the 123rd Rifles, were to halt when he reached a suitable point about a mile and a half short of the station and send out a platoon with a demolition party to cut the railway to the north, He bade him not wait for this party, which marched with the main body of the brigade at 11.30pm.

"The advanced guard marched steadily forward, meeting with no opposition and at about 1.30am on the 14th reached the road junction WSW of the station, whence Lieut-Colonel Cassels sent back a message asking for the demolition party. While he was awaiting it a Turkish transport column came down the Et Tine road and blundered straight into the battalion. There was a scuffle in the darkness, and a number of prisoners were captured by the advanced guard. Lieut-Colonel Cassels then decided to move closer to the station, of which he could plainly see the lights, and was about to do so at 2.30am when the brigadier came up and informed him that he was sending forward the demolition party without delay. Immediately afterwards a body of Turks, three or four hundred strong, attacked from the right, charging determinedly with shouts of 'Allah! Allah!' The battalion faced right, and there was confused fighting, in which



brigade headquarters just behind was involved, before the enemy was driven off with considerable loss. Br-General Anley thereupon concluding that there was no hope of surprising the station, decided to await daylight, and ordered the column to take up a position capable of all-round defence. The struggle with the enemy had one unfortunate result: the sudden burst of fire caused the pack-horse carrying the demolition party's explosives to bolt, and it could not be found for a long time. The party was late in consequence and, meeting with bodies of the enemy along the railway line as day was breaking, was forced to return without carrying out its task. One, or according to some reports two, trains left the station between 6 and 7am, and some prisoners afterwards affirmed that Kress von Kressenstein thus escaped.

"Major-General Palin did not hear of the skirmish or that the 234th Brigade was halted until 6.15am. At the same time he was informed by Br-General Colston (Commanding 233rd Brigade) that there were at Mesmiye two cars of the 12th Light Armoured Car Battery which had orders to report to the

ROUGH NIGHT AT JUNCTION STATION

Australian Mounted Division at dawn. He sent a message that they should instead join the 234th Brigade. At its headquarters they were ordered by Major G M Glynton, GS02 of the Division, who had been sent forward to obtain information, to advance on the station. They drove straight down the road, passing two platoons of the 123rd Rifles which had now been sent forward, and at 8.25am came into action near the station against a party of Turks just quitting it, shooting down a number and driving the rest in wild confusion up the Ramle road. The platoons of the 123rd Rifles found the station abandoned, and the remainder of the 234th Brigade was by Major-General Palin's orders moved up shortly afterwards."

After the final attack on the Gaza defences I returned on 7 November 1917 to company HQ (496th Field Company RE) in Happy Valley. Next day the company moved north but I had to ride south to pick up a detachment which was clearing out an old well south of Deir el Belah and then follow the company up the old track through Gaza towards Junction Station. I remember crossing our front line and the Turk front line. What a small insignificant bit of land to fight three battles for

".....a little patch of ground That hath in it no profit but the name"

(Hamlet)

Although the Turks had gone they had left their flies behind them - millions of them. As the sappers marched north with the sun behind them their backs were black with flies. Oddly enough, I do not remember passing through Gaza but took a photo of a deep well pump at Beit Hanun. I think it was the 495th Field Company who had put it down the well.

I remember a lovely fine day as we edged slowly northward across the flat plain with the infantry in extended order, heliographs flashing and even a squadron of Bengal Lancers with their lances and little jiggle-jogged Arab horses. I hoped they didn't tangle with the Turk infantry who would have made short work of them.

I would explain that an infantry division had three infantry brigades and usually three field companies so that one company could be attached permanently to each brigade. But we had only two companies in the 75th Division so any one of the three brigades could call on us.

The two battalions that made the last attack on Gaza were the 1st/5th Somersets and the 1st/4th Wilts both of the 233rd Infantry Brigade and it was decided that the 234th Infantry Brigade should spearhead the attack on Junction Station. Commanding the 234th was Brigadier General Anley. The typical Brigadier General at that time was a man in his early thirties and one who had seen at least a few months active service. The only time I saw Anley really close to was in the dim light of a fine clear night but he looked as if was in his fifties and this checks with what follows. In the pre-1914 era every King, Czar, Raja, Sultan, President, Khedive, Governor-General or what-have-you had a range of decorations that he bestowed on anyone with any kind of official or semiofficial standing. Anley must have been a military attaché or something similar in a couple of dozen colonies or foreign countries. He was short but broad and had three complete rows of medal ribbons across his chest. These, I was told, were all courtesy decorations or long-service medals so he must have been around quite a time. When the 75th Division was formed in the summer of 1917 Anley, I believe, had seen no active service nor had any of his brigade.

He decided that the 123rd (Outram's) Rifles (Indian Army) should lead the final advance on Junction Station. The CO of the Outrams decided that he wanted a demolition officer and that meant me. I reported to him with a mounted corporal and a pack mule loaded with guncotton. No one told me what I was expected to blow up or where it was. This was standard practice. Few people,

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if anyone, knew exactly what had to be done and those who knew never bothered to tell anyone else!

We were now somewhere near Es Suafir esh Sherkiye and crept forward, stop-go, until after nightfall (about 6.30pm) on 13 November when we were somewhere near El Mesmiye. Here the Outrams formed in colomn of route and started to march up the road marked BCD on the map. Here was the only funny incident. A small party of RE Signals arrived with a limber on which was a drum carrying a long length of telephone cable. I think the idea was to trail this cable with a telephone at each end so that the Outrams could keep in touch with the battalion that was following them (or supposed to be following them) up the road. Whatever the idea was it didn't work and soon we were marching on, all alone, on a nice, calm, clear night on a nice level road. We had been warned to keep a lookout for enemy troops on our left flank where (we hoped) the 52nd Division were advancing. We had the comforting assurance that the Australian Light Horse were sweeping north, up the line marked MNO on the map, and were keeping our right flank clear. A column of the Light Horse had crossed our line of march from west to east about midday on the 13th moving in the direction of point M. I took a photograph of them. I had had more experience of the "Dinkums" than anyone else in the column and whoever was doing any sweeping, either on our left or right flank, was keeping damn quiet about it. Soon we saw a large, bright red blaze miles away in the direction of Junction Station that continued to burn fiercely.

We kept going steadily. About midnight a small party, possibly half a dozen, bumped into us and someone fired at them. Whether they were Turks or local inhabitants I don't know. The firing must have been audible for miles on such a calm, clear night. We kept on until the head of our column reached point D on the road about a mile short of Junction Station where the fire was still burning with an intense red glow.



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Anley, in my opinion, had already made his first serious mistake. He had decided to accompany the Outrams. Militarily he would have done much better to stay behind and chase up the other three battalions of his brigade to support the Outrams in case they ran into serious trouble. Politically he could have blamed the CO of the Outrams if things went wrong. Now he made a second and much worse mistake. The Turks had clearly set fire to some of their important installations which meant that they did not intend seriously to defend the place. Instead of deploying and advancing he hesitated at point D and left the Outrams still in column of route standing and sitting on the side of the road.

One of the minor aims of the exercise was to cut the railway line and trap any trains there still might be on the line from Jerusalem to Junction Station. Anley called on Major Kydd of the Outrams and told him to escort me to point X on the railway to cut the line. It was at this point that I saw Anley close to. He looked decidedly middle-aged and really bewildered. Oddly enough I thought he was wearing the badges of rank of a Major General. Official records say I was wrong.

I unloaded a box of guncotton from the mule, put it down in the middle of the road and was unscrewing the lid when something happened. We were expecting the Light Horse to show up on our right flank and someone certainly did arrive on that flank. There was a hell of a crack of rifle fire. I was tired and sleepy and stood there stupidly staring at the long line of tiny electric-blue rifle flashes. There must have been somewhere between 300 and 400 Turk riflemen. They had crept within 20 or 30 yards before giving us a good dose of rapid fire. An Indian officer a few yards away went down. I think he was shot through the chest. Two sepoys went to pick him up and I heard him say "Arsti, arsti". A British officer kept his head and gave the order to fix bayonets and charge and it was over in seconds. I doubt if the whole affair lasted a minute. I do not remember taking my revolver from its holster but I would have done this automatically.

We were lucky. There was a rise in the ground to our right so the Turks were above us. Everyone tends to fire high at night and probably 90 per cent of their fire went over our heads. If they had fixed bayonets and charged they would have had us cold. I do not remember anything touching me but next morning there was a long graze across the left sleeve of my tunic that wasn't there the previous day. Our two horses and the mule were startled and it was some minutes before we collected ourselves and them.

Here Anley, I think, made his third and fatal mistake. The small but very brave party that had ambushed us was clearly a small rearguard whose duty was to delay us. Having disposed of them we had merely to walk into Junction Station. But Anley, having advanced so boldly through the night, persisted in staying where he was and sending Major Kydd and me to point X. Off we went with some fifty sepoys and reached point X in a matter of minutes.

But where was the railway?

