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DEFENCES OF THE NORMANDY PENINSULA

By Sherwood B. Smith

Lieutenant-Colonel, Corps of Engineers, U.S.A.

(Reproduced from *The Military Engineer* for February, 1945)

A SURVEY of the fortifications on the Normandy Peninsula has recently been completed by the Chief Engineer, Etousa. This survey was made at the request of the Commanding General, Army Ground Forces. The writer was assigned on temporary duty with the Chief Engineer to assist in this work. A general discussion of the defences of the Normandy Peninsula is of interest especially in view of the fact that we are now attempting to break through the Siegfried Line.

When the Germans occupied France, they initiated the construction of fortifications along the invasion coast. However, it was not until 1944 that intensive efforts were made in this regard. At the time of the Allied invasion much of the heavier construction was incomplete, making the landing easier than it might have been at a later date.

The general plan was briefly as follows: Underwater and beach obstacles were used along the shore and were well covered by casemated guns so located that they could deliver enfilading fire. Immediately behind the beach were extensive minefields and, in many places, areas which could be flooded. Generally, these low-lying areas behind the beaches were also covered by artillery fire. Farther back on the high ground there were seacoast batteries designed to protect the approaches to harbours and landing beaches. These were manned by the German Navy and were intended for use against naval vessels supporting the landing. Anti-tank ditches with pill-boxes sited so that they could fire directly along the ditches were used frequently. One such ditch crossed the peninsula between Valognes and Cherbourg. Tunnels were employed for shelter, the storage of ammunition, and supplies and, in some cases, for machine-gun or artillery positions.

In many sections of the coast, high bluffs rose from the sea and no reasonable chance of landing existed. In sheltered areas, better beaches were found. Some of these were flat with considerable areas of low-lying ground behind. Some had high bluffs rising immediately behind the beach with valleys which formed natural exits. These exits were covered by machine guns in tunnels or prepared positions. Landing on this type of beach was extremely difficult.

Shore Defences

It is believed that the German plan was to stop the attack at the beaches. The underwater obstacles employed were a serious hindrance to landing. These consisted of hedgehogs, curved rails, and piles with *Teller* mines attached to the tops. These mines when submerged a few feet were capable of blowing holes in the bottoms of landing craft which struck them. The range of the tide, about 20 ft., made it necessary to use a large number of obstacles in order that they might be effective at the different stages of the tide. On the beaches there were usually sea walls, and directly in front of the sea walls barbed wire was used to prevent taking cover there and gaining access to the higher ground behind. Flame throwers were buried in the sand and so arranged that they could be set off electrically from a central point.

At intervals of about a mile and a half on the beach there were strong points.

Emplacement for Beach Defence.

Defences of the Normandy Peninsula

Artillery pieces had been emplaced in casemates with wing walls to protect guns and embrasures from fire from the sea. These were carefully sited so that the beaches could be covered in both directions. When the landing craft hit the beach and troops started ashore these guns opened up a murderous fire. They were, for the most part, 88, 75, and 50mm. guns. Concrete emplacements, with side walls and roofs 6 ft. 7 in. in thickness, provided protection to guns and crews. The field guns which were used required embrasures much larger than those which would have been needed if the guns had been designed for use in emplacements. These large embrasures offered a good opportunity for our use of machine-gun and rifle fire against the defenders. In addition to the artillery in casemates, Renault tank turrets had been mounted on concrete emplacements called the Tobruk type. Sometimes emplacements of the same design without the turret were employed with a machine gun being fired from a central pedestal.

Personnel Shelters

Shelters were provided for personnel at strong points. These were heavy concrete structures with walls and roofs 6 ft. 7 in. thick. Entrances were covered by machine guns and had heavy steel doors about 1½ in. thick. Defence against gas was provided by collective protectors. Natural ventilation was used, but there were hand-operated blowers available to force the air through cannisters in case gas protection were needed. On top of the shelter there was usually a steel cupola of armour 12 in. thick. These had six embrasures from which machine guns, mounted on a skate ring inside, could be fired. There were usually three machine guns which could be shifted to the side from which the attack came. The guns were so mounted that they could be fired through a steel ball which fitted into a socket forming part of the embrasure, giving freedom of action with adequate protection. When not in use the embrasures or ports were closed by steel doors.

Mines

Mines of all types were used and constituted a major obstacle. A type found frequently was the Mustard Pot, of French make, having 4 ozs. of explosive and a chemical type igniter called the Buck igniter. This igniter is actuated by pressure of 25 to 35 lbs. The same fuze was employed with a can similar to our meat ration can, and also with French 50mm. mortar shells. The standard *S* mine (Bouncing Betty) was found frequently, but the *Schumine* which has a ½-lb. block of explosive in a small wood box was not much used.

In addition, there were a great many improvised mines. A *Stock* mine was placed in a wooden box with the ZZ42 igniter, actuated by a light pressure on the hinged top of the box. Concrete blocks with explosive charges fitted with the Buck igniter were also found. Cases for 81mm. mortar shells were fitted up in such a way that pressure on the top would close an electrical circuit, setting off demolition charges placed in the case.

Teller mines and light German anti-tank and French anti-tank mines were used extensively. In some cases very large shells up to 240mm. were buried with their noses up and fitted with a Buck igniter by use of a nose adapter.

The reason for the employment of every available type of mine, standard and improvised, was apparently the tremendous numbers required for the very extensive fields along the coast. There were numerous dummy minefields, carefully marked in such a way as to make them resemble the real ones. This helped to make up for the shortage of mines.

Pile with *Teller* Mine Attached to Top.
(Picture taken at low tide.)

Multiple Flame Thrower and Barbed Wire in Front of Sea Wall.

Defences of the Normandy peninsula 2

Tobruk Emplacement with Renault Tank Turret.

Shelter with Armoured Cupola for Machine Guns.

Seacoast Batteries

The seacoast batteries were usually about a mile behind the beaches and were located on high ground so as to command the sea approaches. A typical installation of this type was at Crisbecq. This had four emplacements for 210mm. guns in various stages of completion. In addition, there were seven 75mm. anti-aircraft guns and, on the forward slope toward the sea, there were extensive field fortifications providing protection against forces coming in from the beach areas. A command post was centrally located from which the fire of the seacoast guns was controlled. Shelters were provided for the operating personnel. These were prefabricated concrete structures which were built in pits in the ground so that the roof came just level with the surface.

The emplacements had roofs 12 ft. thick, side walls 10 ft. 3 in. thick, and a heavy slab directly in front of the gun, giving protection against the mining effect of bombs and shells which might explode after penetrating into the ground. The guns were operated manually and had limited fields of fire—approximately 120 degrees; the guns were not of modern design. Ammunition was available in magazines directly to the rear of the gun and an additional magazine for storage was underground behind the emplacement. There were no facilities for handling ammunition and, at the time of the landing, service was entirely by hand. It is quite obvious that the handling of the heavy shells for 210mm. guns without hoists and trolleys or ammunition cars would have been very difficult.

The fortifications were constructed by the Todt organization using forced labour and the standards of construction were not as high as those normally found in the United States. Concrete was usually made with bank-run sand and gravel, resulting in an excess of fine aggregate and a weaker concrete. The cement was of German manufacture and is believed to have been of good quality. Tests on three samples of concrete showed an average strength of 3,600 lbs. per sq. in. Reinforcement consisted of ½-in. plain round bars on a spacing of approximately 10 in. These ran three ways and the ends were hooked. Overhead the protection against scabbing of concrete from the underside of the roof was provided by eye beams which went across the casemates with steel plates resting on the tops of the flanges so as to form a complete layer of steel.

The fortifications were heavier around Cherbourg. In addition to the old French fortifications giving direct protection to the harbour there were casemated guns to either side covering the approaches which had been built by the Germans. The harbour was also heavily mined. Immediately to the east of the city was Fort Du Roule on top of a high hill. On all sides except one the ground fell off sharply. The one good approach was well protected by casemated guns, anti-tank ditches, mines, and barbed wire. The hill was honey-combed with tunnels in which the defenders had protection from air attack and artillery fire. It was from these tunnels that the German commanders came to surrender at the end of our prolonged attack.

Conclusion

The defences of the invasion coast were not complete when our troops landed and the defending troops were not of first quality; many of them were of other nationalities, who were impressed into the German Army. The aerial bombardment preceding the invasion undoubtedly had a demoralizing effect on these troops. The effectiveness of such fortifications and defences can not be determined until the whole story of the invasion is known, and we will probably never know how much trouble we would have had if more determined troops had been assigned to the defence of the invasion coast with completed fortifications and defences.

THE WORK OF THE ROYAL ENGINEERS IN NORTH-WEST EUROPE, 1944-45

By Major-General Sir J. D. Inglis, K.B.E., C.B., M.C.

On Wednesday, 19th December, 1945

(Reprinted from the *R.U.S.I. Journal* for May, 1946)

Lieut.-Gen. Sir Ronald Charles, K.C.B., C.M.G., D.S.O., Chief Royal Engineer, in the Chair

The Chairman: Ladies and Gentlemen, it is my great pleasure to introduce to this audience Maj.-Gen. Sir Drummond Inglis, who is going to talk to us about R.E. work in the North-West Theatre of Europe.

Maj.-Gen. Inglis probably is better known to most of you than he is to me, because I am rather an old vintage; but for those who have not had the pleasure of meeting him, I will say that he began this war as a C.R.E. He was quickly pushed up to be Chief Engineer of Home Forces. That body was merged into the 21st Army Group, and he remained as Chief Engineer. He went over with them to France, and has seen that particular operation through from the Normandy beaches right away to Hamburg.

LECTURE

I SUPPOSE that no operation of war can have had longer preparation than did the return to the Continent. I suppose also that I was exceptionally fortunate in being able to watch that preparation right from the very beginning, and see the thing through to the end.

I propose, therefore, to tackle this lecture by giving you the Engineer story as I saw it right from the beginning. I hope you will forgive a rather long lecture; it will take an hour and twenty minutes and will not leave much time for questions.

Early Studies of the Return to the Continent

One must go back to December, 1941, when the 1st Corps were given the task of studying the invasion of the Continent. The Headquarters Staff set off to Minley Manor where they spent two days studying an opposed landing. The site chosen was Narvik, because nobody had ever thought of anywhere else but Norway at that time. In consequence, this exercise bore no resemblance to the eventual operation, but I remember it for two reasons. In the first place, the beaches in Norway were all very steep, whereas one soon began to realize that any beaches which were not backed by cliffs on the coast of France or Belgium were likely to be anything but steep, in fact extremely shelving. This factor seemed likely to present a much more difficult engineer problem than the one we were faced with in that exercise. The problem of getting vehicles ashore dryshod on a shelving beach at that time seemed a difficult one and might well be an engineer problem. Although the Royal Navy later produced a few improved landing craft and various types of piers were tried, the problem was eventually solved by the waterproofing of vehicles, a really remarkable achievement by the Royal Electrical and Mechanical Engineers, and for the build-up by drying out landing craft on a falling tide.

The second thing which I remember about that study period was the astonishment with which a proposal that bulldozers should be landed in the

second flight of landing craft was greeted. This seems strange now, when one remembers that in Normandy on the front of one assault Division alone ten armoured bulldozers landed with the assault and were followed by between twenty and thirty more during the next few hours.

The immediate effect of these thoughts on the nature of beaches was to point to the extreme need for a greatly strengthened engineer intelligence organization in England to study at once the beaches of North-West Europe. At that time, there was literally no detailed information other than from somewhat haphazard intelligence which had been collected by the Naval Intelligence Department and consisted largely of photographs of picnic parties on the beaches of Northern France. In the succeeding years this led to the building up of an engineer intelligence section which produced, if not the perfect answer, a very fair one. The 1st Corps was soon to be disappointed, for it was only three months later that the study of the return to the Continent was made a secondary task and the 1st Corps was instructed to concentrate on the coming invasion of England by Germany. Nevertheless, these early thoughts on the subject undoubtedly produced results later.

One of the Engineer tasks connected with the return to the Continent was the construction of tunnelled Headquarters at Portsmouth, Plymouth and Dover. These were the work of Tunnelling Companies R.E. That at Portsmouth was the largest task and was eventually used as the Combined Headquarters both for the Dieppe raid and for the landing in Normandy. That at Plymouth was considerably curtailed, largely as a result of the sudden subsidence of a rose-bed in the garden of Admiralty House.

Engineer Consideration in Selecting the Point of Landing

Early in 1942, there was a combined Army, Navy and Air Force Conference of high-ranking officers at which a young Sapper officer was given ten minutes in which to make an impassioned appeal that rapid airfield construction should be taken more seriously. I remember that Field-Marshal Montgomery came back from that conference greatly impressed, not only with the importance of the subject, but with the way in which this young man had put it across. A very few days afterwards I was appointed Chief Engineer Home Forces, and one of the first jobs that I was given was to do something about rapid airfield construction. During that Summer we started to raise and train airfield construction groups. Our ideas on the subject were very misguided and those groups were of a very different shape from those which actually took part in the Normandy landings. Nevertheless, they enabled us to work out a doctrine for handling them, and that doctrine, though it too evolved itself somewhat differently, did prove to be a very sound foundation.

This, of course, was only one part of the somewhat desultory preparations which we then started, and in the summer of 1942 we suffered a further disappointment when a great part of the forces which we had been assembling and training were diverted to operation "Torch" which was the code name for the landing in North Africa. Nevertheless, looking back on it one realizes now the immense value which we acquired from the lessons of the North African and Sicily campaigns.

One of the greatest headaches in the early studies of the landing in Normandy was the question of the early establishment of the first airfields. At that time, the plan was to land on the beaches of the Cotentin Peninsula with the immediate object of capturing Cherbourg. Aeroplane photographs, however, showed that Peninsula was hilly in most parts and full of small fields separated by banks and hedges. In such country, it would obviously be very difficult to guarantee the early completion of a large number of airfields.

In fact, it would be extremely difficult even to select with any certainty potential sites for airfields. It was this factor which largely turned our eyes towards the beaches between Caen and Carentan. We had, fortunately, long appreciated the importance of geology in modern war, and at that time had the services of Professor King, who had been with us since the beginning of the War and who in 1943 took up the Chair of Geology at Cambridge University. He was succeeded by Maj. Shotton who, having most ably seen us through the campaign, took up the Sorby Chair of Geology at Sheffield University. Amongst other extremely valuable advice Professor King pointed out that between Caen and Bayeux there was a patch of country which was not only gently undulating, but also possessed a top soil which was particularly suitable for airfields because of its excellent drainage qualities. This was, in fact, one of the main factors which led to the selection of the beaches eventually used. You will appreciate the importance of this factor when I tell you that the first landing strip for fighters was ready on D + 1, and that by D + 10 we had established four airfields; this number had increased to ten by D + 25.

That it was possible to land on this piece of coast which was so far away from a port of any magnitude was due to the conception of the Mulberry or artificial port. This I suppose was the greatest civil engineering achievement of the war, and in itself is a subject for a lecture. The Mulberry was developed by the Transportation branch of the War Office, which is a part of the Corps of Royal Engineers.

Special Engineer Training, and the Armoured R.E.

At the end of 1942, we recognized that certain field formations of Royal Engineers would not have time to be trained in all the branches of field engineering which we might encounter; and it was decided, therefore, that the field sappers of G.H.Q. Troops should to some extent specialize. About this time, the lesson of Stalingrad had made itself felt, and we realized that there was a terrific Engineer task in the assault of such a fortress, and that a similar task would present itself in the assault, first of the coastal defences, and later of the rear defences of ports and of the Siegfried line. Two formations of Engineers each under their C.R.E. were, therefore, instructed to concentrate on training for the assault of highly developed positions with special reference to the coast defences. About this time also, a number of curious devices such as Snakes, Flails, Rollers and Ploughs were being developed by the Anti-Tank Experimental Establishment. There was no organization to hold or operate these devices. Another young Sapper officer, realizing this, put forward a proposal for an armoured unit which would hold and operate devices of this sort. To cut a long story short, this proposal eventually materialized as the Armoured Brigade R.E. of the 79th Armoured Division. Two chemical warfare battalions, which had been converted to field companies and instructed to specialize in the assault, were hastily converted into what was then called Assault R.E. and later renamed Armoured R.E. Later, the Divisional Engineers of the 42nd Division, which at that time had been abolished, were added to form the 3rd Regiment of Assault R.E.