We were now due north of Junction Station and the railway to the north should have been somewhere here but it wasn't. And this is where Kydd and I made a shocking mistake. We should have turned southeast and pushed on but we returned to the main body. As we were on our way back we saw a train coming towards us from Junction Station. As it approached it turned sharply eastward and disappeared into the night. What we had done was, at its best, sheer stupidity. There were excuses. I was tired as I had covered more ground than anyone else since 5 November, including the attack on the Gaza defences. The 75th Division had been more or less continuously in action since 6 November, existing on hit-and-miss rations of bully beef and Army biscuits. I had not been told until well after dark what I was supposed to do and, therefore, had no chance to look at the map. (Even if I had I might have been no better off for the map was wrong!) Major Kydd was my senior -I was only a

Lieutenant – and it was for him to decide whether to go on or turn back. These are excuses. This was the one and only incident in Palestine where I could in any way be faulted and I have never forgotten it.

We still continued to hang about until daylight when it was clear that Junction Station was deserted and we moved in.

But where were the Light Horse? I was later told that they had halted at nightfall somewhere near point M and had stayed there until morning. They had then followed the infantry up the road and actually arrived at Junction Station about mid-day. Instead of arriving from the south about 3am they actually rode in from the west some nine hours later. I took a photograph of them as they moved in. I still have the two negatives of the photographs of the Light Horse (midday 13th and midday 14th) but they are now too indistinct for reproduction. What Allenby said to them I don't know. What I thought of their performance is nobody's business.

Anley "went sick" five days later. The CRE of the 75th Division also "went sick" but he had well and truly blotted his copybook before we set out for Junction Station.

The Official History infers that I was late arriving. This is rubbish. I was with the Outrams from mid-morning onwards. It also blames our pack-horse (who was actually a mule). This is an old threadbare excuse invented in the Boer War and is quite untrue. It does not mention the fierce fire at Junction Station nor the fact that the Light Horse were some nine hours late in arriving.

The only people to come out of the affair with credit were the rank and file of the Outrams who behaved with the utmost steadiness.

Demolitions Under Fire

TEL

This article was published in the RE Journal of 1919 and is republished as a complimentary article to "Rough Night at Junction Station". The expertise of the author is unquestioned (although he wrote under a cloak of anonymity there is no prize for deducing his real name!), and much of what he writes is as applicable today as it was then.

WE were interested in the Hejaz Railway, and spent nearly two years on it. The Turkish counter-measurers were passive. They garrisoned each station (an average of fourteen miles apart) with half a company, entrenched, sometimes with guns, and put in between the stations a chain of small entrenched posts, usually about 2,000 yards apart, and sited on small knolls or spurs within 200 yards of the railway, so that each post could see its neighbours and command all the intermediate line. Extra posts were put on one or other bank of any large bridge. The fifteen or twenty men in the post had to patrol their section of line after dawn each day, and in the afternoon. There was no night activity on their part.

The Turks arrived at their system of defence after considerable experience of our demolition parties, but we were able, till the end of the war, to descend upon the railway when and where we pleased, and effect the damage we wished, without great difficulty. At the same time our ways and means had constantly to be improved. We began with small parties of ten or fifteen Bedouins, and we ended with mobile columns of all arms, including armoured cars; nevertheless I believe that it is impossible for a purely passive defence, such as the Turkish, to prevent a daily interruption of the railway traffic by a decently equipped enemy. Railway defence, to be inviolable, would require a passive force, entrenched with continuous barbed wire fence, and day and night patrol, at a considerable distance from the line, on each side of it; mobile forces, in concentrations not more than twenty miles apart; and liberal air reconnaissance.

The actual methods of demolition we used are perhaps more interesting than our manners of attack. Our explosives were mainly blasting gelatine and guncotton. Of the two we infinitely preferred the former when we could get it. It is rather more powerful in open charges in direct contact, far better for indirect work, has a value of five to one in super-tamped charges, is quicker to use, and more compact. We used to strip its paper covering, and handle it in sandbags of 50lb weight. These sweated vigorously in the summer heats of Arabia, but did us no harm, beyond the usual headache, from which we never acquired immunity. The impact of a bullet may detonate a sack of it but we found in practice that when running you clasp it to your side, and if it is held on that furthest from the enemy, then the chances are that it will not be hit, except by the bullet that has already inflicted a mortal wound on the bearer. Guncotton is a good explosive, but inferior in the above respects to gelatine, and in addition, we used to receive it packed sixteen slabs (of 15 oz each) in a wooden box of such massive construction that it was nearly impossible to open peacefully. You can break these boxes with an entrenching tool, in about four minutes slashing but the best thing is to dash the box, by one of its rope or wire beckets against a rock until it splits. The lid of the box is fastened by six screws, but even if there is time to undo all of these, the slabs will not come out, since they are unshakably wedged against the four sides. I have opened boxes by detonating a primer on one corner, but regard this way as unnecessarily noisy, wasteful and dangerous for daily use. Rail Demolition

Guncotton in 15 oz slabs is convenient for rail cutting. The usual method of putting a fused and detonated and primed slab against the web is quick and easy, but ineffective. The slab cuts a 6in section out of the line, leaving two clean fractured surfaces (Hejaz rails are of a mild Maryland or Cockerill steel). The steel chairs and sleepers are strong, and the enemy used to tap the broken rails again into contact with a sledge, and lay in a new piece whenever the combined fractures were important enough. New rails were ten metres long, but the line worked well on unbolted pieces two or three metres long. Two bolts are enough for a fish plate, and on straights the line will serve slow trains for a mile or two without fish plates, owing to the excellence of the chairs. For curves the Turks, after we had exhausted their curved rails, used short straights. These proved efficient even on 120m curves. The rate of repair of a gang 100 strong, in simple demolition is about 250 cuts an hour. A demolition gang of twenty would do about 600 cuts an hour.

A better demolition is to lay two successive slabs on the ballast beneath the bottom flange under the joint and fish plate, in contact with the line. This spoils the fish plate and bolts, and shortens each of two rails by a few inches, for the expenditure of two slabs and one fuse. It takes longer to lay than the simple demolition, but also takes longer to repair, since one or other rail is often not cut, but bent, and in that case the repair party has either to cut it, or to press it straight.

The best demolition we discovered was to dig down in the ballast beside a mid-rail sleeper between the tracks, until the inside of the sleeper (iron of course) could be cleared of ballast, and to lay two slabs in the bottom of the hole, under the sleeper, but not in contact with it. The excavated ballast should then be returned and the end of the fuse left visible over the sleeper for the lighting party. The expansion of air raises the middle of the sleeper 18in from the ground, humps the two rails 3in from the horizontal, draws them 6in nearer together, and warps them from the vertical inwards by the twisting pull of the chairs on the bottom outer flange. A trough is also driven a foot or more deep across the formation. This gives two rails destroyed, one sleeper or two, and the

grading, for two slabs and one fuse. The repair party has either to throw away the entire track, or cut a metre out of each rail and re-grade. A gang of 100 will mend about twenty pairs an hour, and a gang of forty will lay eighty an hour. The appearance of a piece of rail treated by this method is most beautiful, for the sleepers rise up in all manner of varied forms, like the early buds of tulips.

Simple demolitions can be lit with a 12in fuse. The fish-plate-flange type should be lit with 30in fuses, since the fragments of steel spray the whole earth. The "tulips" may be lit with a 10in fuse, for they only scatter ballast. If however, the slabs have been allowed to get into contact with the metal of the sleeper they will throw large lumps of it about. With a 10in fuse most of these will pass over the head of the lighting man who will be only fifteen yards or so away when it goes off. To be further is dangerous. We were provided with Bickford fuse by Ordnance. The shiny black variety causes many accidents, owing to its habits of accelerating or smouldering. The dull black is better, and the white very good. Our instantaneous fuse has an amusing effect if lit at night among friendly tents, since it jumps about and bangs; but it is not good for service conditions. The French instantaneous fuse is reliable. Detonators should always be crimped on to ready-cut fuses, and may be safely carried in the pocket or sandbag, since great violence is required to set them off. We generally used fusees for lighting.

Speaking as a rule, rail demolitions are wasteful and ineffective unless the enemy is short of metal or unless they are only made adjuncts to bridge-breaking.

A pleasant demolition, of a hybrid type, is to cut both rails, and turn them over, so as to throw them on their face down the bank. It takes thirty men to start this, but a small gang can then pass up the line, bearing on the overturned part, and the spring of the rails will carry on the reversing process, until you have done miles of it. This is an effective demolition with steel sleepers, since you wreck the ballasting. We tried it once on about eight miles of a branch line, with a preponderance of spiked wooden sleepers, and it made such a mess of rails and sleepers that the Turks washed their hands of it.

The Hejaz line carried a minimum of traffic, so that there was no special virtue in destroying the points of crossing places.

Bridge Demolitions.

The lightness of traffic affected the tactics of bridge demolition also, since a single break was met either by transport or deviation. As with the rails however, the methods we used are perhaps more important than why we did it. Most of the bridges are of dressed limestone masonry, in 80lb to 100lb blocks, set in lime mortar. The average spans were from four to seven metres, and the piers were usually 15ft wide and 4ft 6in thick. It is of course better to shatter a bridge than to blow it sky-high, since you increase your enemy's labours. We found that a charge of 48lb of guncotton, laid against the foot of the pier on the ground, untamped, was hardly enough, and that 64lb was often a little too much. Our formula was therefore about 1/5 BT² for guncotton charges below 100lb, untamped. In a pier 15ft broad, had the feet been marked off on it, we would have had no explosive between feet 1 and 3 and 12 and 15. The bulk would have been against 4, 5, and 10, 11, with a continuous but weaker band uniting 5 and 10. Dry guncotton is better than wet for such work; gelatine is about 10 per cent stronger for these open charges. With charges above 100lb 1/6 BT² or 1/7 BT² is enough. The larger your object the smaller your formula. Under fire, the inside of the bridge is fairly safe, since enemy posts enfilade the line and not the bridge arches. It is however seldom leisurely enough to allow of tamping a pier charge by digging. When it is, a trench a foot deep is all that is possible, and this does not decrease a guncotton charge by more than 10 per cent. Gelatine profits rather more in proportion by simple tamping.

A quick and cheap method of bringing down the ordinary pier or abutment

is by inserting small charges in the drainage holes that are usually present. In the Hejaz line these were in the splay of the arch, and a charge of 5lb of gelatine, or 25lb of guncotton, in these would wreck the whole line. The depth and small size of the drainage holes tamp the explosive to an extreme degree. Where the bridge was of many spans we used to charge alternate drainage holes on either side. In the ordinary English abutment where the drainage holes are small and frequent, it would be wise to explode several simultaneously by electricity, since the effect is much greater than by independent firing. Necklacing and digging down from the crown or roadbed are methods too clumsy and slow for active service conditions.

In North Syria, where we came to bridges of great blocks of basalt, with cement joints, we had to increase our charges for untamped work to $\frac{1}{3}$ or even $\frac{1}{3}$ BT².

We found guncotton most convenient to handle when we knotted it up into thirty slab blocks by passing cords through the round holes in the middle of the slabs. These large bricks are quick to lay and easy to carry. An armoured car is very useful in bridge demolition, to hold the explosive and the artist. We found in practice that from thirty to forty seconds was time enough to lay a pier demolition charge, and that only one man was necessary. We usually used 2ft fuses.

Girder bridges are more difficult. In lattice bridges where the tension girder is below the roadway, it is best to cut both compression beams. If the tension girder is overhead, it is better to cut both tensions and one compression. It is impossible to do a bridge of this sort very quickly. We had not many cases, but they took ten minutes or more each. When possible we used to wedge the gelatine in the angles of meeting girders. The only quick way is to lay an enormous single charge on the top of the abutment and root it all away with the holdfasts. This may require 1,000lb of gelignite, or more, and a multiplicity of porters complicates things. I never blew up a plate girder. *Mining Trains*.

Mining trains pertains perhaps more to operations than to engineering, and is, anyway a special study in itself. Automatic mines, to work on rail deflection always sounded better than they proved. They require very careful laying and to be efficient have to be four-charge compound. This involves electrical connection. The best mine action we had was made for us by Colonel R E M Russell RE and we were about to give it extended use when the enemy caved in.

The ordinary mine was fired electrically by an observer. It is an infallible but very difficult way of destroying hostile rolling stock, and we made great profit from it. Our standard charge was 50lb of gelatine. Guncotton is very little use.

However mining is too large a subject to treat of. The army electrical gear is good, but the exploder seems needlessly heavy. By using a single strand insulated wire (commercial) we fired four detonators in parallel at 500m; army multiple-stranded insulated cables will fire two at 500m. In series I have never had occasion to fire more than twenty five detonators (at 250 yards), but I see no reason why this number should not be greatly increased. The army electric detonators never failed us. A meter test might show that some of them were defective, but even the defective ones will fire on an exploder. It is usually unnecessary to insulate your joints. The exploder goes out of action quickly if knocked about in a baggage column, or slung on a trotting camel, so I usually carried two as reserve.

Pre-War Life in India for the Young RE Officer – Part III

LIEUT-COLONEL (Retd) R W OBBARD, MA

INTRODUCTION

I HAD arrived in India by troopship in October 1934 and since then I had been AGE Poona and then Company Officer in charge of a detachment of 44 Divisional HQ (DHQ) Company QVO Madras S&M stationed at Midnapore, Finally I had moved to Dacca to take over the Company prior to its move to Bangalore.

MOVE FROM DACCA TO BANGALORE

The move of the Company from Dacca to Bangalore took a whole week and involved various types of transport. Early in the morning of 16 April the loading of bullock carts at the barracks and their unloading at the river port commenced. The loading of the "flat" which was to be towed down the river gave no problems except in so far as the safe loading of the EL and workshop lorries from a rickety landing stage which nearly collapsed was concerned. Finally with the loading completed the Company was marched down to the river behind the band of the 5th/1st Punjab Regiment which really excelled itself.

Thereafter at 6pm the next evening the flat had to be unloaded at Goolundur – where incidentally there were no facilities for unloading the lorries – and then the Company proceeded by train to the dockside at Calcutta arriving at 8.30am. A desperate rush followed to load all stores and equipment before 11am so as to ensure that the SS Barols did not miss the tide.

We arrived at Madras at 7am on Thursday where we disembarked and loaded up a train for the final stages of our journey and we arrived at Bangalore at 7am on Friday 23 April 1937 almost exactly a week after starting loading at Dacca – India was once again proving that it was quite a large country!

One of the highlights of the journey was awakening early on Friday after the train had reached the Bangalore plateau and seeing a line of monkeys sitting



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on the platform of our next stop. As we stopped they rushed for the train and were welcomed, with food, by the troops and as the train started again they detrained at the double! The few hills we passed seemed to consist almost entirely of great piles of boulders.

LIFE IN BANGALORE

Bangalore was a pleasant station and the flowering tulip trees along its roads made it extremely colourful whilst in the far distance could be seen the famous hill fort of Nandydroog. The only snag was the red dust which permeated everything and finally penetrated into my lungs – it was years before I managed to get rid of its effects.

Social life was good as not only was it the HQ of the QVO Madras S&M but it had a fine club complete with tennis courts and a swimming pool, a sailing club and a racecourse. The British Resident in Mysore lived there and the Yuvaraj of Mysore was a regular visitor to the Mess.

The nearest hill station was Ootacamund in the Nilgiris – the Blue Mountain – a really lovely area of India with its downlands and lakes (photo 1). Trout fishing in the rivers was very good and the views from the edge of the Nilgiris especially those over the forests of the Mysore Ditch were magnificent. The Todas – the original inhabitants and a completely distinctive race met nowhere else in India – still lived in their small downland villages. One had to be very wary of their water buffaloes.

TRANSFER TO TRAINING BATTALION QVO MADRAS S AND M

After a month in Bangalore I handed over 44 DHQ Company to "Attie" Pearse and was transferred to the Training Battalion to take over C Company. This was an interesting appointment and I was most impressed with the method of selecting recruits. After all candidates had arrived on the parade ground they were roughly chosen by appearance and build and then sent off for medical inspection. After this they were tested for "guts" by racing, jumping walls and climbing ropes before final selection within certain scales were made. There were no caste problems and there were Mohammedans, Hindus, Christians and Buddhists amongst the Viceroy Commissioned Officers with whom I worked.

LEAVE IN UK

On 17 July 1937 I sailed from India on seven months combined leave (first two months privilege leave). I had to pay for my return passage home and back but the cost second class and sharing a four berth cabin with three other officers was only £55.

It was absolute bliss to be home again after three years away and those who have no experience of long service overseas cannot possibly realize the wonder of returning from exile. Unfortunately I had to return to UK rates of pay and I discovered with disgust that it had been ruled by some chairborne expert in the Treasury that it was unnecessary for an officer to return to the UK on leave during his five/six year service overseas. Thus as I was not on leave from the UK I was not entitled to the higher rate of ration allowance. The sum involved was small but the mentality of the Treasury Official who made the ruling is and always will be entirely outside my comprehension!!

BANGALORE AND OOTY

I reported back to Bangalore on 12 February 1938. On arrival I found that my Arab charger had been lamed whilst being raced and that I had been appointed to the one job I loathed – Mess Secretary – this was of course in addition to my duties as OC C Company.

However station life continued normally and I managed to break the little finger of my right hand at a Mess Guest Night and later I had to be innoculated against rables — a cut in my hand had been licked by a friend's dog which a few days later went rabid. The daily jabs in my stomach over a seven day period with an enormous needle were most unpleasant and yet I had to carry on my work and social life normally.

By 10 April I was back on leave again — a fortnights Easter leave this time and Joe Nicholls and I decided to go to Ooty. I had a wonderful time up in the hills courting, trout fishing and golfing. Finally before the end of my leave I was fortunate enough to get engaged to Miss Jessie Marjorie Dundas who was out in India staying with distant relatives in Bangalore and who was the second daughter of a retired Inspector General of Police, Bihar and Orissa. Her relatives could be difficult as they maintained that "time was made for slaves" and when l explained this as the reason for their lateness at a special pre-races luncheon in the Mess I was told in no uncertain manner that forty slaves (Mess Members and their guests) were awaiting their arrival!