During the long period of waiting, another line of country was developed which later, during the crossings of the Seine, the Rhine and other big rivers, was to produce good dividends. Two indoor study periods were held at the School of Military Engineering at Ripon under the direction of the Engineer-in-Chief in which the *pièce de resistance* was an opposed river crossing. The second of these periods studied an advance through Belgium to Antwerp

and included the crossing of the Scheldt or Rupel immediately above Antwerp. This study disclosed the fact that we had never really seriously considered the crossing of such an obstacle, which was not only a very wide river but was tidal.

The immediate result of this study period was to start a training centre at Goole, on the Yorkshire Ouse, where field formations of Engineers could be trained in the crossing of tidal estuaries and very wide rivers ; in all some five formations of R.E. underwent long periods of training at Goole, and each in turn developed new techniques of assaulting, rafting and bridging which proved of immense value in the crossings of the wide Continental rivers which I have mentioned. A great feature of all this training, both the indoor study periods and the training on the Ouse, was the participation of commanders and staffs and of units of other arms in the exercises. All this time the War Office, through the Ministry of Supply, were building up supplies of engineer stores and plant to meet the forecasts which we at Home Forces had made and were continually revising in accordance with the latest plans. At that time, other theatres, particularly in the Mediterranean, had priority, and therefore the Engineer-in-Chief had to be very far-sighted in his orders for stores, in order to build up any reserve for us over and beyond the requirements of active theatres. At that time, of course, all planning above the actual landing came very much into the category of " star gazing," but it is quite interesting to look back now at the broad framework on which we based our bridging requirements. In detail, that framework was very wide of actual events, but the fact is that in total quantities it proved to be adequate and not so much in excess of requirements as to constitute an over-insurance.

Bulk Oil Installations

In July 1942, it was decided that, in order to save road transport petrol must be supplied in bulk by pipe lines and stored in bulk. It was the intention that petrol should be landed in this way from tankers and should be pumped forward along the Line of Communication with bulk storage tanks at intervals. It was decided that while the R.A.S.C. would be responsible for the detail issue of petrol and for operating the lorry and can-filling stations, the R.E. would be responsible for constructing the pipe lines and bulk storage tanks and for operating the pumps on the pipe lines. The main problems involved in this were to devise a method of constructing quickly after a very brief reconnaissance a ship-to-shore line across an open beach, and to train sufficient numbers of R.E. to do this and to lay pipe lines on land and erect the necessary pumping stations and tankage.

In accordance with well-established principles the Engineer-in-Chief decided that this must be done with normal types of Engineer units which should, however, receive special training. The first experiments in the construction of a ship-to-shore line were conducted at Westward Ho, but this location proved very unsatisfactory because the coast is so exposed there that the number of days on which no experiments were possible was excessive. It was soon recognized that without long preliminary preparations it was not practicable to lay a ship-to-shore line in such exposed waters. A new training area was, therefore selected at Ryde in the Isle of Wight. Here the technique was developed and the necessary Artisan Works Companies and Electrical and Mechanical Platoons were trained, and last but not least the vast quantities of special stores required for this task were worked out and the necessary orders placed. This task was to prove one of great magnitude. As a record of achievement it can now be stated that the installation at the little port called Port En Bessin just north of Bayeux started to receive

petrol on D + 25 and by D + 40 had acquired 11,800 tons of storage and had received 36,000 tons of petrol. You will see on map 1 the oil pipe line shown in grey. That line does not, of course, represent a single pipe, but a number of six-inch pipes running side by side. Approximately 454 miles of oil pipe line were laid by the British alone in Normandy, and later in the campaign a further 733 miles were laid linking the ports of Boulogne, Calais, Ostend, Ghent and Antwerp and from there carrying petrol forward by pipe lines across the Meuse and the Rhine as far as Bocholt in Germany. This system was connected with the cross-Channel pipe line, which, however, was not a responsibility of the Royal Engineers. The greater portion of the petrol taken into the system was, in fact, brought by tankers. The average receipts of Bulk spirit into the system were 3,000 tons a day, but this rose to over 4,000 tons a day in February, 1945.

Appearance of Beach Obstacles

Up to this point our efforts seemed very remote and academic but, the Dieppe raid had brought home to us the reality of the danger which might arise from the enemy defences and from adverse beach conditions. In October, 1943, the Engineer intelligence section, which by that time was producing vast quantities of information, aided by the geologist, produced a horrible threat in the form of a clay sub-soil and outcrops on the very beaches on which we intended to land. Fortunately, the geologist was able to point to a similar formation on a beach on the coast of Norfolk. It was, therefore, possible to initiate experiments there in methods of getting across such beaches. These experiments gathered momentum and came to include also methods of dealing with the various types of beach obstacle which the aeroplane photographs had disclosed.

In February, 1944, as a result of Rommel's appointment to the command of German Army Group B, there began to appear unpleasant looking obstacles on the beaches of Belgium and France. As D-day approached, so the obstacles got thicker and thicker. Whereas originally there had been a single row, not very far below highwater, the number of rows was now increasing and, as most of the obstacles were brought round from a neighbouring estuary by barge or landing craft, successive rows were placed lower and lower down the beach. We had always said that the way to tackle beach obstacles was to land when the tide was below them and tackle them dryshod. The notion of attacking under-water obstacles with elaborately trained and equipped teams of swimmers in face of the enemy was regarded unfavourably. The fact that an aeroplane bomb dropped into the sea at quite a distance from such swimmers would have much the same effect as fishing with a hand grenade was a sufficient discouragement to put this method right out of court. The account of these activities which appeared in one of the illustrated papers about six months ago was exaggerated. In fact, teams of swimmers were included in the assault force, but only as a safeguard to deal with obstacles which could not be tackled before the tide had submerged them.

Nevertheless, the gradual approach of successive lines of obstacles towards the low tide mark gave rise not only to great anxiety, but to a series of conferences to determine H-hour to suit the opposing interests of the Air Force who required a minimum period after first light to enable them to drop their bombs on the target, the Navy who required a minimum depth of water in order to bring their craft in over the rocks, and the Army who wanted a minimum time in which to deal with the beach obstacles before the tide submerged them. As we watched the obstacles growing farther and farther

down the beach, so the period in which the requirements of the three Services could be met got narrower and narrower and finally disappeared altogether. It was then a question of a compromise. In the event, owing to an on-shore wind, the tide was higher than had been predicted, and the Sappers had a very unpleasant time trying to breach the obstacles when they were partly submerged. The result was considerable damage to landing craft. Two main techniques were evolved for dealing with these obstacles, namely, demolition with hand-placed charges and bodily removal by bulldozers which pulled the obstacles away and stacked them in suitable places on the beach.

Detailed Intelligence of the Beaches

During this study of the beaches and the obstacles, we were much exercised by the possibility that the Boche had contrived some form of land mine which would have a reasonable life on beaches. We were never able to obtain that he had done so, but were never able to ignore the possibility, because it would be so easy to lay an embarrassing number of mines at the last moment should he succeed in guessing even approximately the D-day which had been selected. Moreover, a few months before D-day we did get an air photo showing the plumes of several under-water explosions evenly spaced which were thought to be part of a minefield exploding sympathetically with a bomb dropped near by. Many experiments were instituted to devise means of dealing with mines which might be encountered either just under water or just above water. Owing, however, to technical difficulties these experiments had to be abandoned.

This was done with some confidence because by that time a series of most daring reconnaissances had been carried out by volunteer R.E. officers and N.C.O.s who were put ashore by the Royal Navy from submarines and other special craft and taken off again on the completion of their reconnaissance. Of these detachments all returned safely except one, and they all reported that they had discovered no mines on the beaches other than those found tied to the tops of beach obstacles. The existence of these mines was also spotted in a magnificent series of low obliques taken a few weeks before D-day. Incidentally, these low obliques constituted a new departure in air photography for engineer reconnaissance. They were taken by American aircraft, fitted with forward facing and side facing cameras which were compensated for the speed of the aircraft. The photographs produced were sufficiently good to disclose these 75mm. shells adapted as land mines fixed to the top of wooden stakes on the beach. In the event, it turned out that the enemy had used practically no mines on the beaches themselves, but I am convinced that it is possible to devise suitable mines and moorings for use on beaches. Had the enemy put all the energy into devising and laying such mines that he devoted to his beach obstacles, the story of the Normandy landings would have been very different.

The study of beach gradients and tides to determine H-hour and to ascertain the conditions which were to be expected on the beach at the time of landing proved to be one of considerable difficulty. This arose from the fact that the Naval Hydrographers who originally assumed responsibility for producing the necessary data, while having very excellent and accurate information about ports and estuaries, very naturally had much less information about beaches. The Royal Navy supplemented this with a great deal of data obtained from large scale air photographs; but there were many unknown factors, and the results were not entirely satisfactory. Much of this work was carried out by Headquarters Combined Operations, who performed very

valuable service in this connection. The American Army had appointed an Engineer officer to go into this question. He made a very accurate and detailed study of it with aeroplane photographs, and produced a rival set of figures. As far as I remember, the Admiralty in the end accepted these figures but this occurred only at the last moment, and the existence of the two sets of figures usually produced at Conferences by the opposing interests did not make decisions any easier. The lesson is that in waters where there is a wide tide range this is a matter which requires early and detailed study by one authority and one only.

The Approach of D-day

As D-day approached, the intensive detailed planning by the Second Army and by the 1st and 30th Corps with the Assault Divisions (3rd British Division, 3rd Canadian Division and 50th British Division) put a tremendous strain on Chief Engineers and C.R.E.s at these formations. Magnificent work was done working out the loading tables for personnel and stores, vehicles and plant down to the last detail, and in carrying out exercises which not only served as a check on the arrangements which had been made but which helped to mystify the enemy as to the time and place of the invasion. The period of waiting was very tense, and the anxiety of the last twenty-four hours, when a postponement of twenty-four hours on account of bad weather had to be decided upon, must have been the last straw to many people. As far as Army Group Headquarters was concerned we had for some days shot our bolt and could not further influence the landing. Despite the tremendous confidence possessed by all under the leadership of the Commander-in-Chief, as far as the R.E. were concerned there was always lurking in the background of one's mind that horrible feeling that the enemy might spring a surprise upon us with mines on the beaches laid unknown to us during the last few weeks before D-day. To me, personally, and I am sure to many others who had been working on this plan for so many months, and who knew that the beaches had been selected as long ago as May, 1943, it seemed impossible that the secret had not leaked out. This danger of mines was, therefore, quite clearly a possibility, and it was one for which we had no universal cure but had to rely on the slow and cumbersome method of clearance by hand with mine detectors. It is true that we had flails to clear the initial gaps for the assaulting armoured fighting vehicles, but the problem of clearing the beaches to make way for the hordes of men and vehicles and craft which would shortly spread all over them, would have been appalling. You can imagine the intense relief when at our Headquarters at Portsmouth at 9 o'clock on the morning of D-day we heard that we were ashore on all beaches and going strong.

Development of the Beaches

Looking back on our preparations afterwards, one felt that many of them had in the event proved unnecessary, but it would have been impossible to neglect these preparations without causing a lack of confidence in the troops who were to take part in this great undertaking. As it was, they went into the battle with tremendous confidence, in the knowledge that they had been given everything in the way of equipment that it was humanly possible to produce. The supply branches of the War Office and the Ministry of Supply itself deserve great credit for the way in which they fulfilled last minute requirements arising out of the growing obstacles on the beaches. To anyone who was privileged to visit those beaches during the first week of the invasion it was a tremendous thrill to see the terrific volume of shipping lying off the beach and the hordes of soldiers and vehicles streaming across them inland and

others working away at their various tasks in the neighbourhood of the beach itself.

In this latter connection one must mention the construction of N.L. Pontoon Causeways for the dryshod landing of personnel and vehicles. One field formation of R.E. was allotted to this task and did a fine job of work both in assembling the pontoons in Southampton Water prior to D-day and in erecting them on the beaches on the other side. There was much controversy as to whether these causeways were necessary or not. They were an insurance against the possible serious deterioration of the surface of the beaches owing to the clay sub-strata which I have already mentioned, and in addition, were intended to enable vehicles to be landed from L.C.T.s at all states of the tide. It must be remembered that up to D-day, it had been ruled that L.C.T.s could not be dried out and allowed to discharge their vehicles when the tide had receded. In practice, L.C.T.s had to be dried out, and the damage which occurred to them in consequence had to be tolerated. Later L.S.T.s were also successfully beached despite predictions to the contrary. This contributed materially to the vehicle build-up.

I have already mentioned the artificial port. The story of this great conception is fairly well known. Construction was started on D + 4, and by D + 10 ships were unloading in the shelter afforded. On D + 12 the first vehicles were landed on to the piers, and finally the port was handling as much as 7,000 tons per day of stores and 400 vehicles. The construction was much handicapped by the storm which broke on D + 13 and lasted for three days. Severe damage was caused to the "phœnixes," which was the code name given to the enormous concrete breakwaters constructed in England, towed across the Channel and sunk in position off the town of Arromanches. The experience of that storm enabled the design of the "phœnixes" to be improved, and a further number with the improved design were installed later in order to protect the port against winter gales in case we were confined West of the Seine during the winter. It is interesting to note that those "phœnixes" of improved design are still standing. It is also of interest that "phœnixes" have been successfully used to close the final gaps in the breaches of the dykes on the island of Walcheren. This work, though carried out by the Dutch engineers, has been greatly energized and assisted by a small band of R.E. officers working under the Chief Engineer of Netherlands District who have earned the lasting gratitude of the Dutch people.

The Build-up in the Beach-head

Following the successful landing and establishment of the bridgehead, there came that long period of hard fighting and build-up in a very congested area in the British sector. The strategy of that operation has been described by the Commander-in-Chief in his lecture given in this room last October. From the R.E. point of view it was characterized by two things; one mines, and the other roads. Here we encountered the Schumine intermingled with Teller mines and half a dozen other forms of mines. The minefields laid by the enemy were supplemented by our own defensive minefields, for it must be remembered that on that left flank we were very much on the defensive at times. We learnt to our cost that it is not practicable accurately to record minefields laid at night in the face of the enemy. Such minefields may have to be laid, but if they are laid when our turn comes to advance, they may prove almost as great a menace as those of the enemy. The moral is that our own main minefield defence should, if possible, be laid in the rear of our forward defended localities where the work can be done preferably in daylight and be properly recorded.

I should think that most Sappers who worked in the Normandy bridgehead will have the word "roads" indelibly engraved on their hearts. The roads in that sector were a headache such as was never experienced in the American sector; they were always on the outer flank with much more "elbow room." By D + 50 there were 150,000 vehicles in the bridgehead, which was then about twenty miles wide and ten miles deep. At about this time, 18,000 vehicles were counted crossing a certain cross-roads in twenty-four hours. Every road worthy of the name was in use all the time, and it was practically never possible to close the road completely, and only with difficulty could some of them be limited to one-way traffic.

This experience proved one thing, and that was that we had much to learn about repairing roads under these conditions; this lesson was repeated again and again throughout the campaign. We know now that, in the first place, we must devise some rapid means of repairing the haunches of roads while they are still under, at any rate, traffic in one direction. In the second place, we have learnt that we must have the organization and equipment to tar-spray and blind roads at great speed. Although it is good technical practice to repair pot-holes first and spray afterwards, our experience showed that the essential thing was to get the spraying done. The repair of pot-holes can come along afterwards.