MARRIAGE

Jessie and I were married at Holy Trinity Church, Bangalore on 24 August 1938. She was given away by Colonel Gordon, the British Resident in Mysore, my best man was George Gibbs, and the reception was very kindly given by Colonel and Mrs Anderson — he was Commandant of the QVO Madras S&M. We drove off to a tea planters bungalow in the Nilgiris near Ooty for our honeymoon and on our way back we had a special honeymoon tent erected for us by John Cameron at Nanjangud bridging camp. It was a truly wonderful period in our lives.

Jessie and I had had ample time before our marriage to select a suitable bungalow in the Cantonment in which to start married life and our staff consisted of no fewer than nine — Butler, Cook, Second boy, Cooks mate, Syce, Driver, Dhobi, Mali and Sweeper. In addition we'd collected a dachshund puppy and a "slow loris" — the latter was a most amusing little animal which Jessie and I could handle easily but its teeth were needle sharp and the snake charmer who originally displayed it only dared hold it by the scruff of its neck (photo 2).



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Photo 3. Stone bridge over River Cauvery.

Rates of pay were Rs 30 per month for the butler and cook and were reduced progressively down to Rs 10 for the dhobi and sweeper. The pay of the syce who lived with his wife and son in a quarter next to the stable was less than the forage allowance for the charger and yet he was always smart and was somehow managing to have his son educated. The total monthly pay of the entire household came to under f.13!

MARRIED LIFE IN BANGALORE

During the eight months of our married life in Bangalore we attended the Dasera festival at Mysore – the state elephants were splendidly arrayed and carried magnificent howdahs or pulled special carriages – we visited Seringapatam with its stone bridge over the R Cauvery (photo 3) – each upright pillar was a single monolithic block of quarried stone and it had removable cross members of stone (Sir Arthur Wellesley's idea).

However our main tour took place over the Christmas/New Year period when we visited Cochin and stayed in luxury at the Malabar Hotel and then motored up the Travancore High Range and spent New Year's Eve in the tea planters club at Munnar – whilst staying there we saw Indian levitation for the first time. The return journey was down the other side of the High Range to the Coimbatore plain where terracotta horses guarded the villages and then up the thirty one hairpin bends of the Biligiri Rangan range and so back to Bangalore.

We had one separation and that was when I was sent off on a TEWT to Malabar to study the Moplar rebellion - I wonder how many people nowadays have even heard of it!

MOVE TO NASIRABAD AND AHQ SIMLA

In April 1939 I was posted back to MES Southern Command as AGE Nasirabad - as usual the posting was in the hot weather - and on 16 April Jessie and I left on our long trip North. We travelled in the old car (photo 4) as far as Bombay and then on by train to Nasirabad.

It took us nine days to reach Bombay but we did the journey gradually and went via the 800ft Gersoppa Falls in Mysore and Karwa on the coast just south

Pre-War life in India for the young RE Officer- Part III (3)

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of Goa. On the first day we had an encounter with a rabid dog which chased our dachshund — with great presence of mind our driver knocked it out with a spare spring from the car — on the second day we reached Gersoppa and on the third Karwa. Here the sea bathing was delightful and we went off in a catamaran to the Portuguese Island of Anjidiv. After three nights at Karwa we left for Belgaum and Poona and we fortunately stopped for a day in Poona and called on the Chief Engineer Southern Command. When we told him we were enroute for Nasirabad he asked who on earth had posted us there and we had pleasure in telling him "You have". Later **b** like to think that we reaped the benefit of this call.

The next day we motored on to Bombay and the CRE looked after us very well, accommodated us in his flat, took us sailing and introduced us to the sacred precincts of the Royal Bombay Yacht Club.

We left Bombay on the evening of the 26 April by train for our final journey to Nasirabad though we broke the journey at Abu Road Station so as to visit Mount Abu, the hill station for Raiputana, where there was an MES bungalow -the famous Dilwara Temple and the Maharajah of Bikaners palace were the main sights. Then after a final night in the train we were met at Ajmer on the 29th by the deputy AGE who motored us to Nasirabad over practically desert country with Jessie quoting "Where the cactus and the camel are the only things that thrive". I find it impossible to describe the heat and the horror of Nasirabad with its barren surrounding and its haunted empty bungalows.

On 1 May a telegram arrived instructing me to report to Simla not later than 8 May for temporary duty for the planning of the Reserve Base Ammunition Depot at Jubbulpore and for posting there in due course. Jessie and I stood not upon the order of our going but left for Simla via Delhi the very next day.

Thus from MES experience which covered only maintenance and minor works I was entrusted with much of the planning and the layout and building supervision of an Ammunition Depot costing at least 70 lakhs of rupees – in those days, even though it was still peacetime, such changes were taken in ones stride as a matter of course!!

AHQ SIMLA AND JUBBULPORE

Life for Jessie and me in Simla seemed heavenly. The air was fresh, there were no motor cars on the roads and the views were magnificent.



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PRE-WAR LIFE IN INDIA FOR THE YOUNG RE OFFICER - PART III 124

From mid May onwards I was concerned with designs, estimates and contracts for the Arsenal and this involved a months visit to Jubbulpore to prepare lay-out plans and a "Project Estimate" for the overall cost. It was my first experience of such work and yet the estimates had to cover miles of roads, railways, power lines, water supply pipe lines – including well boring – and also enormous excavations and reinforced concrete ammunition stores plus ancillary buildings and married quarters. Somehow with the assistance of the GE Jubbulpore's staff the work was completed and on my return there was actually time to send me off to Poona on a Southern Command Staff College Course – commonly known as a "backward boys" course – to help me qualify for the Staff College.

This is the end of my story as war broke out before the end of the course and all students were recalled to their units. The pre-war life that I had enjoyed as a subaltern and junior married Captain in India was over for ever.

FINALE

It will be seen from this article (Parts I--III) that in pre-war days a junior RE officer in India really did get a chance to see much of the world and do many of the things that he would have had no opportunity to do on his pay in the UK.

He would be expected to organise shoots for big game, to hunt, to play polo and to play hockey with his troops and the opportunities for further travel whilst on leave were excellent. He could manage all the above on his pay and in addition take part to the full in the opportunities of station life such as sailing, swimming, dining and dancing.

As a bachelor he had a full time bearer who was on duty for twenty four hours a day and who would travel around the country with him. When once married, and thirty or over, he and his wife could select a house in the Cantonment and employ a staff of at least nine.

Military training might lag behind but if one served with the MES in a normal station one would be attached to a regiment for combined exercises and there was always ample shooting practise on the range. If one was fortunate one served on the North West Frontier whilst serving with the Sappers and Miners but this I regret was an experience I missed — service in the Additional Garrison Bengal was hardly the equivalent, though it counted as such!

Finally it was essential to take sensible precautions against getting cholera, malaria, dysentery and infected cuts. I found that a packet of permanganate, a bottle of iodine and a "chota peg" every evening was all the medicine I needed.

Those were the days - or were they? In retrospect they appear to belong to another world and to be acons of time away!

Self Erecting Pier

LIEUT-COLONEL J P FITZGERALD-SMITH, B Eng, C Eng, MICE

MY motive in writing an article about the Medium Girder Bridge (MGB) Portable Pier is not to impart information, which is more properly gained from the User Handbooks; but to try and correct some of the impressions the pier is making and to outline the potential of this remarkable piece of kit.

As originally conceived the portable pier was to extend the capability of C1 60 Single-Span, Double Storey bridge from 30m to 51m. The pier was built on the bank and transported to its final position by the bridge itself and then lowered from the deck until its feet were bearing on the ground. No special preparation of the river bed was required, and the pier was successfully built to its full height of 13m and then tested under very severe conditions with a 50%

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Fig 1. Two pier parties erecting piers simultaneously on centre line of bridge.

overload, such as legs sloping in all directions at 1 in 10, sinking supports, sudden settlement under live load conditions. It has passed all its tests and was accepted for the British Army with no reservations in 1974.

Compared to the bridge the pier has not "sold" well despite the excellent design - Why?

There must be many sappers whose only contact with this pier is as a piece of Corps Silver. If they have ever built the pier, it will probably have been a fleeting acquaintanceship, where a two span MGB on a portable pier had to be built by a course, or possibly a combination of courses. Here by the nature of these courses, most of the course would have been building the 2 spans of bridge - only eight men would have built the pier, and the responsibility for the construction was probably vested with an experienced QMSI or senior NCO.

It was not surprising when, at the beginning of the Self Erecting Pier Trial which I conducted last October (1977), I asked the eight sappers detailed for the trial if they had any experience on the pier; they admitted a nodding acquaintance. To the question; What did they think of it? One forthright character replied too B *** complex! In a way he was right; I had had a similar



Self Erecting Pier (1 & 2)



Fig 3. Difficult loads parbuckled down banks.

reply from a very shrewd Swiss engineer who was considering buying the pier for the Swiss Army. It is however the complexity of trying to understand the rigging of a yacht from written instructions, when you have never been able to rig it practically.