The roads in North-West Europe which we took over from the enemy had been neglected for four years. They were all badly in need of tar or bitumen and were just ripe for breaking up under the heavy traffic which we imposed upon them. Early tar or bitumen spray, had we been organized for it, would have been a "stitch in time"; as it was, the unfortunate Sappers and the Pioneer Companies working with them paid for it by many weeks of hard and uninteresting labour. It was not possible to show on the map all the roads repaired and constructed in the bridgehead owing to the scale of the map. Those shown are the main routes maintained by the Army Group. Whenever a static situation developed, a vast network of roads, in addition to those shown, had to be maintained by Armies, Corps and Divisions.

In the first thirty days in the Normandy bridgehead, 35,000 tons of Engineer stores were landed—an average of 1,200 tons a day, but by D + 90 this tonnage had increased to 172,000 tons, an average of 1,900 tons a day.

The Break-out and the Advance into Belgium

A few days before the break-out occurred, the General Staff became wildly optimistic about the probable speed of our advance. Their predictions as to our arrival at the Somme or even at the Albert Canal seemed at that time fantastic, and yet I think that even they were short of what actually occurred. The provision of bridging equipment up to and including the Seine had been well covered, but the requirements for these further advances presented a difficult problem to the Director of Works. He overcame the difficulty by organizing the wholesale picking up of bridges now left behind and scattered all over the L. of C. and, in conjunction with Q Movements, organizing a flexible programme of shipment of bridging equipment which could be brought in by small ships to successive ports as we moved Eastwards along the coast.

The fact that our advance to the Albert Canal exceeded even the most optimistic estimates was of course largely due to the disorganization of the enemy, which fortunately caused a break-down in his demolition arrangements in Belgium. Nevertheless, between the Seine and the Albert Canal some 127 bridges were eventually built, and only in the Pas de Calais and the coastal belt of Belgium was our advance actually delayed by demolition. Map II,

covered with spots, gives a good idea of the incidence of enemy demolitions. Each spot indicates a bridge rebuilt by the Sappers. The number of bridges destroyed by the enemy was, of course, far greater.

Crossing of the River Seine

For the crossing of the River Seine two plans had been prepared, a deliberate crossing and a scramble. The scramble plan was put into effect in order to seize the advantage of the enemy's weakness on the East Bank. In the case of one Division the assault began ten hours after the arrival of the leading troops on the river. The lack of reconnaissance led to many errors and minor failures and there was some criticism, but the fact is that the crossing was completed with very few casualties. The assault was carried out on three Divisional fronts and in all nineteen bridges were constructed by the British.

Although it had been decided that, owing to the tide and more particularly the tidal bore, no crossing would take place below Rouen, at the last moment, finding no opposition on the far bank, the 49th Division, collecting what equipment they could raise from other sectors, crossed in storm boats and rafts on the day on which the bore had been predicted and did in fact occur. In spite of great difficulties which were increased by the effects of the bore, 875 vehicles were ferried across the river where it is 750 feet wide in the course of three days.

The story of airfield construction during this rapid advance from the bridgehead to Brussels is one of great achievement. During that period some thirty airfields, including twelve completely new runways, were brought into commission in a period of six weeks. Anyone who saw the aeroplane photographs of some of the remaining eighteen German airfields, which had to be repaired and extended, after our bombers had finished with them will realize that this was no mean task. Of the six Airfield Construction Groups which took part in these operations, five were Army Groups composed of R.E. and Pioneer Corps. The sixth was an R.A.F. Group working under R.E. control. A further four, less mobile R.A.F. Airfield Construction Groups, worked under the Director of Works on the L. of C. carrying out the more permanent work of construction and accommodation for the R.A.F.

Arnhem

The battle of the rivers known as Operation "Market Garden" started on 17th September, 1944, ten days after our arrival on the Albert Canal. Owing to the capture of Nijmegen bridge and the failure to hold Arnhem, the engineer work turned out to be less than had been expected. Nevertheless, a number of bridges were built, including a Bailey bridge on barges at Nijmegen.

The repair of airfields at Eindhoven and Volkel involved the Airfield Construction Group in some fighting which they greatly appreciated. That long and tenuous salient which one remembers so well on the Operations Room Map of the time meant that any arm, no matter what its task, was liable to find itself in the front line.

The plans of the Chief Engineer 30th Corps for this operation were of great interest. The successive crossings of some five canals, as well as the Maas, the Waal and the Neder Rijn, with all the permutations and combinations of what might occur if the bridges over those obstacles were or were not captured intact, presented the Chief Engineer with a pretty problem. An enormous bridging material depot was established by the Second Army at Bourg

Leopold, which is the Aldershot of Belgium. Close to this town there was a fine expanse of sandy heath which provided an excellent area for this dump. The Chief Engineer 30th Corps organized his bridging on wheels in a number of columns so that he could call forward whichever column or columns suited the circumstances of the moment. The fact that there was only one main road up which the fighting troops and all their maintenance traffic had to pass greatly complicated the operation.

Rehabilitation of Communications in Belgium

At this point the opening up of the railways requires mention. The railway had been carried forward from the beachhead to the River Seine, which was bridged by 21st September, twenty-six days after the crossing of the river, thus linking the beachhead with Brussels, Dieppe and Antwerp. The shortage of rolling stock and particularly of locomotives was the limiting factor in the use of rail transport.

During the comparatively static period which followed the Arnhem battle, engineer effort was devoted to opening up road, rail and canal communications which had been interrupted by the German demolitions in Belgium. These demolitions, apart from those in the coastal belt already referred to, were concentrated mainly in the area North of the Albert Canal. In these tasks, the Field Formation engineers and Transportation engineers co-operated, and one of the major problems was the replacement on canals of the low-level tactical bridges by high-level bridges with navigation spans. This involved considerable numbers of piled piers, the piles for which were obtained by Forestry Companies working in the Ardennes under the Director of Works. Throughout this time, also, the wear and tear on the roads was tremendous, and a great engineer effort was necessary to keep those roads going during the winter. This problem was greatly aggravated by the long period of frost which occurred during December and the first half of January. Not only did this make work on the roads extremely difficult owing to their frozen state, but gave rise to considerable damage when the thaw occurred. This was not for want of foresight, because the lessons of the thaw damage from the previous war and in 1939 had not been forgotten ; but the regrouping to counter the German offensive in the Ardennes, to which I shall refer later, necessitated a number of operational moves just as the thaw occurred.

In the meantime, the Armoured R.E. had been gaining much experience and doing valuable work. In the Normandy bridgehead some costly lessons in the employment of this new arm were learnt. There was a tendency to employ them as fighting tanks, largely because with their gallantry and enthusiasm they were always ready to undertake any task. However, the lesson had been learnt, and they did excellent work in the capture of the rear defences of Havre, Boulogne, and Calais ; particularly in the capture of Havre the co-operation between the Armoured R.E. and the Divisional Engineers was a model of what it should be.

Protection of Bridges by Booms

I have not mentioned the successful attack by specially trained German swimmers on the bridges at Nijmegen. This happened almost immediately on the capture of Nijmegen. A team of about twelve Germans swam down the river with specially prepared charges that were capable of having their flotation adjusted by the compressed air bottles which they carried. It was evidently the intention to demolish both the road and railway bridges at Nijmegen. Fortunately, the charge on the road bridge failed to damage the

pier and only succeeded in blowing off the decking from a portion of the roadway on either side of the pier. This was easily repaired. Had the pier been blown, the whole of the 800-foot centre span would have been dropped in the water. The attack on the railway bridge was highly successful. One of the temporary piers which had been erected by the Germans supporting the centre span was completely destroyed, dropping the centre span into the river.

This incident led to the provision at Nijmegen of a whole series of different types of booms varying from naval river nets down to balloon cables supported on jerry-cans. The problem soon became a vicious circle. The river nets were extremely difficult to moor in the fast current of the Rhine and would not stand up to large quantities of debris carried down by the floods. It seemed necessary therefore to provide some kind of boom upstream to divert the debris. This boom in turn required protection against floating mines and so on. In the end the solution appeared to be large numbers of light booms made of balloon cables on jerry-cans, so that a series of mines coming down and exploding on the boom would not penetrate the defences before fresh booms could be strung to replace those cut. For the rest, patrol boats, searchlights and Bren-guns were provided to sink by fire any suspicious looking objects floating down the river. Fortunately for us the temperature of the water fell rapidly after the Nijmegen incident and produced conditions which no swimmer could stand. Had the campaign continued into the summer we should have had to take special steps against swimmers. River nets may be the answer, but they cannot be replaced quickly should they be cut by explosives and the solution seems to be some kind of detection apparatus which will disclose the approaching swimmers who can then be dealt with by patrol boats with suitable depth charges.

The most tempting targets for the swimmers are undoubtedly the masonry piers of permanent bridges; these should be surrounded below water with masses of Dannert wire which will make it difficult for swimmers to place their charges. The possibility of ice conditions greatly complicates the boom problem. The only solution seems to be to remove all booms, except possibly the balloon cable type, as soon as ice conditions intervene.

The German Offensive in the Ardennes

In December the German offensive in the Ardennes diverted our attention for a few weeks. Considerable numbers of the Sappers of the 21st Army Group found themselves preparing for demolition the Meuse bridges between Namur and Maastricht. This was something that we had not expected, and a new factor soon appeared. A bomb dropped in the neighbourhood of one of the railway bridges being used by the Americans and detonated the demolition charges. This resulted in urgent requests from the Americans that we should remove all charges from the bridges. In the end, we compromised by removing detonators and ensuring that no detonators or cordtex was allowed to be within two feet of the charges. It is clear from this lesson that once the charges are connected up with detonators and cordtex there is a real danger that a splinter from a bomb striking one detonator may set off the whole system of inter-connected charges.

Study of the Meuse and Rhine

All through the winter we made an intensive study of the Meuse and the Rhine. The three main conclusions from this study were, first, that icing conditions were liable to occur any time between December and the end of

March, and that on the Rhine in particular they might prove very severe, so severe that no floating bridges could possibly stand. It was also evident that our plywood pontoons would not stand up to much less severe ice conditions, because even thin ice floating down the river would quickly cut through their thin wooden skins.

The second conclusion was that although the winter and spring months would see the end of the floods on the Meuse, severe flood might occur on the Rhine at almost any times in the year, certainly up to the end of June. It did seem, however, that March and April were slightly less subject to flood than other months. From the engineer point of view, therefore, the end of March was the best date for the assault crossing of the Rhine. The question of the assault of the Meuse did not arise because operations from Nijmegen and from the American sector East of Roermond would be able to pinch out that part of the Meuse still in enemy hands.

The third important conclusion drawn from our study of the Rhine was that, having failed to capture Arnhem and the island lying between the Waal and Neder Rijn, we had lost control of the Germans' ability to cause very serious flooding of that island. It was clear from this, therefore, that the original plan for entering Germany on the Nijmegen-Arnhem-Zutphen axis was no longer possible, and that we must seek for crossing places upstream from the point at which the easternmost arm of the Rhine Delta, namely, the Ijssel, begins. The built up area of the Ruhr was obviously to be avoided, and if the crossing was to be carried out by the 21st Army Group, crossing places must be found between the Ruhr and the Ijssel. This boiled down to Rheinberg, Wesel, Xanten, Rees, and Emmerich. Emmerich was ruled out as an assault crossing because it was overlooked from Hoch Elten.

True to form, the Rhine gradually rose in January and February and flooded the island between Nijmegen and Arnhem through the breaches made by the enemy in the dykes. He also flooded a considerable area just East of Nijmegen on the South bank of the Rhine.

At the end of February, within a month of the projected D-day for the Rhine crossing, a view of the valley from the neighbourhood of Nijmegen was indeed a depressing sight. The country was flooded eastwards almost as far as the eye could stretch, and one wondered, even if the floods were to subside, whether the flat ground on either side of the river would ever dry out sufficiently to allow the vast numbers of vehicles required for the crossing to deploy. However, once again the geologists proved right. The Rhine valley consisted of gravel covered with a clay loam which unfortunately at certain places was very thick, but the great thing was the gravel subsoil, and sure enough when the floods subsided at the end of February and a spell of dry windy weather intervened the ground dried rapidly.

Engineer Work on the L. of C.

At this point, as one approaches the crossing of the Rhine which somehow everyone felt must be the climax of the campaign, it is opportune to look back at the work that was going on at the base and on the L. of C. At the risk of boring you I must give you some figures to show the magnitude of the task which was carried out under the direction of the Director of Works, Maj.-Gen. Tickell, now Engineer-in-Chief at the War Office. Under him the Forestry Companies felled a quarter of a million tons of timber. One-fifth of this quantity was for pit props for the Belgian mines which would otherwise have had to close down with disastrous effects on the military forces based on that country. Enormous quantities of hutting were erected, and in order to give you some picture of this quantity I can say that it was

equivalent to 180 miles of twenty-foot span. Of this, some thirty miles was manufactured locally. Two million tons of stone was quarried, and that stone was very nearly the life blood of the British Army during that winter through rain and frost and thaw in an area congested between the boundary with the American sector on one side and the sea on the other. Twelve hundred miles of oil pipes were laid, including 330 high pressure pumps and 110 bulk storage tanks with a total capacity of 101,000 tons. These bulk oil installations alone consumed 97,000 tons of engineer stores. The total engineer stores imported were three-quarters of a million tons, and this was in a period of eleven months. Some 25,000 items of engineer plant and machinery were imported and, in addition to the foregoing, local production of engineer stores was carried out to the value of three and a quarter million pounds sterling. On the electricity supply side, 420 electric generators totalling 10,000 h.p. and 280 miles of overhead line were erected. Three thousand miles of insulated cable were installed.

As to airfields, including those in the Army area and those on the L. of C., a total of 125 airfields were constructed or repaired; to give you an idea of what this means, the total area to be levelled, graded or repaired is equivalent to 2,000 miles of twenty-foot road. The area actually surfaced with some form of surfacing material was equivalent to 360 miles of graded road.

For the crossing of the Rhine, it was necessary to send forward to the Army Depots immediately West of the Rhine some 22,000 tons of Assault Bridging equipment. This included 2,500 pontoons, 650 storm boats, 2,000 assault boats, sixty river tugs, 650 outboard motors, seventy small tugs, 600 propulsion units and very large quantities of steel wire rope, blocks and tackles. The total length of steel wire rope for this operation was 260 miles, plus eighty miles of balloon cable. In addition to the foregoing, some 15,000 tons of bridging material was sent forward for the semi-permanent bridges which were required to replace the floating bridges, and for these some 250,000 items of special parts were manufactured locally in Belgium or in the Engineer Workshops. During the period from 8th December to 28th February, some twelve weeks, 203,000 tons of stone were sent forward to the Armies.

In November, operations had been continued to clear up the Germans remaining West of the Meuse. During this fighting, the Armoured R.E. did valuable work, particularly with their various forms of bridge laid by armoured vehicles R.E. It was in this fighting that the Skid Bailey was first used and proved so successful. As its name implies, it comprised a Bailey bridge on skids which could be pulled and later pushed by armoured vehicles R.E. and so launched over gaps up to fifty feet. Here again the humdrum road work, which is so unspectacular but so important, was the greater part of the Sappers' task. The organization required to receive on rail and distribute the quantities of stone which I have just referred to, on roads most of which were nothing but country lanes carrying considerable quantities of day to day traffic, was no mean problem.

Closing on the Rhine

Early in February, Operations "Veritable" and "Grenade" opened with the First Canadian Army attacking Eastwards from Nijmegen between the Meuse and the Rhine and the Ninth American Army attacking Northwards from the Roer; and once again the Sapper task was minefields and roads. The American attack was delayed about fourteen days by the Germans opening the Roer dam sluices. This involved the Chief Engineer, Ninth American Army in some nice calculations to predict the date by which the flood would have subsided sufficiently to permit a crossing. The road problem was

particularly serious because, of the two main roads running East and West between the rivers, the most northerly was cut for several miles by the floods to which I have referred previously. For the regrouping for Operation "Veritable" fifty miles of new road, much of it corduroy, were built by the Sappers of the Canadian Army through the tracks in the Reichwald and a further 400 miles of road repaired, using 63,000 tons of stone. Very heavy fighting ensued, and this in itself played havoc with the roads which were later to become the main communications behind the assault of the Rhine.