It is very difficult to get familiarity with the equipment as things are at the moment. The stores required are; 2 Bridge Sets, 1 Span Junction Set and 1 Pier Set. To collect all these stores is quite a major logistic exercise. At least thirty two men will be required to build the bridge and piers. A suitable gap will have to be found, and finally most difficult of all; time to build and repalletize stores will have to be found. At the end of all this perhaps one or two will have gained erection experience and would feel confident to build the pier without supervision. It is little wonder the present attitude to the pier exists.



Self Erecting Pier (3 & 4)



Fig 5. Pier leg used as a trestle bay.

SELF ERECTING PIER (SEP)

I make no apology for the title. I know, from certain quarters, objections were raised to the title and it was thought that it ought to be described as the "Independently Erected Pier". An infantry officer once came up to me after a film on the subject, and claimed he had been "conned". He had sat quietly through the film waiting for the pier to arise "phoenix like from the mud". All he saw was eight men working very hard to erect a pier. It is a self erecting pier, in that it does not need auxiliary equipment such as cranes to erect it.

No change is proposed in the MGB Portable Pier, all that is advocated is a new way of using it. In fact the name ought to be changed. Drop "MGB" because the pier could be used under a wide range of bridges including reinforced concrete bridges, quite independently of the bridge. In fact I want to see the pier stand on its own feet literally and metaphorically. How this is done will eventually be the subject of a revised User Handbook, but some idea of how this was achieved can be seen in the photographs taken during the October 1977 trials at RSME.

The most difficult part of the operation was getting half pier beam sections into the gap. Parbuckling down difficult banks is one solution, while another solution is flying in components by helicopter – Wessex, Puma or Sea King – a worthwhile task for their limited lifting capability.

The pier can be erected along the proposed centre line of the bridge at its correct station by a party working independently of the main bridge party, and off the critical path. The two principal construction advantages that arise from this are, no nose need be constructed and the pier can be ready at the same time as the bridge has reached the station. An objection that has been raised to any pre-positioning of piers along the bridge; is that in civil engineering construction it requires an accurate survey if the piers are to be correctly aligned and all the work not wasted. This is one of the great advantages of the MGB pier. The centre point of the pier can be misplaced within a circle of error 60cm in diameter for piers 6m high and correspondingly more for higher piers. It was shown by a trial that using sight rods, lines and tapes it was possible to place the pier within a 5cm circle of error. The tolerance of the pier to setting out error is achieved by operating the pier articulators which moves the beam left or right by sloping the pier legs (the pier can take its full load while leaning out of the

Self Erecting Pier (5)

SELF ERECTING PIER

vertical up to 1 in 20), errors in longitudinal positions can be corrected by taking in and letting out the pier head supporting ropes. The time to build a two span bridge and portable pier is approximately 2½ hours by the usual building methods, but this time can be reduced to about 1¼ hours.

Multispan construction times tend to increase with the square of a number of spans if built by the shuttle method:

No of Spans	2	3	4
Times by shuttle method	2½ hrs	5½ hrs	20 hrs
Times using SEP	1¼ hrs	2¼ hrs	3½ hrs

Dramatic as these reductions in timings are, it is in the training that the biggest advantages occur, changes which will completely alter attitudes as far as the pier is concerned. The training now becomes a section task under a junior





VERY RESTRICTED LAUNCHING PROBLEM

(RE ENTRANT TAKEN OUT BY ENEMY DEMOLITION)

Diagram 2. "I would leave the reader with a problem."

NCO. Only two pallet loads are required. It takes one hour to build, and one hour to strip.

A section can be allocated a pier set for a morning or an afternoon session, every section in the squadron can build the pier with a weeks allocation of stores. The junior NCOs gain valuable command experience and responsibility on a real sapper task. If the use of a pier is a solution in an exercise every section can perform this task. They will probably start improvising other uses in emergencies: like Loading Gantries.

A suggested training programme is as follows:

(1) QMSI and a Cadre of section commanders build the pier and strip back to pallets (on any suitable field).

(2) First section builds and strips with the next section commander to build the pier as a working number.

(3) Second section builds and strips with next section commander as a working number, and so on.

FUTURE POSSIBILITIES

One of the most exciting things that has happened as a result of the Self Erecting Pier concept is the ability to solve a whole range of sapper problems that we have not been able to tackle since the great days of Bailey Special uses and improvisations.

The Four Metre Tidal Range Problem. With bridge spans approximately 23m and slopes limited to 1 in 10, landing bays in Double Storey Floating configuration will be restricted to (2.3m + 1m) 3.3m bank heights, if a SEP is used as a trestle bay and the beam set at a height of halfway between bank and water level a tidal range of 7m is possible.

The lligh Flood Bank Problem. Two SEP can be erected at the home side 23m apart and 23m from the near bank. (Diagram 1.) The time need not be any longer than $2\frac{1}{2}$ hours with forty men.

So versatile is the system that I feel quite confident in making a sweeping statement. I do not think there is any bridging problem real or imaginary that cannot be solved by these new powerful techniques. It is hoped to carry out

SELF ERECTING PIER

confirmatory trials building Independently Erected Piers in wet gaps for those occasions when a floating pier cannot be used for some reason or another. The technique exists but it has yet to be done practically. Finally I would leave the reader with a problem the solution of which might stimulate interest in one of the most useful pieces of kit the British Army has ever had. (Diagram 2). Acknowledgement

My thanks to QMSI Hooper of the RE Sales Team who had often to keep both my feet and the pier feet on the ground. Also to Corporal Atkinson RE and Lance Corporal Bohan RE both of 38 Engr Regt at Ripon, who were the first pier commanders; who, it is hoped, will be the "first of many".

"And all in Eight Months"

SECOND LIEUTENANT J D W COOPER, RE

The Author joined 34 Field Squadron RE on a Short Service Limited Commission (SSLC) in March 1977 and left in September to go up to Oxford as a University Cadet. He was attached to 1 Troop which was Spearhead Troop in April 1977 and was on Project Reunion (extending BFPO 52) in May-August 77.

ENTERING the Army was quite a shock to the system. My "Sabbatical" started off with three hectic weeks at Sandhurst where I was thrust into a strange rigid environment and kicked around for every second of the day. I had a week to recover in the leather armchairs of the RE HQ Mess admiring all the glorious silver and paintings. But man does not win wars with relics alone and I was posted to Tidworth to do some real work. In fact I did practically nothing. This was inevitable since there was nothing I was capable of doing until I had assimilated some of my very new and bewildering environment. However, I found myself some interesting jobs like organizing the Regimental Sports. It was mainly a case of looking for opportunities to do things that I knew I could do.

The Spearhead commitment was enjoyable with physical exercise and weapon firing which got me out of that hive of inactivity – the Troop Office. At one point we thought we might be deployed somewhere which really got my adrenalin going and brought home to me the Army's role.

Over the weeks I had a chance to see the Troop to which I was attached do various civil and combat engineering tasks and learn how all its members fitted together. Squadron dinner nights and all rank parties helped me to get to know everyone. All this proved valuable experience when I had my own project in Gibraltar. Away from the Regiment in Gibraltar, life was very different. The Troop had a much greater sense of identity and there was more work for me to do. I felt that I actually belonged. Up to this point my work had been almost totally paper work and telephone calls to people I never even saw. In Gibraltar I worked with the men of my own Troop, organizing adventure training and recreation for them and later running a small project with a section of men. We also had our own parties and I got to know people even better.

The project on which I was working was not completed due to a colossal series of unforseeable circumstances. We were never meant to finish anyway, the project being jacked up at short notice so we could start it (or no one would) and another unit would finish it off at a later date. It was quite an experience as disaster after disaster arose and I probably learnt more that way than if it had all run to plan. Many problems could be solved; others like the lack of hardcore (the last thing you can find on the Rock is rock!) meant that the project was delayed. Negotiating with the PSA, Taylor Woodrow and the resident Sapper Squadron, in these circumstances, proved rather an interesting challenge, hopping between all three all day in a Landrover and dealing directly with the personalities involved. Throughout my SSLC I found that nothing goes according to plan (Sod's Law) and that you are always given a job to do in less time than it takes with less men and equipment than you need. I am told this is what would happen in war-time and therefore operating with shortages is realistic training!

Much of the interesting work I was given was because those tasking me had recently read an article in the *RE Journal* by Second Lieutenant G D Phillips RE, who pointed out that SSLC Officers often have little to do. I was no exception though thanks to his article (which should be reprinted every year) the problem was, for me, partly alleviated. Less helpful publications were *Joining Your Regiment and Customs of the Service*. Whilst giving many useful tips both were out of date failing to reflect the relaxed formality that, in my own experience, exists in the Army today.

The things I enjoyed most in the Army were the working relationships formed with the NCOs and men, and the social relationships with my fellow officers in the Mess. There was an exhilarating sense of purpose and achievement in working with a small team in the field that was totally lacking when I sat down at a desk with a pile of papers to sign. I gained an ability to see humour in situations where humour is at first not apparent, and also learned *Negative Capability*. This is defined by Keats as "Capable of being in uncertainties, mysteries, doubts without any irritable reaching after fact and reason."

I thoroughly enjoyed my SSLC and as a direct result applied for a University Cadetship. I look forward to my summer attachment this year.

Memoirs

MAJOR GENERAL W F HASTED, CB, CIE, CBE, DSO, MC Born 28 September 1897, died 29 October 1977, aged 80

I FIRST knew Bill Hasted when I went to Cheltenham in 1912 and joined him in Southwood House. He was just six months older than me and we soon became friends. A fine games player with intelligence and a strong character, he was clearly born to be a leader. By September 1914, when he became seventeen and decided not to return to school but to join the army through Woolwich, our friendship had developed and my admiration for him had increased.

His military career did not often cross mine, but his personality left a marked impression wherever he went, and his ability and courage are clearly shown by the honours he was awarded. I saw a good deal of him on the games field, where he was a tower of strength in the RE hockey side at a time when we were able to beat most of the senior hockey clubs in the London area. He played hockey for the Army and England. Later, when he was an instructor at Kingston, (1926-30), he took up badminton and won the Canadian Doubles championship, straining his heart in the process. Our paths did not cross during the Second World War till the Burma campaign, where he became Chief Engineer in Bill Slim's XIVth Army team which drove the Japanese out of Burma. He was subsequently E-in-C in India before retiring from the army in 1948. As a civilian he had a very successful and varied life, first as Controller of Aerodromes, Ministry of Civil Aviation, as President of Loughborough College, then Controller of Development in the State of Kuwait, and finally as a construction engineer in Tasmania. However, his sense of duty was such that in 1969 he gave up the comfort and interest of his successful life there to return to England to take charge of the family property in Suffolk, and to look after his sister who was living alone and being financially exploited. His final success in life was to reinstate this property and to leave it in first class condition for his wife and family.

MEMOIRS

In spite of his success in all he undertook he was always modest, unselfish and generous and I cannot remember him ever saying an unkind word about anyone. He was in every respect the best type of an English Gentleman.

OLR

I first met "Bill" Hasted in the 1920s mainly on the hockey field. He was a brilliant half-back, the kind a forward likes to have behind him, and played not only for the Army and Combined Services but also for England. The next close contact was in India during WW2 first serving under him on airfield construction for the Eastern, later XIVth Army and the Americans; and again after the war in Delhi when he was E—in—C for a while after serving as General Slim's Chief Engineer in Burma. His chief quality as I saw it was the kind of common sense that enabled him to size up problems very quickly and, that done, he acted with decision. You knew where you were with him and it was both a pleasure and a privilege to serve with him and have him as a friend. He was human and humorous. As a small example, when Cassels was arranging his hearing aid at a morning conference Bill would wait and ask, "Are you on the air yet, Cassy?"

Bill Hasted first came to India and took command of a Field Company of the Bengal Sappers when he was a Major. For many, lack of previous service with Indian troops in a more junior rank might have been a disadvantage, but not for him. His ability to cope calmly and cheerfully with the variety of problems and situations, both of individuals and operations, earned him the lasting affection and respect of all who were close to him. His short cheerful laugh would bring all back to their senses when a sense of proportion was lacking. He was never ruffled. Of particular note was his service during the 1937 Waziristan Operations, when his outstanding ability became apparent and brought him the DSO. Though hardly on a level with his influence on operations, it is worth while mentioning that he was one of the very best on a hill. He was tireless.

I had the great good fortune to serve in his Field Company of Sappers and Miners during operations against the Fakir of Ipi in Waziristan in 1937. His own officers and men already knew his worth. Within days of our arrival in Waziristan his astonishing energy, clear headed good sense and ability to get things done became apparent to his new CRE and the principal commanders of the expedition. Within a month his company had been chosen to accompany the leading brigade that advanced to Arsal Kot and destroyed the Fakir's village and headquarters. Hasted was the first to enter the Fakir's cave and personally fired the charge that blew it up. He was a natural leader. His energy, initiative and ability to influence people were his principal characteristics. He was universally respected and admired as a good organizer whose troops loved him and were prepared to work unremittingly for him. The war against the Japanese gave him the chance to show his full capabilities.

JCW

I would like to pay my tribute to one of Billy Hasted's great achievements when he was my Deputy E-in-C (RAF Works). When the Japs had taken Singapore and were turning their faces towards Burma and NE India, the AOC-in-C, Sir Richard Peirse demanded that 250 full length metalled air strips should be built in six months all over India from Assam to Cape Comorin. I told him the work must be done under my direction, but that I would establish a Deputy E-in-C RAF Works with the rank of Major General who would report to him. He agreed and on the advice of General Roome, with his vast knowledge of Indian Army Sapper Officers, Billy Hasted was brought

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back (I think from the Middle East), promoted Major General and put in charge of this vast job. He went at it with immense ability, drive and enthusiasm. It was not easy because the actual contracts had to be handled by Chief Engineer Commands. But thanks to the sterling work of Billy Hasted, and the excellence of his relations with all those with whom he had to work, the target would undoubtedly have been achieved had it not been for the Indian Congressinspired strikes of August 1942. As it was the work (reduced to 220 air strips) was delayed by two months. It was a splendid achievement.

The last time I saw Bill Hasted was a few years ago in Tasmania when he was working for a Civil Engineering firm. He was exactly the same cheerful unassuming man I had known fifty years before. I think his success in technical matters was largely due to a remarkable knack of foreseeing what snags were likely to be met within any job and taking steps to be ready for them. Another thing was being helpful to other arms and services. The head of one, who had worked with him in XIVth Army, said to me some years later, "Whenever I went to see 'H' I always came away with the impression of when can we start?" He was a remarkable man, modest, capable and unambitious.

Billy Hasted started and ended his life with the same quality, faultless courage and unselfishness. Three incidents may typify him. In France, 1917, when going over the top, he saw an infantryman waver and turn back; he took him by the arm and said "Come along, remember you're an Englishman"; the man turned at once, only to be killed, but in a moment Hasted had imparted to him the right spirit. Next, in Waziristan, when ambushed and in an apparently hopeless situation his imperturbability encouraged Pir Khan, his *badrugga*, to stick it out rather than earn an heroic epitaph. (For his courage Pir Khan was awarded the George Cross). Finally, last October he attended the Bengal Sappers Association lunch knowing (what we did not) that he was a dying man; yet he greeted one of the ladies cheerfully and affectionately, and in answer to her question about himself replied "Oh I'm all right"; such was his attitude in the face of a shrewd suspicion that he had perhaps only another month left to live. The memory he leaves is one of very great admiration.

JGOW

My service acquaintance with Hasted was limited to the latter part of my time as Chief Engineer of the XIVth Army (1942-44). At that time he was Chief Engineer to the RAF and responsible among other things for all the Engineer Store Depots in India. He tackled the job with great energy with the result that our stores situation immediately improved. He also brought his distinct inventive faculty into use. "Bithess" is an example of this. He succeeded me as Chief Engineer XIVth Army in April 1944 and went with the Army into Burma and its conquest. There is no doubt Hasted inspired confidence. General Slim obviously thought very highly of him, and he was one of the few personalities mentioned in Defeat into Victory.

HEH

It is fitting to conclude this Memoir with a tribute, highlighting two incidents, paid by Field Marshal Sir William Slim, GCB, GCMG, GCVO, GBE, DSO, MC in his *Defeat into Victory*. During the approach to the Irrawaddy, movement was extraordinarily difficult. All-weather road construction posed a major problem because of lack of resources – he writes:

"It would have been impossible had not Bill Hasted, my Chief Engineer, and one of the heroes of the campaign, made a revolution in road building by using

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RLB

WDMC

'bithess'. The earth formation of the road was levelled and packed tight, largely by hand labour; deep ditches, with frequent spill ways, were dug along each side, and the surface covered by overlapping strips of hessian cloth, dipped in bitumen. . . . For over a hundred miles this novel surface proved able to take a thousand vehicles a day when the monsoon came."

Later, when it was decided to use rivers as a major part of the lines of communication he writes:

"There was one serious obstacle... we had no boats.... I took Bill Hasted, my quiet spoken Chief Engineer, a little upstream of Kalewa and said 'Billy, there's the river and there are the trees', pointing to the great forests within half a mile of the bank. 'In two months I want five hundred tons of supplies a day down that river.' He looked thoughtfully at the river and the trees, and then at me. 'The difficult we will do at once; the impossible will take a little longer,' he quoted, and with a grin, 'For miracles we like a month's notice!' 'You're lucky,' I answered, 'You've got two!'

"But it was I who was lucky, lucky to have such a Chief Engineer."

BRIGADIER F W HOUGHTON, DSO, MC Born 28 May 1904, died 17 November 1977, aged 73

IN the death of Francis Watson (Freddie) Houghton the Corps has lost a good Sapper and a gallant officer and his many friends a much loved companion whose uninhibited and infectious laugh they will long remember. Our sympathies must go to his equally well loved wife "Bubbles" and his two sons and two daughters.

Freddie was born in Ireland in 1904, and, after prep school, Cheltenham and the Shop was commissioned in 1924. On leaving Chatham he was posted to 3rd Fortress Company at Dover followed by Garrison Engineer duties at Lydd and Catterick. In 1931 he was posted to the Royal Bombay S & M with whom he served in Kirkee and Kohat and was one of the privileged few to command the Chitral Detachment which he always regarded as the highlight of his career in India.