The bridging of the Meuse had been proceeding all through the winter, starting on the two flanks where both banks of the river were in our hands. Now, as the whole of the East bank of the river was in our hands, it was possible to complete that task and provide all the bridges necessary for the support of the Rhine crossing. These bridges were the most varied in design and the most interesting bridges of the whole campaign. At the time of the Rhine crossing, there were in addition to the permanent bridge at Grave a total of three Class 70 and nine Class 40 bridges. These included two high-level Bailey bridges constructed on the piers of demolished railway bridges at Mook and Gennep. Prior to the construction of this bridge at Gennep a Class 40 Pontoon bridge had been built there while the river was at the height of its flood. This bridge was 4,000 feet long, although the actual width of the normal river bed at that point was only 600 feet.

The Rhine Crossing

The crossing of the Rhine was carried out by the 16th American Corps on the right, which crossed on a two-division front, the 12th British Corps in the centre and the 30th British Corps on the left, both of which crossed on a front of one division. For this operation and for some four weeks before, the Second Army was reinforced with seven American Engineer Combat Battalions who worked under command of the Chief Engineer, Ninth American Army, but to the requirements of Chief Engineer, Second Army.

The assault was carried out with landing vehicles tracked, storm boats being used to carry the follow-up infantry, amphibious tanks were sent across as soon as exits for them from the river had been reconnoitred. Class 50/60 raft ferries were constructed by the Armoured R.E. for the build-up of tanks. These ferries were operated by balloon winches. Class 12 Support Rafts were also provided for the build-up of vehicles until the bridges were opened. In the American sector Bailey Pontoon Rafts were used for tanks instead of Class 50/60 rafts. Initially, four bridges were provided in the American sector and four in the British sector, later five more were added in the American sector and five more in the British sector. Of these, two were so-called "all-weather bridges," that is to say they were designed to deal with the maximum rise or fall of the river likely to occur.

Generally speaking, enemy resistance on the right was light, but increased steadily through the centre to the left, where the 30th Corps encountered heavy opposition during the first thirty-six hours. The assault took place at various times according to the Corps front, between 2100 hours and 0200 hours. Airborne landings followed at 1000 hours. On the 30th Corps front, attempts were made during the following day to establish rafts, but the town of Rees on the far bank of the river still held out, and the accuracy of the enemy artillery fire which came down whenever an attempt was made to operate rafts, showed clearly that they had observers in the buildings of Rees which overlooked the west bank along practically the whole of the Corps frontage. The Chief Engineer of the 30th Corps asked his Commander whether he should press on with the establishment of raft ferries regardless

of casualties, but the Commander was prepared to accept a delay because the infantry and amphibious tanks which had already crossed were firmly established and making slow though steady progress. As soon as Emmerich had been captured by troops crossing at Rees, a further two bridges were established there by the Canadian Army in preparation for their drive Westwards to the Ijssel, which they crossed at Deventer and in the neighbourhood of Westervoort, providing bridges at both places and later at Zutphen. In this way, Arnhem was eventually captured from the East and two pontoon bridges were constructed there across the Neder Rijn.

Final Stages

It had been decided that semi-permanent bridges on piled piers were to be constructed, starting about fourteen days after D-day with a target of six weeks for completion. It was appreciated that this six weeks might have to be extended up to as much as ten weeks, particularly if river conditions were unfavourable. It was originally intended to provide two-way bridges of this type at Wesel, Xanten, Rees, Emmerich and Arnhem, the latter being continued by a further two-way bridge across the Ijssel at Zutphen. The bridge at Wesel was to be the task of the American Ninth Army. Very soon after the actual crossing, however, it became evident that German resistance was weakening. It was, therefore, decided not to proceed with the bridge at Emmerich and to reduce the bridge at Xanten to one-way. The bridges at Rees and Xanten were eventually completed in approximately seven weeks. The additional week above the target was accounted for by the fact that some of the Bailey equipment which had been provided for them had to be diverted to the Second Army who were at that time approaching the River Elbe, having once again advanced at a speed far in excess of anything that had been anticipated.

It had been feared that the Germans would again make good use of mines on the East bank of the Rhine. It was felt that the sector in which the crossings were to be made must be fairly obvious to them and that within that sector the actual points of crossing could be narrowed down to comparatively small frontages. However, observation from our own bank prior to D-day disclosed little enemy activity, and in fact very few mines were encountered. From this time onwards the disorganization of the German Army seems to have prevented the enemy from arranging a supply of mines, as very few were encountered between the Rhine and the Elbe. His demolitions, on the contrary, increased enormously. Undoubtedly, the fact that he was ordered to stand and fight greatly simplified his demolition problem. There was no question of deferred or final demolitions waiting until his own troops had been withdrawn across them. Local Commanders indulged in an orgy of demolitions and blew up every bridge they could find. The figure of 508 bridges constructed by the 21st Army Group between the Rhine and the Elbe is a small indication only of the destruction which the Germans brought to their own country, forming as it does a high proportion of the total of 1,525 bridges constructed during the whole eleven months of the campaign. Map 2 shows this point very clearly.

By the time that the leading troops were approaching the River Elbe the bridging supply problem was becoming serious, not so much in regard to the quantity of bridging available in the theatre, but owing to the problem of carrying it forward from the railheads West of the Rhine. As things turned out, with the collapse of the German Army and the rapid advance to the Elbe, it would undoubtedly have been better to reinforce the Railway Construction Troops of the Transportation branch with Field sappers in order to

speed up the establishment of the railways Eastwards across the Rhine and the Weser, instead of employing Port Construction Groups of the Transportation branch to reinforce the Field Sappers on the construction of the semi-permanent road bridges across the Rhine. As we approached the Elbe we were studying the problem of bridging up through Schleswig-Holstein and Denmark. By this time the Second Army, being faced with the problem of carrying everything forward by road, had necessarily become very economical in their number of forward routes, and there is no doubt that the bridging supply would have lasted. Nevertheless, we were just beginning to get anxious when, about a week before the end, the Chief of Staff told me one day that he was extremely optimistic and that in his opinion the Boche had "had it." In less than a week the end had come and all anxieties had ceased.

Royal Signals

Some mention should be made of the extent to which R.E. activities are dependent on efficient communications. Planning and prior reconnaissance play an important part in R.E. work, and to assist in these matters Royal Signals sections have been provided in a complete chain from the Chief Engineer at Army headquarters down to the reconnaissance parties at bridging sites, etc. For major assaults on water obstacles a special Signals layout was always provided to meet the particular requirements of the occasion. None of this organization existed before the war, and its importance as a major lesson therefore needs stressing.

Railway operating would be impossible without the Royal Signals companies permanently attached to railway operating groups to provide line facilities.

An important lesson, emphasized by this campaign, is the need for the closest liaison between the Royal Engineers and the Royal Signals, in order to minimize the amount of damage caused to communications through R.E. work. Until such liaison became an established principle, damage was on a vast scale, far greater than from any enemy efforts. In particular, airfield construction, road repairing and demolitions of all kinds were causes of much anxiety to the Royal Signals. Bulldozers appear to have a natural instinct for finding and cutting cables, particularly the multi-core variety carrying main communication arteries.

The Activities of Transportation

In his lecture in October the Commander-in-Chief said that his planned operations were never held up even for a single day by any lack of administrative resources. This extremely satisfactory state of affairs must be attributed as much to the R.E. Movement Control Staff and the R.E. Transportation Service as to the other administrative staffs and services. The whole story of their preparations and of the problems they encountered would take as long to tell you as my lecture this afternoon, and although the thread of their activities runs through my talk, I cannot conclude without a summary of their work.

The Transportation Service, in addition to the prominent part they played in the construction and operation of Mulberry, had the responsibility of restoring and operating the railways, canals and ports of the liberated countries and later, in occupied territory, to meet the maintenance requirements not only of the 21st Army Group, but also to a certain extent of the American Armies on our right. The rapid advance to the Seine and beyond demanded

improvisation of rail facilities to meet the ever increasing requirements along in L. of C. which lengthened daily. During this period the French railway system was disorganized, yards were demolished and bridges blown. Yet a bridge was constructed across the Seine at Le Manoir in eighteen days and a skeleton rail service East of the Seine was rapidly developed and extended. Concurrently with this, the Channel Ports were being opened up. Later, as the situation stabilized, Transportation was faced with the enormous task of rehabilitating the railways and waterways on the Low Countries. The latter was a particularly formidable job. Yet the rail traffic increased as the Winter drew on, supplemented more and more by canals ; and the growing demands for the maintenance of the Armies and for the essential internal economy of the Low Countries were met.

The development of Ostend, Antwerp and Ghent to receive the heavy tonnages for maintenance during the winter was up to programme, and it is interesting to note that in every case ports were ready to discharge and clear cargo before seaward access by minesweeping could actually be obtained.

As the campaign stabilized, the extent of demolition over the transport systems increased and there were requirements for new rail bridges over nearly all the major water crossings of the trunk lines in South Holland and Belgium. Concurrently with the programme for construction of road bridges across the Rhine we planned a rail bridge at Spyck near Emmerich. There was a spur leading to the site selected, but the whole project had to be planned in the dark for a place at which no railway bridge had previously existed. This bridge was completed ahead of its scheduled date. It took one month, the first pile being driven by the Quartermaster-General on 9th April and the bridge being open for traffic on 9th May. Although it did not contribute towards the maintenance of the Armies during the campaign, it has been vital in achieving the rapid build-up of stores necessary in Germany for the maintenance of the occupational force.

I think that the work of the R.E. in Movement and Transportation spheres during the campaign will be best summarized by giving you a few figures. At the height of the winter there were some 35,000 of all ranks employed, and during the campaign some 7,000 miles of railway lines and 900 miles of canals were opened for traffic. Over 1,000 locomotives and over 3,000 wagons were imported and some 2,700 locomotives and 4,200 wagons were repaired. Ninety-one railway bridges were rebuilt, involving a total length of over three miles of bridge work.

Work of R.E. Survey

I cannot conclude this lecture without reference to the Survey branch of the Corps of Royal Engineers.

From the very early stages of planning, the Survey units which were on the " Overlord " Order of Battle were engaged in printing, under conditions of highest security, many special maps required for planning, e.g., Overprints of enemy defences, Intelligence maps, Tank Going maps, " bogus " maps for briefing—as well as large quantities of normal maps for the operation. Assistance was also give to Counter Battery officers and Air Photographic Intelligence Section interpreters in plotting the grid co-ordinates of enemy targets from air photographs. All this had to be done while the Survey units were preparing themselves—training, mobilizing, waterproofing vehicles—for the campaign, in which they, in effect, started to operate some four months before D-day. The second major Survey task before the assault was the complete organization of map distribution to the assault and follow-up formations. This necessitated a widespread system of map depots in concentration and

assembly areas; these were provided by Home Forces, but organized and controlled by the 21st Army Group. The matter was much complicated by the paramount need for security; and arrangements had to be made, by a system of sealing and use of a code, to ensure that the right maps were issued without the map depots or the recipients knowing what those maps were.

Ten tons of maps, to allow for switching of divisions, were landed on D-day. Other map stocks followed rapidly, with the loss of only one ten-ton lorry load. Map distribution in Normandy proceeded smoothly, though the nature of the country produced demands for the large scale (1/25,000) map far in excess of War Office authorized scales. These were printed in the field and supplied. The triangulation data available for Normandy was known to be unreliable. Topographical Survey Troops were therefore sent over at an early stage of the assault and were continuously engaged on the provision of a reliable trigonometrical control for Survey Regiments R.A. until the break-through occurred after Falaise.

After the break-out from the bridgehead, operations moved quickly and the major Survey problem became map production and distribution. Although printing had been carried out of areas well ahead and astride the planned axis of advance, a shortage of maps began to be felt, and the difficulty of transporting the right maps from bases in Normandy was acute. Arrangements were made for daily deliveries by air from the United Kingdom to Belgium, and the situation was put right.

During the winter in Holland, map stocks of Germany were built up ready for the advance across the Meuse and Rhine. Advantage was taken of the static conditions to revise from air photographs and bring up to date the existing large-scale maps of Germany. In addition special extra large-scale maps (1/12,500) were prepared along the Meuse and the Rhine, and for the attack on the Dutch Islands. Field survey was carried out for Artillery along the whole front under most difficult conditions of intense cold and very poor visibility. One task which calls for special mention was the survey carried out at great speed for the location of the many Radar stations erected in Belgium and Holland as defence against the V.1 attacks.

The German counter-offensive in the Ardennes necessitated very rapid printing of a large number of maps, especially 1/25,000 (which cannot, owing to their numbers, be held in stock for areas where formations are not planned to go), and some extremely urgent map distribution. Trigonometrical survey was carried out, co-ordinated with Survey Regiments R.A., to cover the planned defensive position along the River Dyle. This was finished in time for Topographical Section to go forward and provide trigonometrical control for the Artillery in the British counter-offensive.

The Rhine battle was preceded by provision of trigonometrical survey control for Artillery along the whole front; and in addition over forty points were fixed on the enemy side of the river. Survey Company R.E. provided two Topographic Sections for survey of the bridging sites at Xanten and Rees, and also a few surveyors to help during the construction of the permanent bridges.

The biggest Survey problem during the whole of the campaign was map printing and distribution, the main difficulty being to transport the right maps forward fast enough. A very delicate balance has to be struck between printing too far ahead (and so increasing the load to be carried forward) and printing too late to get the lighter load forward in time. In addition, however, R.E. Survey units were fully employed on field survey and air photo survey.

Retrospect

Looking back on this campaign from the viewpoint of Chief Engineer, I think there are certain high lights which stand out.

First, I am convinced that the peace time education of the young Sapper officer has been an outstanding success. The background given by the mixture of military and academic education at the School of Military Engineering and Cambridge has produced a type of officer who, with a properly directed subsequent career, is quite first-class. But the proper direction of the subsequent career is very, very important. The second high light was the magnificent support which we received from the War Office and the Ministry of Supply in the form of an abundance of first-class equipment and materials. I would underline the achievements of the Experimental Bridging Establishment at Christchurch, an example of a successful experimental establishment run throughout the years of peace by the Army. Outstanding amongst these was, of course, the Bailey Bridge named after Mr. Bailey, a civilian member of the staff of that establishment to whom the chief credit for the design is due.

Finally I wish to pay tribute to all ranks of the Corps of Royal Engineers who took part in the campaign. Some of them were fortunate enough to work on spectacular tasks such as the Rhine bridges and to be personally congratulated on their work by the Commander-in-Chief or by their formation Commander. Others less fortunate, were employed wholly on unspectacular work such as road repairing or on some obscure task tucked away on the L. of C. Their work was no less important and no less appreciated by me as Chief Engineer and, to my personal knowledge, by all formation commanders from Field-Marshal Montgomery downwards.

Discussion

Maj.-Gen. K. Ray: Of those 125 airfields constructed, I would like to ask how many were of all-weather construction?

The Lecturer: That is rather an awkward question. It is rather a long time since I gave up thinking about this. I am afraid I just do not know. The majority of them, of course, were not all-weather; they were either just plain earth runways or else they were square mesh or Sommerfeld track; and a number of them were Prebitumenised Hessian Strip. Later on the Director of Works developed quite a lot of all-weather airfields, but I am afraid I do not know the number. I do not know whether the Director of Works would like to say.

The Director of Works: I would not like to say, myself.

The Lecturer: You might get the answer at the Engineer-in-Chief's Conference, if you are attending.