In 1938 he returned to England to command "A" Company of the Training Battalion at Chatham until, on the outbreak of war, he went to France on the Staff of E-in-C BEF but was soon posted to command the 9th Field Company. During the retreat his company was continually engaged on demolitions and he was only evacuated on the penultimate day and won the MC for his services.

After spells as 2IC of first 141 OCTU at Aldershot and then 140 OCTU at Newark he was posted as CRE 52nd Lowlands Division with whom he served in France and Belgium and was awarded the DSO for his part in the assault on Beveland which was largely a "Sapper planned" operation. After the war he returned to India for two years first as CRE Calcutta and then as Chief Instructor with QVO Madras S & M at Bangalore.

On return to England in 1948 he commanded 9 Training Regiment RE at Aldershot until he was posted as Colonel to command 11 Engineer Group in Osnabruck. This was a very happy time for him as both the E-in-C BAOR and the CCRE 1 British Corps were old friends from his YO batch. He had the pleasure and interest of starting the Osnabruck Hunt which he ran with such tact and skill that it continued as the sole British pack after the Germans resumed responsibility for all field sports and in face of the Goering Game Laws. He went to great lengths to make it a success and ensure good sport and was only slightly abashed when a well nurtured litter of fox cubs was found by the CCRE during his Administrative Inspection!! In 1954 he returned to England to command the Training Brigade RE at Aldershot until his retirement in 1957.

To help educate his children he bought New Barn, a dairy farm outside

Paignton where he worked largely single handed. With cows in the basement it was not perhaps the most convenient house for his wife but a joy for his friends and their children for whom he kept two caravans. Those lucky enough to have spent a holiday there will long remember the laughter, the bathing picnics and sailing in Torbay in his 18 foot National.

His youth in Dunmore had been spent in hunting or sailing in small boats and, when he exchanged his 18 foot for a 2½ tonner, he was anxious to start cruising and asked me to help. Equipped with his daughter's school ruler and protractor and an ancient chart we completed an hilarious "port-crawl" from Paignton to Plymouth Sound and back. Encouraged by this he studied for his Board of Trade Yachtmasters Certificate which exam he passed in six months at the ripe age of sixty two. Thereafter he frequently cruised with friends and was flattered and delighted at seventy to accept an offer to crew a yacht to Gibraltar.

Since his days as a young officer in India he was imbued with a deep religious faith which, though he never forced it on others, supported him throughout his life. He was extremely active in his parish and it was perhaps fitting, and would have appealed to his sense of humour, that death came suddenly to him at a church gathering in the presence of a bishop, three rural deans and six parsons.

The little parish church was crowded for his funeral and, at his own request, he was marched out to the tune "Hurrah for the CRE" which, though causing some embarrassment to the pall bearers, was a most fitting epitaph for one who had spent his whole service in Sapper units.

CEMH, DRG.

LIEUT-COLONEL W R C TIMPSON RE Born 22 March 1937, died 26 November 1977, aged 40

WILLIAM ROBERT CONRAD TIMPSON started his Army career in June 1955 and after a few months he entered Sandhurst. He was commissioned into the Corps in December 1956 and following two years academic and YO training joined 29 Field Squadron in Hameln as a Troop Commander. After a further tour in Germany he moved to the Far East where he spent two years with the Malaysian Engineers. He returned to UK for four years including attendance at the Staff College as a student. January 1972 saw him back in Hameln as OC 29 Field Squadron. Although his time with the Squadron was brief, and included a N Ireland tour, it was one of his happiest periods because he was back doing that which he most enjoyed - serving with soldiers. In July 1977 he arrived back in Germany to take up his appointment as CO 26 Engineer Regiment. He soon earned the respect and affection of all who served under him because of his professionalism, enthusiasm and warm, cheerful personality. He was dedicated to making the Regiment not only an efficient unit but also a happy one. Although he was with us for only a brief spell he achieved both these aims in full measure. His motto was "work hard and play hard" and he lived life to the full. He will be remembered with deep affection by all who knew him.

DJ

I first met Bill Timpson sixteen yeats ago and soon found that he was one of the best Troop Commanders in 2 Division Engineers. He was also one of the best games players. Sadly he met with a training accident which badly damaged one of his eyes. To a sportsman this must have been a heavy blow. However, he never complained and remained his usual cheerful self. After his accident he came into Div HQ and showed that he was equally good on the staff. From time to time our paths crossed in subsequent years and I was happy to find that his abilities were being recognized by good jobs and promotion at the head of his contemporaries. He was a cheery, modest, kindly man who produced good results without any fuss or bother.

MEMOIRS

Bill Timpson was appointed Adjutant of the Royal Engineers of 2 Div in Germany at the early age of twenty six in the days when the CRE commanded his units direct. He had, therefore, not only to exert his influence on Squadrons at Hameln, Osnabruck and Munster, but at the same time make his mark with the staff at Div HQ at Lubbecke. He accomplished all this with a nice mixture of toughness, commonsense and charm. He was, to the CRE, an ideal Adjutant; completely loyal, a tiger for work and with a happy knack of unobtrusively picking up the bricks that his "Holdfast" dropped. To these attributes of the outstanding Staff Officer he added the sure touch of a born leader. His soldiers knew always where they stood and, furthermore, knew that there was little point in producing anything but work and service of the highest standard. With his tragic death at such an early age not only has the Corps lost an outstanding Commander but his brother officers a sure and steadfast friend.

SEMG

I first got to know Bill well when he was a student at the Staff College, Camberley and I was on the Directing Staff -1969? We played cricket together for the Staff College side. There was no doubt at that stage that Bill was a very able operator. He did extremely well on the course, and was posted to a testing Grade 2 job in Staff Duties in the Ministry of Defence. It was a great moment for me when I heard that he was posted to be OC 29 Field Squadron when I was commanding 35 Engineer Regiment in Hameln. He was a first class squadron commander in every way and there is no doubt that his soldiers liked and respected him. He was loyally supported by his delightful wife, Wendy, who was always willing to help in Squadron and Regimental matters. Bill was an excellent trainer of men and was particularly keen on fitness training. He soon worked his squadron up into a very effective team. He always set very high standards and led by example from the front.

On a personal note I shall always remember Bill for the hours — not too many! — that we spent in the bar at Hameln drinking his favourite Herforder beer and putting the Corps, the Army and world to rights! What a great chap and what a tragic loss to the Corps.

As DAAG AG7 Bill excelled himself, he displayed a depth of human understanding beyond his years, and brought to that appointment a firm but compassionate control of the administration of all Officers of the Corps serving regimentally and in their army wide career interest. During this period the effects of a defence review, which would result in considerable redundancy and could dilute future career and job prospects if not handled well, was an issue that placed an unusual demand upon him. He met this demand magnificently and the Corps will continue to benefit from his total commitment at that time. From my overall knowledge of him I can say, without reservation, that he would have achieved high rank.

ANB-S

MM

Bill was born in Rushden, Northamptonshire. He and I were first cousins, Bill being nine weeks older than myself. We grew up in the same town and attended the same schools. We decided to join the Army at about the same time and in so doing we were the first from our family to select careers as Army Officers. Of our many mutual cousins we were the closest and I counted him as a great personal friend, whose company I always enjoyed because of his warmth of character and enormous charm.

He was always successful. As a schoolboy he became head of his house at an early age; at the half-way point at RMA Sandhurst he was top of his intake's order of merit and on commissioning he passed out in third place. He had great

strength of character and this, combined with his zest for life, drew people towards him. His subordinates always knew where they stood with him because he was straightforward in his dealings with them. He commanded respect and affection. I only served with him on two occasions; when we were students at Shrivenham and Camberley and later when we were on the Directing Staff at the Staff College. However, we were Squadron Commanders together in Hameln in neighbouring Regiments. His reputation as a first class commander, with a deep understanding of his men and an ability to extract the best from them, quickly spread to my Regiment. I have subsequently met many officers, NCOs and soldiers who served under him then, who have spoken with great admiration of him and with pride at being in his Squadron. His time as a Squadron Commander was cut short to enable him to be posted as the DAAG at AG7. He subsequently told me that, of all his staff appointments, he enjoyed the one at AG7 most of all because he gained a greater understanding of the Corps during it. As a staff officer he had the wonderful ability never to allow himself to become bogged down. He could see what was important and disregard the trivia; thus he made relatively light work of his tour in the demanding post of GSO2 in ASD2. He was never afraid to express his views to his superiors, however unpopular they may have seemed.

He kept himself very fit and for years he had made a practice of running most days, often before catching the commuter's train to the MOD. I last saw him a few hours after he had been told the nature of his illness. He told me then that exactly one week before he reported sick he had comfortably completed his Battle Efficiency (BE) Tests. I had always admired him but never more so than when he told me that he had cancer. He had also been told that he would never return to his beloved Regiment. His calmness and bearing were such that it was difficult to accept that his days were numbered.

He married Wendy in October 1962. She gave him her full support throughout their fifteen years together, particularly when his Squadron was in Northern Ireland. To Wendy and her three children go our deepest sympathy and best wishes for the future.

He died whilst in the appointment he had wanted most of all - the command of a Regiment.

RLP

Correspondence

Brigadier R E Fryer, OBE, C Eng, MICE Winchfield Comric Crieff Perthshire PH6 2JU

PROFESSOR E H THOMPSON, OBE

Sir, - In the March 1977 Journal you published a tribute to the late Tommy Thompson. Although nearly twenty years younger than me I got to know Tommy very well both in MI4 War Office in 1935 and later as one of my staff when I was D Svy GHQ Middle East in 1944.

I am sure that all that is written in his memoir is true. He was, with the late Martin Hotine and John Salt, one of the greatest mathematicians the Corps has ever had, especially in Survey. But he did not live wholly on a diet of stereoscopes, comparators, plotters and photogrammetry. He was, in fact, a most ordinary Sapper. Perhaps he came under the title of a bit "mad" at times, but he was not "married or methodist" when I knew him!

He even suffered fools, like me, gladly and would clearly and slowly explain things if you said "Tommy, I don't follow that at all". At times, of course, like all brilliant mathematicians, he perhaps gave you a hidden hint that you ought to have learnt that in your prep school!

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In our GHQ Survey camp at Maadi, some seven miles south of Cairo, Tommy had a hut close to mine and when 1 posted him to a unit in the Desert he left behind outside his hut in the sand an old Egyptian "banger" of a car he had somehow acquired. Egyptians being what they are – or were then – bits of the car gradually began to disappear till the car was literally sitting wheel-less on the sand. Despite my letters to Tommy telling him about this he didn't answer, so I sold what remained and sent Tommy the proceeds. He seemed quite satisfied.

Once Brigadier Prain and I were having dinner in the St George's Hotel in Beirut when in walked Tommy with a very pretty girl. He must have been a bit taken aback seeing two brass hats of his own service where he least expected them. But, with I thought great initiative, he boldly introduced the lady to us both and then dined and danced for the rest of the evening without a care in the world.

I know he had a terrible time escaping from Crete and he often talked to me about it. I wonder if he ever recorded the whole story of his adventures?

In writing to you, Sir, my only object has been to record what a happy, human, and brilliant mathematician the Corps has lost in his passing. - Yours sincerely, Eliot Fryer.

Brigadier P A Clauson, MBE The Close Netton, Nr Salisbury Wilts SP4 6 AP

MAJOR GENERAL M W PRYNNE, CB, CBE, MA

Sir, -1 do not think that the Memoir on General Prynne (March 1978 issue) would be complete without a reference to his great interest in horses and coaching. Late in the forties or early fifties he took the Corps Coach out of mothballs, borrowed a team and put it on the road. My wife and I were kindly invited and had an exciting drive with him from Roehampton through Richmond Park, narrowly missing the Exit gate post. He was elected to the Coaching Club in 1951 and regularly attended meetings and dinners. As well as the official representative, a number of members were present at his Memorial Service. – Yours faithfully, P A Clauson.

Book Reviews

INTO BATTLE A SOLDIER'S DIARY OF THE GREAT WAR

JOHN GLUBB (Published by Cassell and Co Ltd. Price £5.95)

LIEUT-GENERAL SIR JOHN BAGOT GLUBB, KCB, CMG, DSO, OBE, MC (*Glubb Pasha*), served in the Royal Engineers from 1915 to 1926. He is the author of over fifteen books but this one is different. In essence it is his diary of WWI. In November 1915 he left for France at the age of eighteen to join 7 Field Company RE in the Ypres Salient. He served at Ypres, on the Somme, at Arras and Cambrai; for long periods he commanded his company, until the night in August 1917 when he was seriously wounded by a German shell. After nearly a year of hospitals and convalescence he rejoined his old unit in July 1918 to share the final victory of the British Army on the Western Front.

The book is intensely human. The author has, to a great extent, avoided up-to-date comment and the book has retained the relatively simple prose of a young RE officer. This makes the book live - you are *there* and *share* the horrors, sufferings, fortitude, heroism and eventual triumph. The Preface sets the scene, the diary tells the story. It is not an autobiography, it describes both work and play (with many humorous stories). The book is well illustrated with clear maps and drawings which enhance the text.

In the Preface the author writes "At a time when survivors who actually fought in that war are becoming fewer and when the war itself is often misrepresented to support modern political propaganda, it seemed to me that these artless pages, written day-by-day in trenches and bivouacs, might be not entirely lacking in interest". The book *is* of great interest, it is also compulsive reading, and, once started, is very difficult to put down.

THE ROYAL ENGINEERS JOURNAL

CODE NAME MULBERRY

THE PLANNING, BUILDING AND OPERATION OF THE NORMANDY HARBOURS

GUY HARTCUP

(Published by David and Charles, Newton Abbot. Price £4.95)

GUY HARTCUP's book is an excellent story of the Mulberry Project from its inception to construction at Arromanches-les-Bains in June 1944. He has carried out a tremendous amount of research, and corresponded not only with the men who designed the structures but also with the Contracting firms which built them. The index at the end of the book would appear to mention every well known British Consultant, Civil Engineering Contractor, Steelwork and Concrete firm. He has recorded the quarrels, the rivalries and the arguments which took place during the build-up to the invasion; he has written an intensely interesting history of the project.

Writing of events which took place over thirty years ago Mr Hartcup, a young man, could not be expected to recapture the tense atmosphere of these far-off days; he did not know the Sapper Officers, whose skill and determination made construction "in the field" possible.

Mulberry was constructed in Normandy and succeeded because of four gallant and remarkable men – Brigadier A E M "Wally" Walter – a caim, relaxed, unflurried, always courteous Regular Army soldier; his Second-in-Command was Colonel A E "Daddy" Howarth, a brilliant Civil Engineer; two ex-Territorial Army Officers – Lieut Colonel S K Gilbert (in charge of construction of the caisson breakwater) was a delightful and most experienced engineer who had commanded Port Construction units in North Africa and Italy; Lieut Colonel A R Mais (in charge of construction of the piers and pierheads) an utterly determined and forceful officer, had served with the BEF (1939–40), on commando raids, in Northern Persia, with the 8th Army in North Africa, and latterly at the Combined Operations School in Scotland. These men, by sheet force of character, inspired a very "scratch" and inexperienced company of men to build the harbour and to "hold" it, against the odds, through the "great storm" of 19–21 June 1944.

Mulberry Harbour was one of the most interesting and notable feats of military engineering of all time and Mr Hartcup's book is a most welcome appreciation of the engineering problems which had to be overcome during its construction.

RJPC

THE ROAD TO PASSCHENDAELE

THE FLANDERS OFFENSIVE OF 1917 : A STUDY IN INEVITABILITY

JOHN TERRAINE

(Published by Leo Cooper, London. Price £11,50)

THE very name of "Passchendaele" has come to be synonymous with the worst horrors endured by those who fought in the Kaiser's War. As the sub-title implies, John Terraine's book examines the wider background to the third battle of Ypres, the British need to deny the Belgian ports to the German Navy, the politico-military controversy which surrounded the planning and finally an Army-level view of the progress of operations which, after much argument in the Cabinet, began late and then spread over three months of unluckily deplorable weather. The examination takes the form of a series of carefully researched extracts from authoritative source documents, interspersed with occasional comments and explanation by the author. Thus, the book discusses the aspirations of the British High Command and the British and French operations of 1917.

Few readers can fail to be appalled by the amount of internecine strife which seems to have occurred between Generals and politicians for most of the war and by the almost total lack of co-ordination between the Allies even on the Western Front. In 1916 the French Army had exhausted itself at the battle of Verdun and the British on the Somme. Nivelle's offensive virtually failed and serious mutinies continued in the French Army throughout the spring and summer of 1917. Despite French assurances, there was little confidence that they would co-operate by exerting pressure to help keep enemy reserves
away from the British front. Indeed, the French Generals evidently wanted to avoid further casualties by waiting defensively for the fresh American Divisions to arrive and finish the war for us.

The Calais and Paris conferences of 1917 further underlined the general lack of mutual confidence in Haig's plans which were disapproved by Foch and subjected to continual criticism in the Cabinet, particularly by the "Eastern" lobby. Nevertheless, despite all these difficulties Haig's plans and preparations proceeded relentlessly towards zero hour. Almost at the last moment political agreement was given for the transfer of 100 guns to the Italian Front and the BEF had to begin operations short of 100,000 infantry.

In a preliminary battle in early June, the Messines Ridge was successfully captured. On 31 July the third battle of Ypres started. The BEF struggled for three months across flat country in appalling conditions of rain and mud until the Passchendaele ridge was captured at a cost of 70,000 casualties of whom 10,000 were killed. The Belgian ports remained in enemy hands. The Germans fought much harder and much better than the intelligence forecast, though they suffered to a degree which undoubtedly contributed to their eventual collapse in 1918.

Many modern military minds will be left wondering how the Allies won such a major war against the German war machine with so little political will to co-operate and without machinery for effective co-ordination of strategy, even in one theatre, until 1918.

This is not a bedside book. it is however an excellent one from which the serious student of World War I will learn a great deal about the political and Allied background to the operations of 1917.

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