The Chairman

I hardly know where to begin, but if you would excuse one personal experience which is, I think, rather to the point, I should like to say that some thirty-six years ago I put in one month voluntarily (with no pay) at the War Office, being on leave from India at the time; the job I was given to do was to edit the draft and produce the first proof of the first edition ever of *Engineer Training*. I worked on it very hard, and I produced what I thought was something rather useful, and handed this in to the then Director of Staff Duties, who returned it to me with the remark: "This book gives an

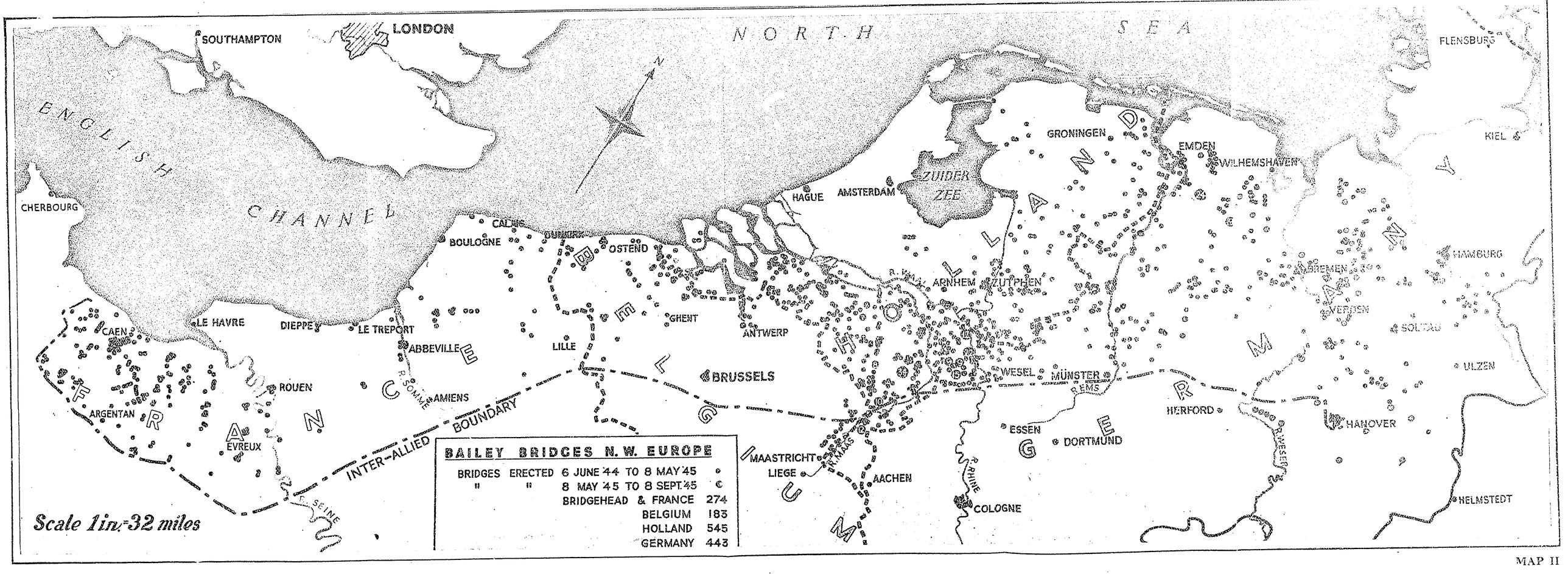
exaggerated idea of the importance of Engineers in warfare." That was a slight damper to a young officer who also, incidentally, was a Sapper.

However, with that personal experience, I should like to say to Gen. Inglis what an intensely interesting lecture he has just delivered. It has filled me with amazement at the way in which he, as the Chief Engineer who controlled all these very remarkable achievements prior to the landing on the Normandy beaches and subsequently the whole way through to the eventual defeat of the Germans, carried out the multifarious duties which helped to make victory possible.

It is impossible to sum up a lecture of this type, and many of you did take an actual part in the operation. My own efforts were limited to endeavours to get out to the theatre of war, which were, very properly, turned down by the Commander-in-Chief; but I think I may, on your behalf, say that we have listened to a very remarkable story of what our brother officers and men in the Corps have done in the defeat of the Germans, that the story has been placed before us with a remarkable lucidity and in such a way that we have been able to follow clearly the many different operations and activities of our Corps over which General Inglis presided with such outstanding success.

AIR CHIEF MARSHAL SIR ROBERT BROOKE-POPHAM: I am sure you would like me to thank Gen. Charles, who has kindly taken the Chair this afternoon. Like most efficient gentlemen, he is a Sapper of course, and I know that spending a couple of hours in this way means that he has got work to make up when he gets home, or perhaps at the week-end.

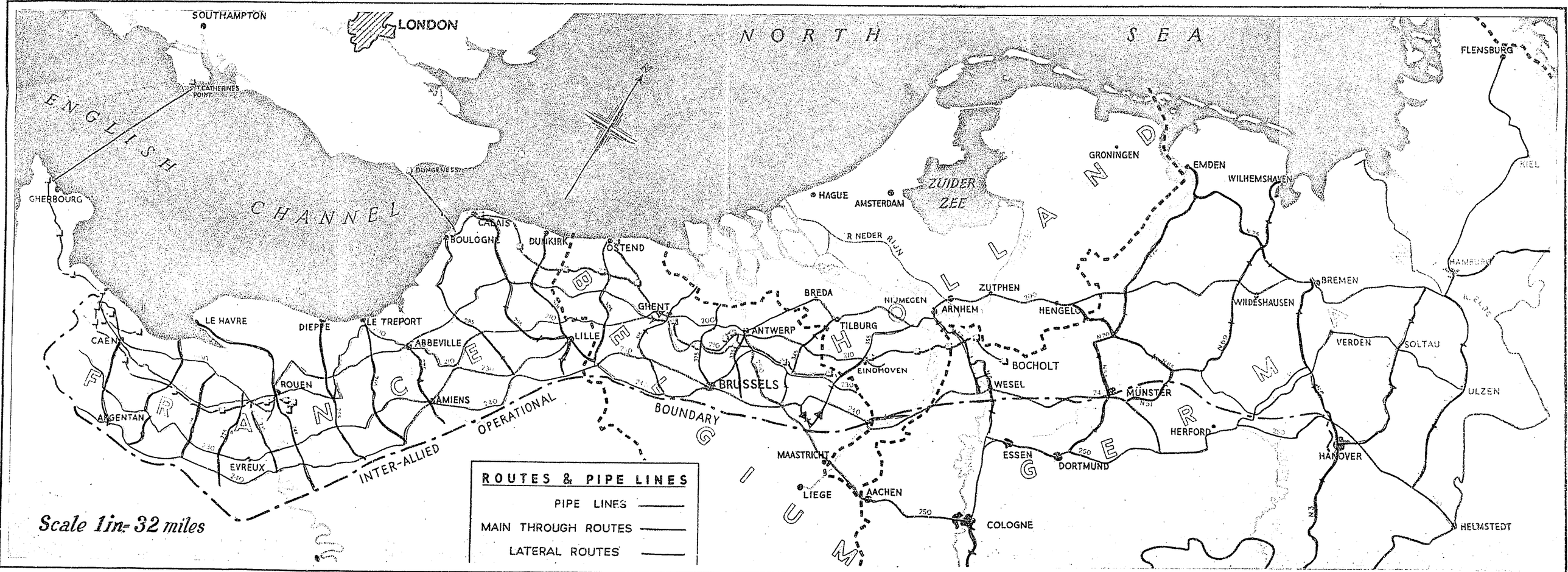
The customary votes of thanks to the Lecturer and Chairman were carried by acclamation.



BAILEY BRIDGES N. W. EUROPE

BRIDGES ERECTED	6 JUNE '44 TO 8 MAY '45	•
" "	8 MAY '45 TO 8 SEPT. '45	○
	BRIDGEHEAD & FRANCE	274
	BELGIUM	183
	HOLLAND	545
	GERMANY	443

MAP II



COMMUNICATIONS USED FOR OPERATIONS IN N.W. EUROPE 1944 - 45

MAP I.

AID TO RUSSIA
THROUGH THE PERSIAN CORRIDOR

A Broadcast to East Africa made on 6th December, 1944

By Brig. Sir Godfrey D. Rhodes, Kt., C.B., C.B.E., D.S.O.

WHEN I stepped into the aeroplane on Nairobi Aerodrome on October, 1st, 1941, I had in my pocket a telegram from the War Office, instructing me to proceed to Tehran, as quickly as possible, to take over the duties of Director of Transportation, Persia, and informing me that full instructions would be sent immediately by air. These instructions were handed to me at Khartoum on my way through, and informed me that the War Cabinet had decided to open new Lines of Communication to Russia, through Persia, and that the project had been given the highest priority. Locomotives, wagons, and stores were already at sea, and a nucleus staff was flying out. Technical troops would follow as soon as ready. So this important project came into the world. In June and July, 1941, when the decision was taken, even Mr. Churchill probably did not foresee the giant size that this new baby would eventually attain.

I arrived at Baghdad on October 5th, after travelling over a very dusty and bumpy road from Habbanyah, strongly reminiscent of the old days in Kenya, then by rail to Basra, in a comfortable air-conditioned coach, to stay a night in the modern air-conditioned Airport Hotel. The climate at that date was becoming slightly more bearable, but the air-conditioning was, nevertheless, much appreciated. The next day, an Anglo-Iranian Oil Coy's plane flew me over the Shatt-al-arab River, up the Khor-musa to Bandar Shapur, the Red Sea terminus of the Railway, and then put me down at Ahwaz, where I caught the express to Tehran. I shall never forget the thrill with which I saw from the air a train pulled by a large and apparently well-cared for locomotive. Evidently the railway "worked." At that time I knew nothing of Persia, and next to nothing of the Trans-Iranian Railway, which I had seen described in the technical Press several years before. My trip, by train to Tehran, taking just 24 hours, was most interesting and instructive. The Railway had been built by the late Shah, at a cost of approximately £30,000,000, entirely out of local revenue and taxation, not a penny of borrowed money. It started at deep water at Bandar Shapur, where there was a timber jetty, stretching out from mud flats, capable of taking only two steamers. It continued along the flat country through Ahwaz to Andimeshk, near Dizful, where the climb into the hills began. For the next hundred or so miles, the railway wound through deep gorges, over numerous bridges, and through over a hundred long and often spiral tunnels, climbing steadily at 1.5% grade to 7,000 feet, then dropping down over undulating country to Tehran, at 4,000 feet, and some 500 miles from the sea. From Tehran, as I discovered later, the railway traversed another 300 miles of heavy country, crossing the Alburz mountains, by 2.3% grades, with magnificently aligned and engineered tunnels, spirals and bridges, which make this part of the line fully comparable with some of the mighty railway achievements in the Rockies in Canada and the U.S.A. As an anti-climax, the railway ended as it began, on mud flats at Bandar Caspian at the south-east corner of the Caspian Sea. Only this time, instead of deep water, there was shallow water, due, some say, to the use of the Volga water for irrigation purposes in Russia. Worse still it was getting shallower every year, so that the port was

by this time only usable, without extensive dredging, by shallow draft vessels.

Such was the railway as I found it. It had been well engineered and well-built, but was a single line, equipped only for a comparatively few light rains. As it had only been completed in 1937, the Persians were hardly yet trained to be efficient railway men. How much I would have given for my K.U.R. and H. staff! Our target was 2,400 tons per day, of useful "Aid to Russia" traffic, and we aimed at 12 to 15 trains per day. This meant many additional crossing stations, more water, completely new telegraph and block signalling equipment, much enlarged marshalling yards, enlarged port and new pier at Bandar Shapur, and a completely new branch railway and port at Khorramshahr on the Shatt River, and last but not least efficient train crews, and operating staff, new bi-lingual rule books, and many other less important but essential details.

Our policy of necessity was to keep the Persian management and staff in the chair, and supplement them gradually as British personnel came out. And here I would like to pay a tribute to the work of the Persian staff, as a whole, though there were of course exceptions who gave us trouble from time to time. The work went on and by June, 1942, we were beginning to sight our target, though our reinforcements and equipment had not come forward as rapidly as we had hoped. British resources were, as you know, seriously taxed about that time, by problems in the Pacific and the Middle East. But Russia needed still more help, and we had been asked to prepare schemes for 6,000 tons a day by rail, and an additional 6,000 tons a day by road. This new demand, of course meant vast increases in rolling stock, and personnel and port equipment. Our original plans and designs had been generously drawn and were adequate, but many more men and special equipment, such as Diesel Electric locos, were required, as double-headed and triple-engined trains were not possible through the tunnel section with steam locomotives, owing to smoke, which asphixiated the train crews.

At that moment, Mr. Churchill came out to Tehran to see us, and after full discussions it was decided to ask the Americans to come and help us by taking over the operation of the railway and road in Persia. The invitation was accepted, and by April, 1943, the Americans had taken over the operations of both services with a splendid force of men and equipment.

It was a disappointment of course, to find we could not complete the task given to us, on its new scale, but it is satisfactory to know that all our improvements and developments, which we designed and completed, stood the test of the larger demands made upon them. I should have stated that, early in 1942, the Russians made themselves responsible for operating the northern sections beyond Tehran, both to the north-east towards the Caspian, and to the north-west towards Tabriz. So the Persian L. of C. developed into a close partnership between Russians, Americans, British and Persians, which, though a little uneasy at times, with good will on all sides, worked extremely well on the whole and produced the results desired. Our best combined effort, over a period, was 10,000 tons a day, of tanks, guns and stores of all kinds, delivered into Russian hands. Even more than this could have been accomplished, but was not required. As a result of the three-year effort from October, 1941, to October, 1944, over four million tons of "Aid to Russia" traffic of all kinds have been delivered through the "back door" to Russia, which have helped in no small degree to make the Russian victories possible.

Now my time is up. I have of necessity, in a brief talk had to omit most of the interesting and human details. How cold it was in the mountains, how hot it was in summer on the plains! How the locomotive injectors failed to lift the almost boiling feed water into the boilers in a temperature of over 137° in

the shamefaced trade! How wagon couplings from America were not strong enough, allowing trains to break in half and run away; and how magnificently our young British lads worked and sweated in that first year, doing what experienced drivers and trained men would often have hesitated to attempt. They were a grand lot, one and all. Many of them are now showing their mettle, and proving their worth again in other theatres of war. And last, but not least, how many real friends we made among our Russian and American colleagues. Some day, I hope a pen more eloquent than mine will write the story of the "Back Door to Russia."

NOTE BY EDITOR

Permission has been received to publish the following letter, which was printed in *The Times* of 19th March, 1946, and is a striking tribute paid to the work carried out by the Royal Engineers, described above by Brig. Sir Godfrey Rhodes.

TRANS-IRANIAN RAILWAY

To the Editor of *The Times*

SIR,—In *The Times* of March 6 a Correspondent lately in Persia, referring to the supply of war material to Russia by the southern route, writes:—"While the running of the railway from the Persian Gulf to Tehran was soon handed over to the Americans, British troops remained responsible for the security both of the railway and of the roads . . ." This sentence may, I think, have the unintended effect of belittling an epic achievement of the British Army.

In October, 1941, when Brigadier Sir Godfrey Rhodes and his staff began to reorganise and develop the Trans-Iranian Railway, it could carry only 200 tons of paying loads a day. In almost every department the organization of the line was, by occidental standards, chaotic. Half the locomotives were awaiting repair and the rest in a parlous condition. The Royal Engineers, exercising extraordinary tact and patience, had to overhaul the Gilbertian edifice from top to bottom, to carry out a huge constructional programme, and to keep the line in operation at the same time. Working double-headed trains through the 140 tunnels (some spiral) between Andimeshk and Dorud, British locomotive crews were often overcome by the fumes and the terrible heat. Some Sappers died; but the loads which the Russians so desperately needed always got through. By the end of 1942 the monthly lift had been multiplied nearly eight times.

The Americans, coming with comparatively unlimited resources, were able greatly to increase the lift again. They richly deserved the tributes widely and lavishly paid to their achievement. But in justice to the British engineers it should be remembered that the Americans took over a system already completely reorganized and enormously developed by British stamina and skill.

The British remained responsible for inland water transport and continued to run convoys over the formidable western section of the 3,000-mile road system put in order by Persian contractors under R.E. supervision. The contribution of Paiforce (Persia and Iraq Command) to the "Aid to Russia" lift was never limited to protective duties. The whole story had to be kept dark for reasons of security, and in consequence a splendid achievement by thousands of British and Indian soldiers in the conquest of distance and climate has received pitifully small recognition.

Yours faithfully,
R. C. HUTCHINSON.

Garrick Club, W.C.2.

FIGHTING OIL WELL [illegible] FIRES IN SERIA, BORNEO

By LIEUT. [illegible] B. UNDERWOOD, R.A.E.

THIS report covers work [illegible] done in extinguishing fires started by the Japanese in the Seria Oil[illegible]ilfield over the period from 21st June, 1945, when Seria was captured, to 2[illegible]h September, when the last fire was put out.

The report includes :—

1. Introductory Remarks.
2. A brief description of t[illegible]e oilfield.
3. An outline of the ene[illegible]y demolition and denial programme.
4. A description of the m[illegible]thods used.
5. A general list of the e[illegible]uipment required.
6. The provision of neces[illegible]ary services such as water, gas, etc.
7 to 10. A detailed descript[illegible]n of the technique employed on several wells.
11. A summary of results.

[illegible]. INTRODUCTORY

The object of the campaig[illegible]a in North-West Borneo was based firstly, on the naval and air base pote[illegible]ntialities of Brunei Bay and, secondly, on the economic importance of the oil[illegible]fields of the Miri-Seria area. At the time of the advance from Brunei township [illegible] towards Seria, when the success of the whole operation seemed assured, it [illegible]s evident that problems other than those of a purely military operation wer[illegible]e going to be met. For many miles before reaching Seria clouds of smok[illegible] by day and a glow in the sky by night clearly indicated the position of the e[illegible]oilfield; no apparent decrease in volume being discernible over a period of d[illegible]ays. When Seria was occupied on 21st June, it was abundantly clear that t[illegible]he enemy had taken advantage of the readily destructive nature of the field [illegible] and the installations. A large number of wells were on fire, extending over t[illegible]hree miles of the length of the field, the roar from most indicating very hi[illegible]gh pressures. All arms immediately became concerned with the obvious e[illegible]normous loss of oil and the possible permanent damage to the largest produ[illegible]cing oilfield in the Empire. Various parties attempted to extinguish fires [illegible] and some small fires were put out by beating, smothering with sand, etc. Si[illegible]nce the final objective of the Force required a further eight miles advance, [illegible]necessitating the commitment of all arms, the Force Commander ordered t[illegible]hat the R.A.E. Platoon would take whatever action was possible to extingu[illegible]ish the fires, any work undertaken to be subject to operational requirements. At this stage, the R.A.E. Platoon were responsible for the area inclusive Br[illegible]unei to inclusive Baram River, a distance of 80 miles including two unbridge[illegible]able river crossings, involving the construction and operation of firstly impr[illegible]rised, and later standard equipment, ferries, the reconstruction of four p[illegible]rly demolished bridges in Seria, and normal checking for booby traps, U[illegible]X.B. disposal, road repair, water supply, etc., together with the operation [illegible] of outboard driven, shallow draft watercraft—canoes and folding boats—f[illegible]r patrols and supply up rivers inland. This called for a fairly full commi[illegible]itment of available sappers, and a small initial detachment was set to work on [illegible] the fires. Gradually the area of responsibility was reduced, better ferry eq[illegible]uipment came forward, work was completed, operational demands became [illegible] less and the work of fire fighting eventually became the main job in hand. Native personnel who were former employees on the oilfield were recruite[illegible], and, from one man on the day Seria was

occupied, their number was gradually increased to about 200 on actual fire fighting work, together with others indirectly involved. These men were of all types, foremen, tradesmen and labourers comprising Malays, Dyaks, Chinese, Indians, Javanese and Eurasians and were invaluable. Most of them had fled into the jungle sometime before the invasion, and time and some trouble were required to bring these men back from inland areas. In some cases they were behind groups of enemy in the jungle and were unable to return until these enemy groups were driven out or moved on. A few days after the capture of Seria an officer of the N.I.C.A., who was an oilfield engineer, arrived and provided a great deal of valuable information about oilfields and the nature of oil wells, and joined in with the fire-fighting team. Later two American experts arrived from Texas, U.S.A. These men were professional oil well fire-fighters and had had a considerable amount of experience and success over a period of twenty years. It was decided that their patented method would be used to extinguish the remaining fires. Since the only suitable equipment available was that already in use by R.A.E. and, since the sappers and natives had already had some experience in the work, it was decided that the job be completed by joint action, R.A.E. to carry out the work under the experts' guidance.

2. The Oilfield

The oilfield consists of both high and low pressure wells. Before evacuation, a number of wells had been sealed off with cement. Some of these the Japanese managed to drill out and put on production again, but some were still as originally sealed off. In addition the Japanese had drilled sixteen wells during their tenancy. The wells vary in depth, an estimated average being 4,000 ft. Plate No. 1 illustrates the characteristic arrangement of well-head fittings—the "Christmas tree."

Oil and gas are drawn together from the tubing through a 3-in. lead line, into which is fitted a constriction of, say, $\frac{3}{8}$-in. diameter, known as the bean. The diameter of the bean is varied to suit the well and production requirements, so that the flow is controlled, thus controlling the tendency of the screens at the foot of the well to choke by sanding up. Some of the wells in the field have high natural pressures, others relatively low pressures. Again, other wells require gas lift using gas from high pressure wells. Wells which were fired were high and medium pressure wells.

A well may be "killed" by filling it with a fluid which will produce at the bottom of the well sufficient hydrostatic pressure to overcome the natural pressures. For this water, or, more usually, sand-free liquid mud of high specific gravity is used.

The Japanese had installed gas compressors to carry out some refining for the extraction of some components of the gas. This installation was very badly burned out and the plant was irreparable.

3. Enemy Denial of Resources

The enemy programme included setting fire to 37 oil wells, burning out buildings, stores, installations, cutting and burning bridges and the immobilization of all types of plant by removing essential components. Further, his continued complete disregard for mechanical maintenance brought plant to such a condition that repairs were almost invariably necessary.

Items of machinery, mud pumps, fire pumps, oil pumps, water pumps and M.T. were immobilized by removing parts such as carburettors, magnetos, valve covers, valves, cylinder heads, etc., and either burying or dumping these in rivers which had soft mud beds. Some of these were located and

salvaged, and by improvisation and by selective cannibalization, sufficient repairs were effected for the purpose.

Stores normally housing spare parts, tools and such essential items as packing, etc., were completely destroyed by fire. This was done as in other buildings, by setting a 50-kg. aerial bomb among a stack of drums of oil, smothering the whole in oil and igniting. This arrangement failed in an electrical goods store, and, very fortunately, in the machine shop. The bombs and oil were removed from these buildings, the machine shop later being indispensable.

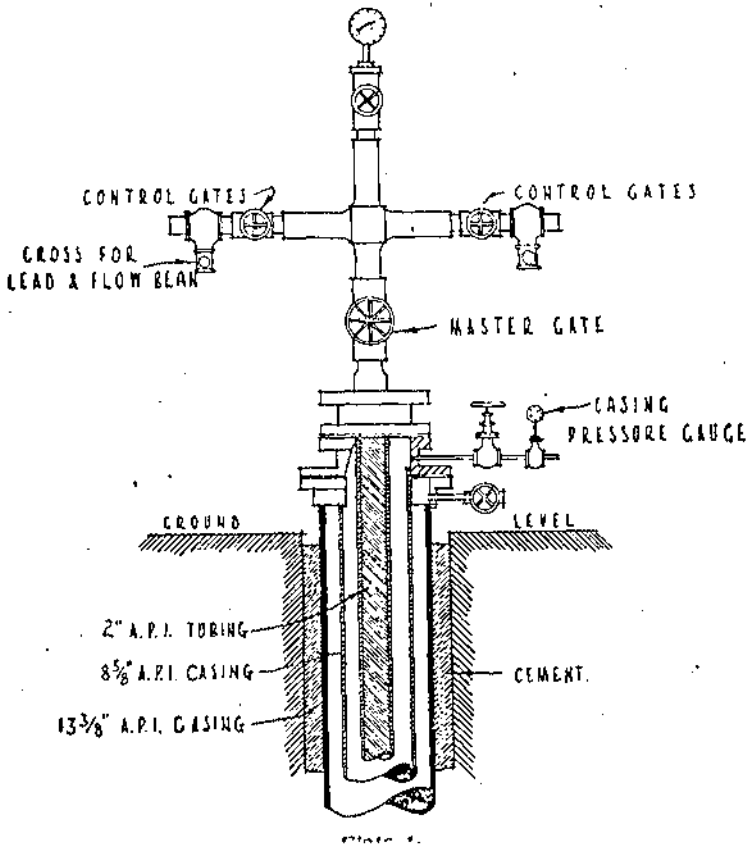
In the main oil pump station pipes, leading from a well, reticulated oil and gas to prepared jets directed at machines. These were then ignited, rendering compressors, pumps, electric motors, etc., irreparable. Set among these machines were a number of 50-kg. bombs without fuses, some of which did not explode, the picric acid filling evidently being not sufficiently sensitive to heat. The pipelines were traced back from the jets and when a valve was reached it was turned off.

Most of the well fires were apparently started by providing a 3-in. opening at the " Christmas tree " and lighting the gas and oil flow with a long handled, oil soaked, burning taper. In some cases, however, a 50-kg. bomb had been placed at the well-head and exploded after the fire had been started. Bombs had also been exploded against heads of wells which did not catch fire, the " Christmas trees " being blown off. An unexploded bomb was found against the head of a well, which had been on fire and which had been extinguished. The bomb was found to be fitted with normal aerial fuse, with the propeller removed, and set with a simple pull wire mechanism for remote initiation. The burning jet had been flowing well clear of the ground and throwing far out from the well head. The bomb was removed, examination revealing that the striker had struck the cap which was faulty. Another similar bomb was found at a well-head set for initiation by safety fuse and detonator. Of the 37 fires, one had gone out by sanding-up before Seria was captured. A number of other wells with small fires had evidently been large fires originally, the flow having dropped as a result of partial sanding-up. The remainder were large fires, three of which sanded-up later and went out.

4. Fire Fighting Methods

Early examination of the position soon showed that fire fighting equipment available was practically nil and that, at best, two or three fire pumps, which had been immobilized, could probably be made workable, together with some lengths of hose. At the same time some fires appeared as though they could be quickly extinguished. Some of these were very large horizontal jets, but, with a favourable wind and some small screens, it should be possible to turn off the master gate valve, either by hand, by using a pipe spanner or by using a long-handled fork shaped tool made to fit between the spokes of the valve wheel. A small detachment worked along these lines with success in most of the cases to which these methods could apply. In two cases the valve was so badly burnt out that it could not be turned off. It was necessary to work in relays for short periods and with the wind. When the main jet had been turned off it was necessary to put out burning gas leaks at damaged casing head flanges. This was done by shovelling or bulldozing sand and smothering them out. Further attempts were then made using a bulldozer to feed sand over a complete fire. This was unsuccessful with all but small fires and proved too exacting on operators, as no asbestos suits or pumps were available at this time.

All relatively easily handled fires having been dealt with, attention was



Typical Christmas Tree.

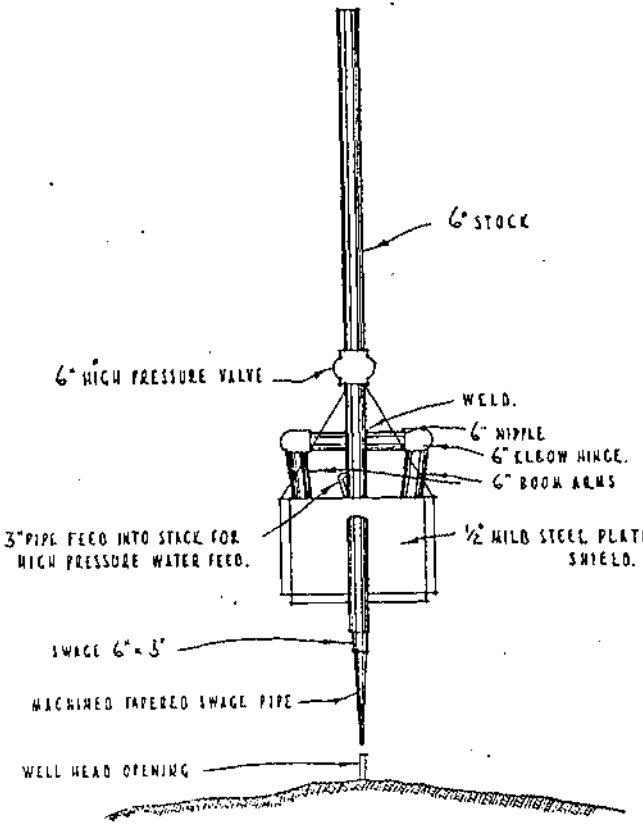


Plate 2.

Patented Apparatus.

turned to some of the larger fires. The first was from a well producing gas without oil. Two pumps were now available and water directed at the fire, falling on hot sand which had been bulldozed over the "Christmas tree," immediately turned into steam, the steam mixing with the gas and producing a non-inflammable mixture, the fire going out. The area was cooled off, the "Christmas tree" uncovered again, and the well brought under control by removing the upper portion of the "Christmas tree," fitting a new open master gate valve and then closing the valve.

Meanwhile work had been proceeding in the machine shop to build a piece of apparatus to divert the main oil flow from the head of the next fire. Three failures were met with, due to inadequate design of the apparatus and unreliable pumps, hoses, etc., but the fire was eventually put out. This is described in detail below as Well "A." Experience gained on this fire indicated the efficacy of steam, and it was decided to attack a fire using steam only.

Boilers were collected and set up in a battery for the next fire. More equipment, such as heavy transport, cranes, better fire pumps, welding plant, etc., had now arrived greatly facilitating preparation work. The fire was successfully put out and was followed by a further two. By this time more boilers were being made mobile and it was possible to prepare for these fires in advance. Further, technique was improving with experience and it was considered that by careful placing of the steam jets to give the most efficient results, fewer boilers could be used per fire. The method is described in detail below for Well "B."

At this stage experts, under contract to the owners, arrived and work was carried on using their patented equipment. By using this method the danger to men working to bring a well under control, after the fire had been extinguished by steam, was eliminated. This work involved cutting away hot clinker and steel with crowbar and pick from around the "Christmas tree," from which a full blast of oil and gas was blowing. Although water sprays were continually played on the men, one spark would have been sufficient to cause a serious accident. Further, the process of fitting a new valve over a nipple, from which a full 3-in. bore of gas and oil was blowing, produced many temporary eye casualties and some cases of gastric disorders. The method as applied to Well "C," is described below. The principle involved is that the well is "killed" while still burning, the flames gradually decreasing during "killing" and when "killing" is complete the flame is automatically extinguished. The method is to have a vertical pipe tapering down from top to bottom with a high pressure valve half way up the stack and a line teed in at a point below the valve. The tapering is achieved by using standard high pressure swages, the bottom swage consisting of a high pressure pipe section forged to a taper and machined off. The last swage is fitted into the vertical section of the "Christmas tree," from which the main oil jet is emitting, so that a good leak-free seat is obtained. Some manœuvring may be necessary to obtain a good seat. The oil and gas then flow from the top of the stack pipe and is usually ignited by the remainder of the well fire. High pressure slush pumps are connected to the tee line by high pressure drilling hose, and water or mud pumped through. The valve on the stack is then closed and pumping continues against pressure down the tubing. Gas and oil leaks continue from the casing head fittings and continue to burn. Eventually water passing down the tubing builds up in the casing until it returns through the casing head leaks. Usually the first return is water, oil and gas emulsion. Pumping is continued until this is free. The fire goes out and the well-head and surroundings are cooled off. Pumps are stopped and the wells are "killed." The stack is withdrawn, crane backed away, clinker is cut away and new well-head fittings are added. The well is then safe. The apparatus is shown in Plates

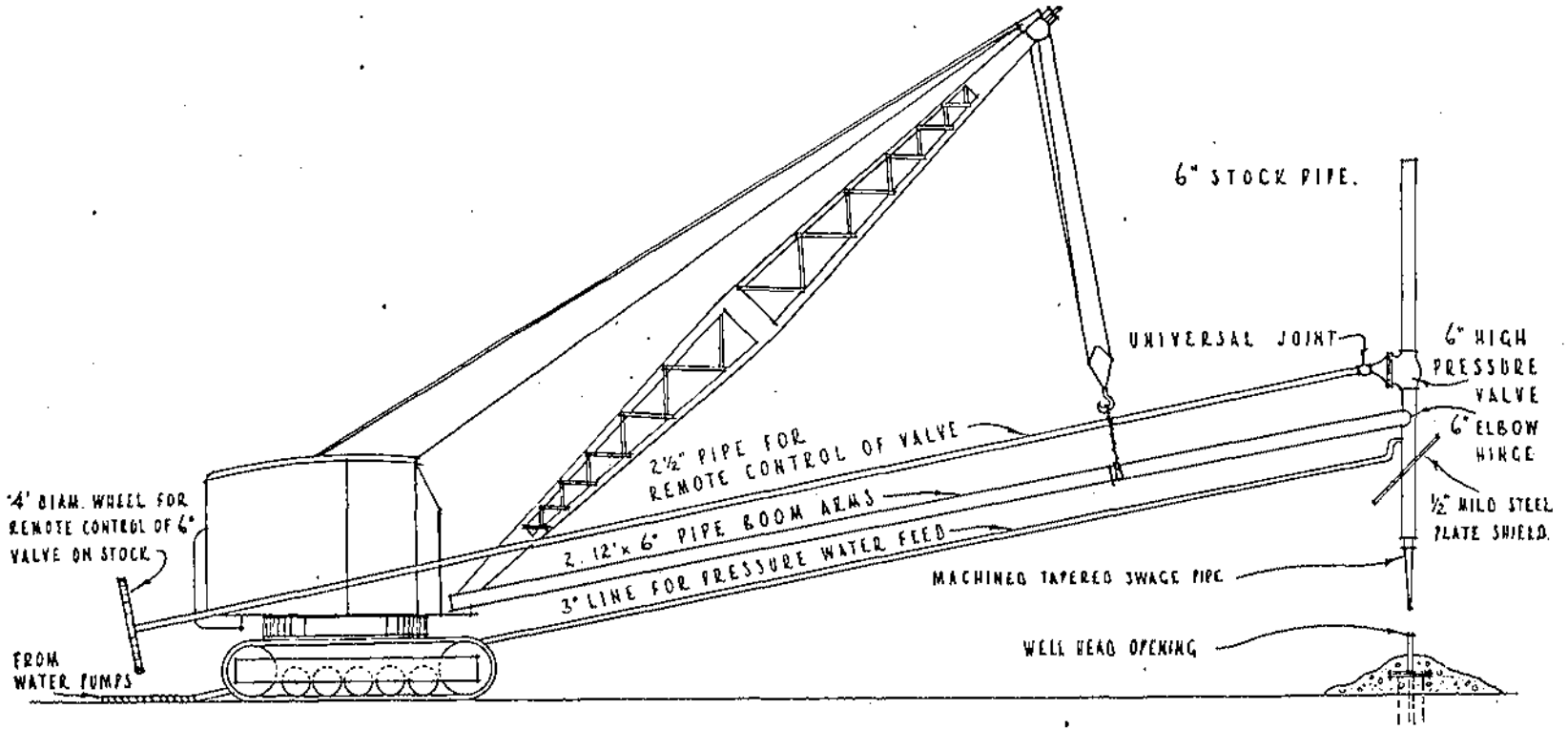


Plate 3.

Crane for placing Patented Apparatus.

2 and 3. A number of tools which could be fitted to the bottom of the stack in place of the machined swage were made and used on various fires for cutting, raking, hooking, etc.

5. Equipment

a. Fire Pumps

From the immobilized fire pumps found in the area three were eventually put in order and, although unreliable, were at first the only pumps available apart from the standard No. 4 Pumping Set, which gave good service. The arrival of six Jupiter type fire pumps remedied this position. These were fitted to provide two delivery hoses and Y pieces were made to give four per pump.

b. Mud Pumps

These consisted of two cylinder, steam driven pumps, usually with interchangeable pump liners and pistons to provide varying outputs and pressures. There were a number of these on the field, all having suffered either from fire or were deficient in parts removed by the Japanese. Eventually four pumps capable of 1,100 lbs. per sq. in. when compounded two in series, were put in working order. Another pump was recovered from near a fire and, as the damage was mostly on the steam end, it was overhauled and used. This pump was capable of 2,000 lbs. per sq. in. when used single. The store which had contained spares for these, such as rubber valve seats, all types of packing, etc., had been completely destroyed and improvisation was necessary. This resulted in a number of failures at inopportune times—such as lead gaskets for steam chests on pumps softening and blowing out and incorrect packing on high pressure water end piston glands, etc. The only answer to this was continued replacement, nursing, and luck. On such occasions the possibility of losing the benefit of the previous period of pumping called for fast work and the native tradesmen invariably were up to the mark.

The pumps were set up in positions where several fires could be handled without necessitating removal. They were connected so that by operating valves, they could be compounded to pump either in series or in parallel. 100 h.p. boilers working at 250 lbs. per sq. in. were hauled to a convenient site and set up with feed-water tanks and pumps. The delivery from the pumps was run towards the fire and, by means of high pressure reinforced rubber drilling hose, was connected to the patented equipment as described below.

c. Boilers

Throughout the field pumping stations were situated where the oil was collected from a number of wells and then pumped to a main tank farm. Boilers normally used for this were removed from their sheds, put on wheels and towed to a site suitable for use. Included were 30, 75 and 100 h.p. boilers. They were set up in batteries of 6 or less, and feed water tanks and pumps installed. Gas lines were laid and the boilers tested. The majority were found to be in bad shape, maintenance by the Japanese having been practically nil. All were of the fire tube type. It was found necessary to replace some tubes and all others required expanding. One boiler was found to be in very bad condition and it was necessary to weld all tubes—and then it could be used once only. Some boilers had been damaged by aerial straffing, and patch-welding and weld-filling was necessary before they were serviceable. Six boilers were sited in installations reasonably close to fires and it was not necessary to move these, steam being taken off through 4-in. mains as far as 300 yds. Three boilers were acquired from Kuala Belait, eight miles from the field. In all, about twenty-five were recovered.

d. Transport

Normal transport issued to R.A.E. was used. In addition, a number of light vehicles found on the field were put into commission. Heavy transport was supplied, a seven-ton semi-trailer and an 18–20-ton transporter proved very useful. A Diamond T recovery truck was very useful for carrying mud pumps, etc., and manœuvring them into position. Two tracked cranes were used for setting tanks in position and one of these was used to operate the patented apparatus. Two R4 tractors were employed on all types of haulage work, and a D4 and an HD7 bulldozer were indispensable in cutting and building up tracks and ramps to the fires.

e. Welding Plant

Welding equipment of a Welding Platoon R.A.E. was employed on many jobs. Repair work to tanks, pipe lines, boilers, etc., was essential. Two sets were kept employed for some time in the machine shop.

f. Patented Equipment

The apparatus was built in the machine shop from component parts drawn from all parts of the field. It was designed to fit the 12-ton tracked crane with a 35-ft. jib. It was of heavy construction to ensure a good seat for the swage and to ensure that once seated it would not be thrown out by the pressure in the well. When completed the load on the crane was comfortable, but it was found that in soft going the tracks tended to bury when the jib was forward, but when trailed, movement was smooth.

g. Wind Machine

Work on fires with the patented equipment necessarily had to be timed to suit the wind in order to protect the crane. In each case preparation work was done using the usual afternoon sea breeze. To aid this and to allow a little flexibility in direction of approach with the crane, a stripped Wirraway aircraft was used. This machine was towed as far as possible towards the fire with an R4 tractor and then manhandled into its correct position, 5 ft. by 6 ft. mats of A.R.C. mesh being thrown under the wheels for movement. The fuselage was aimed at the source of the fire and the tail packed up to a desirable height. Since this could not be done with the engine running it was necessary to keep aircraft and men under a water spray. When pickets had been driven and the tail lashed down, the engine was started, the air stream then providing enough cooling for fuselage and fuel tanks.

h. Machine Shop

The machine shop at Seria was found to be in disorder but recoverable. Diesel power units were checked over, lathes, drills, forges, etc., checked and a staff of native craftsmen set to work. Working under a native foreman this shop turned out some very good work with very few hand tools available and often under rush conditions. The shop was expanded to provide large and small diameter pipe threading lathes by moving power units and machines from Kuala Belait. Welding was done initially with a set found in the shop and later by personnel and machines of a Welding Platoon R.A.E. When gas was made available the forges were brought into use and did good work. Many tools which had been damaged in fires were retempered. This was the only way in which pipe screwing and pipe cutting tools were made available.

6. Water and Mud Supply

Water supply was drawn from the Badas River at Badas some seven miles inland, communication being by narrow gauge railway. Two 6-in. and one 4-in. pipe led from Badas to Seria where mud and water were stored and

repumped through reticulation systems throughout the field and for domestic supplies at Seria and Kuala Belait. The pumping station at Seria had been burnt out, pumps being damaged but recoverable.

On 25th June a patrol of Infantry with R.A.E. and native fitters attached moved out to Badas. Three locomotives were found, one of which was made mobile. The other two were towed back to Seria. Examination of the pumping plant showed that of the twin pumping sets one could be repaired and the other, which had a broken crankshaft, was doubtful. This was later welded and turned in the machine shop and reinstalled.

Mud is made at Badas by slurrying clay, adding caustic soda to throw out the sand and allowing to settle and is finally pumped to Seria. The mud plant consisted of boilers, steam pumps, mixers, etc. The boilers were in bad shape but the remainder appeared to require little repair.

The patrol returned by rail and a few days later a company of Infantry moved to Badas to secure the area and to patrol from there inland. Fitters moved to Badas to work on the pumps and mud plant. The machines were found to be in very bad condition but eventually one pump was set running. The Seria pump station was under repair at the same time and two pumps were made workable. The water reticulation lines had suffered considerably from air attacks and leaks and breaks in the lines were repaired by clamping, and by welding, water then being available throughout the field.

The mud plant was eventually got going and a supply of mud pumped to Seria, where it was stored ready for use.

Temporary water storage at Seria had been effected by using one of two mud pits and retaining the other for mud. The tanks in the main tank farm had all suffered from aerial attack. Five large tanks were recovered by cutting away torn plates and patching with plates cut from other non-recoverable tanks. A large number of bullet and shrapnel holes were weld-filled and patched also. When these were complete the water and mud storage position was eased, and, further, storage was available for oil for projected naval requirements.

7. Gas Supply

The whole field was reticulated with gas pipe lines, the gas being drawn from wells together with oil and separated. In order that boilers could be fired both at Badas and Seria, and so that forges could be operated it became necessary to put a well on production. A well which had been on fire was put on restricted production to provide the required supply. Oil produced at the same time became an embarrassment when all available tanks were filled. This was pumped back down another low pressure well which had also been on fire, but which had been extinguished. Gas was also supplied for domestic use and was quickly used in all cookhouses and hygiene arrangements were greatly improved. Gas lines had also suffered from air attack, and repairs were necessary in several places.

8. Well "A"

a. Description of the fire

The fire consisted of a main oil jet from a 3-in. elbow, the jet moving horizontally, together with leaking casing head flanges and a leaking 2-in. valve which was attached to a tee line on the tubing below the 3-in. elbow. The main jet gave a flame approximately 40 ft. long and 15 ft. high.

b. Diverting the main oil jet

It was decided to try to divert the main oil jet so that the oil would flow

unignited into a pit and then to extinguish the flames of the small jets from leaking valve and casing head flanges, etc., with water hoses.

A special apparatus was designed to fit on the elbow at the top of the well. The junction was at first made with a sleeve valve, but later this was altered to an elbow connection which was more successful. The back pressure of oil was also found to be too great for the water and so steam was used instead. The apparatus was fixed in position by means of a crane attached to a bulldozer (see para *f.*).

c. Water Supply

An installation of fourteen, 2,500-gallon tanks, which had been used for oil storage but which had been burnt out rendering five unserviceable, was located close to the fire. The remaining nine were used for water storage. An additional four 3,000-gallon water tanks were installed on the opposite side of the fire.

d. Water Pumps

Two pairs of pulsometers driven by a No. 4 pumping set power unit provided four hoses. Two captured enemy pumps each provided four hoses.

e. Steam Supply

Steam for the elbowpiece was supplied by a 100 h.p. boiler at 80 lbs. per sq. in. Three 100 h.p. boilers, at 180 lbs. per sq. in., located in a nearby pump station, were used to provide steam jets. These jets were directed underneath the main fire and also over the pit bottom at the point where the diverted oil flow would fall. These latter jets were to ensure against any re-ignition of this stream of gas and oil.

f. Crane

A crane was constructed from an " A " frame boom found in the oilfields, a set of steel wheels and axle which were removed from a drilling trailer and two 30-ft. lengths of 3-in. pipe welded to form an " A " frame type drawbar. The crane was rigged with a fixed topping lift and a 2 : 1 lifting tackle operated from the winch of an HD7 bulldozer. The draw bar of the crane was made to fit the draw yoke of the dozer.

g. Pit, Ramps, etc.

The pit for receiving the diverted oil was sunk by a bulldozer being roughly 100 ft. long by 50 ft. wide and up to 10 ft. deep. A ramp was run up towards the burning jet, the machine working up from the bottom of the pit. The height of the top of this ramp was made 6 in. to 12 in. lower than the 3-in. elbow from which the main oil flow was emitting. This was arranged to ensure that when the elbow was in place the lead-off line was tilted slightly downwards, ensuring a minimum back-pressure.

On the other side of the fire a ramp was dozed up for the approach of the crane, A.R.C. mesh was laid on this sand ramp by men working in relays behind shields.

Bulldozer operators worked with the wind blowing from the work towards the fire. They wore asbestos suits and worked in relays of 5 minutes per man.

h. Extinguishing the Fire

Water hoses were played on the ground surrounding the fire for about 20 mins. for a preliminary cooling. Steam jets were turned on. The crane with the elbow fitting was run half way up the ramp and a flexible steel steam hose connected to the steam lines attached. This steel hose was connected at the other end to a steam line run from the single 100 h.p. boiler. Both steam valves " A " and " B " were slightly opened to expel all air from the elbow and lead-off line. The crane was then pushed forward until the 8-in.

elbow was directly above the 3-in. elbow at the top of the "Christmas tree." A man in an asbestos suit moved between the crane wheels and the bulldozer to guide the 8-in. elbow into position. Another man gave directions by hand signal to the dozer operator from a side position. All water hoses were then directed at the well head and "Christmas tree" and the 8-in. elbow lowered over the 3-in. elbow. Valve "B" was fully opened and the fire was immediately extinguished. The end of the lead-off line was allowed to rest on the top of the ramp from the oil pit and the unignited oil allowed to run into the pit. Water hoses were kept running to cool off the surrounding area, coke, etc.

i. Closing the Well in

When the well-head, etc., was sufficiently cool, the elbow fitting was raised and dozer and crane backed away. Inspection showed that all pipe-work above the casing head required replacement. All fittings and valves were stripped down and a new master gate valve added and closed. A pressure gauge was fitted and within an hour the pressure was 800 lbs. per sq. in., building up to 1,400 lbs. per sq. in. 4 hours later, and stabilizing at that.

9. Well "B"

a. Description of the Fire

The main fire consisted of a burning jet from a 3-in. elbow flowing horizontally from the "Christmas tree." Bad gas leaks from casing head flange leaks were jetting in several directions, and a burnt out pressure gauge connected to the casing also provided a small jet. The main flame was about 50 ft. long and 15 ft. high. Other jets varied from 2 to 10 ft. The well had been ignited on 10th June and at the time the fire was extinguished the well-head was surrounded by a large block of clinker which was the collected residue from weeks of burning.

b. Water Supply

A number of tanks were placed in groups around the fire and manifolded to provide a positive water feed to the fire pumps. Jupiter pumps each provided four hoses, a No. 4 pumping set provided one hose, and two captured pumps provided two hoses each.

c. Steam Supply

Boilers were sited in two batteries, each provided with feed water tanks and pumps. After test and repairs had been completed steam lines were laid to the fire. It was necessary to direct the steam jets so that (i) a steam blanket was provided cutting off the supply of air from the fire to choke combustion and (ii) a mixture of steam with oil and gas would be obtained, thus raising the flash-point of the mixture to a point where the mixture would be non-inflammable. Both these effects were obtained. Each boiler provided two steam lines—a 3-in. line from the normal steam take-off and a 2-in. line from the boiler blow-down valve. The lines were run into and around the fire from all directions, the vertical angles being adjusted to give the best blanketing effect. Each line was tested in turn and any necessary final adjustments were made by men working close-in in relays, clad in asbestos suits. One steam jet was placed behind and slightly above the main oil jet. This proved very effective as it ensured a good mixture of steam with oil and gas to give a non-inflammable mixture and also gave a steam blanket above the fire.

d. Extinguishing the Fire

All water tanks were filled and set running with delivery valves closed. Hoses were run out as far as possible towards the fire. Boilers were raised to

full pressure with all steam valves closed, water level being above normal. All water delivery valves on the pumps were opened and fire hoses were played into and around the fire. Simultaneously all gas fires under boilers were extinguished. After about 30 secs. all steam valves were opened and within 10 secs. the fire was extinguished. Steam valves were closed in another 30 secs. The water jets were continued to cool off the well-head and surrounds to prevent re-ignition of oil and gas by hot surfaces. Oil and water were drained into a previously prepared pit. This was to prevent oil floating down drains with the possibility of re-ignition from neighbouring fires. When sufficiently cool, work was started to bring the well under control.

e. Closing the Well in

Examination showed that the remains of the " Christmas tree " were in very bad shape, the stem of the master gate valve having melted off. The " Christmas tree " was stripped down, fitting by fitting, and a new open 3-in. master gate valve manœuvred over the jet and screwed home and closed. Additional pipes and fittings were then connected to provide an outlet 120 ft. from the well-head. The new master gate valve was opened and the tuning allowed to blow off to prevent the casing pressure building too high.

The burnt out pressure gauge was leaking badly. Half-inch fittings were removed and an attempt made to fit a weighted $\frac{1}{2}$-in. high pressure valve over the now very high velocity blowout from the casing. This could not be done and the reducing bushes were removed resulting in a 2-in. blowout. An open 2-in. high pressure valve was eventually manœuvred over the blow-out, screwed home and then closed. The closing-in period occupied about 3 hrs. Twelve hours later the casing pressure was 1,100 lbs. per sq. in.

10. Well " C "

a. Description of the Fire

The fire was originally similar to the fires " A " and " B " in that the main oil flow was horizontal from a 3-in. elbow and the casing head, etc., flanges were leaking.

In order to use the patented apparatus it was necessary to obtain a vertical opening on the " Christmas tree." This was done by cutting off the " Christmas tree " at a suitable point by means of a 2-pdr. A.Tk. gun using A.P. ammunition. Three rounds were sufficient at 100 yds. range.

b. Ground Preparation

Water from hoses flowing away from the fire tended to carry a quantity of unburnt oil which ignited again later. To preclude the possibility of this draining towards and forming pools around the crane, it was necessary to build up a bank of sand in a semi-circle about and close into the fire on the side from which the crane was to approach. At the same time a track was smoothed out to within 20 ft. of the fire for the crane to move in. This was done with a bulldozer, operators wearing asbestos suits and working in short shifts to cool off machine and personnel.

c. Water

Water was supplied from tanks sited near the fire. Jupiter pumps were used as before. It was necessary to cool off the area before and while the bulldozer was working close in to the fire, and when placing the stripped aircraft in position. When the crane and patented apparatus were run in and until the fire was out, it was necessary to direct hoses on the crane, the jib, cables, and on the stack, for the whole period.

Once the apparatus had been seated, 3 hrs. pumping was sufficient to kill the well. When the fire was out, the swage was removed and the crane

backed away. New " Christmas tree " fittings were screwed into place, the new master gate valve was closed and the well was then safe.

11. Summary of Work

Of the thirty-seven wells set on fire by the enemy :—

a. Three small fires around well-heads were beaten out.
b. Eleven well fires were extinguished during the initial stages by turning off master gate valves and by smothering with sand.
c. One gas well fire was extinguished with water.
d. Two fires were put out by methods involving diversion of the main oil flow.
e. Three were extinguished with steam.
f. Twelve were put out using patented equipment.
g. Four wells sanded-up, extinguishing themselves.

The work covered a period of three months, involving 7,600 man-days worked including 2,400 by Army personnel and the balance by civilians. An indication of the plant worked can be gained from the following :—

Wheeled Transport	..	4,400 Plant Hours
Tracked Equipment	..	2,300 „ „
Fire Pumps ..	..	1,400 „ „

INDIA'S ENGINEER WAR EFFORT 1939–1945

(Contributed by the E.-in-C. in India)

THE following statistics are submitted as a matter of interest to the Corps as a whole, and as a tribute to the Emergency Commissioned Officers and Other Ranks of the Royal Engineers, Indian Engineers and the Military Engineer Services, who made them possible.

1. WAR EXPANSION—EXCLUSIVE OF TRANSPORTATION AND SURVEY

Strength on the outbreak of war		
Officers R.E. and I.E.		175
Other Ranks I.E.		12,002
S.D.Os. and Overseers		909
Strength on V-J Day		
Officers R.E. and I.E.		7,179
Other Ranks I.E.		235,482
S.D.Os. and Overseers		6,484
Order of Battle—I.E. Units		
On outbreak of war :—		
Field Companies		17
Field Troops		3
Army Troops Companies		4
Div. H.Q. Companies		4
Printing Sections		2
Total		30

On V-J Day

H.Q. Engineer Troops, all types	47
Divisional Units, all types	124
L. of C. Units, all types	311
TOTAL	482

There were 54 different types of units in all.

Countries in which served

North-West Frontier of India, Egypt, Palestine, Libya, Eritrea, Tunisia, Iraq, Iran, Syria, Cyprus, Malaya, Burma, Assam, Sicily, Italy, Greece.

2. WAR EXPANSION—TRANSPORTATION AND SURVEY

These services were the responsibility of the D.Q.M.G. (Mov. & Tn.) and of the Surveyor General of India, respectively. Neither service had any military units pre-war.

Strength on V-J Day

	Transportation	Survey
Officers R.E. and I.E.	1,463	206
British Other Ranks	649	820
Indian Ranks I.E.	88,287	3,053

3. MILITARY ENGINEER SERVICES (M.E.S.)

A. Expenditure (including work done by P.W.D. agencies)

Year	Total (£ million)
1939–40	4·72
1940–41	15·93
1941–42	35·40
1942–43	74·82
1943–44	76·93
1944–45	52·36
1939–45 TOTAL	260·16

B. Cost of Works/Cost of Living

Since the outbreak of war in 1939 the cost of works in India has almost doubled, whilst living costs have nearly trebled. Taking costs during August, 1939, as a basis, the increases can be shown as percentage increases above this basis.

Year	Percentage of Cost in 1939	
	Cost of Works	Cost of Living
1940	134	110
1941	152	138
1942	205	212
1943	187	277
1944	179	255
1945	187	262

4. EXAMPLES OF LARGE ENGINEER PROJECTS

		Cost
(i)	*Bases.*—Six major bases, providing covered storage accommodation of 19 million sq. ft. besides offices, personnel accommodation, Railway sidings and Transport facilities	£16,419,000
(ii)	*Storage Depots.*—Ordnance, Medical Supply, Engineer and other storage accommodation other than in Bases. Covered storage accommodation 30,000,000 sq. ft.	£22,500,000
(iii)	*Personnel accommodation* for 900,000 troops ..	£27,000,000
(iv)	*Hospitals.*—A total of 150,000 beds provided by new construction, conversion of existing buildings and requisitioning	£13,500,000
(v)	*Docks.*—Ports, Bases and other Naval projects—26 major projects including 4 Fleet Air Arm Stations	£8,100,000
(vi)	*Roads.*—Major roads; total length 1,600 miles ..	£5,500,000
(vii)	*Oil Pipe Lines.*—1,191 miles of pipe lines. 50 million gallons port tankage. Container manufacturing plants. Container repairs and cleaning facilities. Rail transhipment and loading facilities	£4,000,000
(viii)	*Camps.*—For a total of 870,000 prisoners of war	£4,040,000
(ix)	*Three Combined Training Centres*	£2,220,000
(x)	*Defences on the Frontiers of India*	£2,750,000
(xi)	*Airforce Projects.*—A large proportion of the work was carried out by P.W.Ds. of the Central and Provincial Governments and of the Indian States, under the direction of Chief Engineers.	
	Built :	
	215 Operational Airfields .. £81,538,462	
	60 Satellite Airfields .. .. .. £ 769,230	
	260 Hangars .. .. .. £ 3,076,920	
	3,000,000 sq. ft. warehousing .. £ 769,230	
	Accommodation, other than Airfields, for 80,000 troops £6,153,840	
		£92,307,682

5. ENGINEER RESOURCES

The Engineer Resources Directorate was formed to co-ordinate and control engineer stores, plant, labour, transport, movement and certain commodities.

The work involved in providing Engineer Stores is best indicated by the growth of the Engineer Stores Depots. The number of depots grew from one Depot, with a capacity of 30,000 tons, in 1939, to fifteen Depots, with a capacity of 1,250,000 tons, in 1944.

The actual quantities held rose from a negligible tonnage to 750,000 tons in 1944.

The peak months in each year, 1943 and 1944, showed that the tonnage handled in those months was 104,000 tons in December, 1943, and 137,000 tons in April, 1944. These corresponded to the periods of heavy fighting in Arakan and Imphal.

The movement of Engineer Stores rose from some few thousand tons in 1939 to one million in 1943 and one and a quarter million in 1944 and again in 1945.

The following are the tonnages which passed through G.H.Q. Depots to Mid-East :—

1941	..	49,000 tons	1944	..	7,000 tons
1942	..	131,000 tons	1945	..	1,000 tons
1943	..	82,000 tons			

Sources of Supply

The tonnages of stores received into depots from 1943 onward are given in tabular form below :—

Source from which received

Year	U.S.A.	U.K.	Eastern Group	India
1943	(——————	137,000	——————)	378,000
1944	190,300	56,000	96,900	388,000
1945	164,300	109,400	30,800	310,600

The figures for 1945 are for half the year only.

An indication of some of the stores issued can be gathered from the following :—

Electrical Supplies

8 million electric lamps.
34,000 miles of electric cable.
447,000 electric fans.
9,800 generating sets of total 322,500 KW.

Water Piping, Bridging, Hutting

15,000 miles of water piping.
34 miles of bridging.
48 million square feet of hutting and shedding.
The hutting was made in India.

Mechanical Equipment

750 varieties of machine were in use, and the spare parts lists numbered 5,000,000 items.

250,000 mechanical horse power were available in the mechanical equipment in use.

At one time during the campaign in Burma, 4 tons of spare parts were being flown to forward areas each day.

6. CONTROL AND SUPPLY OF SPECIAL STORES AND BULK COMMODITIES

P.B.S.—At a time when aerodromes were required to be constructed very rapidly, P.B.S. (Prefabricated Bitumenized Surfacing) was introduced from England. Considerable experimental work was carried out at high speed and thereafter the entire manufacture of P.B.S. used in India and by S.E.A.C. was carried out in India.

57 million square yards were produced in the jute mills in Bengal.
53½ million square yards were issued.

Cement, Bitumen, Asbestos Cement, Timber

Owing to the large demands made by the War and the necessity for ensuring that the armed forces and important civil consumers got their fair share of these commoditities, the E.-in-C. controlled their allocation in accordance with G.H.Q. priorities.

The military consumption of cement, from September, 1942, when control started, to September, 1945, was nearly 4½ million tons, and the civil consumption a little more than half that figure.

Of Bitumen, some 570,000 tons were imported for military use and 200,000 for civil purposes.

During the same period, the Forces used 220,000 tons of asbestos cement and the civil consumers 75,400 tons; 958,606 tons of timber were used by the Engineers alone; 677,920 tons by other military users and 360,070 tons by civil consumers.

Container Production

For the greater part of the war responsibility for production of containers was exercised by the D.G.M.P.

It was decided in 1945 to transfer production to the E.-in-C. In the month of July, 1945, the Container Production plants reached their highest combined production. The following production figures were achieved :—

Type of Container	Actual Output in July, 1945
44 Imp. Gal. (55 U.S. Gal.)	282,487
42 U.S. Gal.	48,589
4 Imp. Gal. (5 U.S. Gal.)	346,983
Jerricans	63,867

Labour

Labour also had to be controlled to prevent uneconomic competition between various parties. The total labour employed, both direct and through contractors, in the M.E.S., P.W.D. and E.S.Ds. on military works rose from 17,800 in 1939, to over one million in 1943–1944, after which the number began to decrease, being 835,740 in 1944–1945.

7. MISCELLANEOUS

Bombay Docks Reconstruction

In April, 1944, two explosions in a ship carrying 1,200 tons of explosives, followed by fires, caused extensive damage to two of Bombay's principle basins and the surrounding dock areas.

A military organization under the Director of Transportation was set up to undertake the task of reconstruction and 13 Divisional and L. of C. units were allotted to the work.

Work undertaken involved :—

Clearance of debris, sunken ships, wrecked land transport, and damaged buildings.

Reconstruction of quay walls.

Reconstruction of warehouses, sheds, offices and other buildings.

Laying of new roads and paved area. Reinstatement, often with improvements, of services of all kinds.

Working often two and three shifts, the work was completed and the docks again in use in late October, 1944.

Open Cut Coal Mining

Early in 1944, shortage of coal threatened the maintenance of India's transportation and industrial effort. Military Mechanical Equipment was brought back from Burma to develop open cut coal mining. A Mechanical Equipment Company, a Well Boring Platoon and two groups of Military Pioneers were loaned to the Coal Commissioner. As a result an increased output of 60,000 to 70,000 tons of coal per month from open cut mines was achieved before the end of the year. During 1945 civilian labour was recruited and heavy plant procured from America and now, as military units finally hand over their work, an annual recovery from open cut mines of about 3,000,000 tons is being approached.

THE ASSAULT ON BREMEN

By Maj. D. J. Willison, R.E.

ON 24th April, 1945, the situation around the great port of Bremen, on the River Weser, was that on the north bank a Division had been attacking along the north bank of the river for some days, but was meeting stubborn resistance in the factory district to the east of the city. R.A.F. heavy bombers had carried out several large scale missions on these factories. To the south of the city, after bitter fighting, Brinkum had been cleared by the 3rd British Infantry Division, and all the country to the northwards as far as the Delmenhorst—Bremen main road had been well and truly "liberated." A third Division had occupied Delmenhorst unopposed.

From the southward, the city was defended by a broad belt of flooded land, 5 ft. deep in places, caused by breaching the banks of the Weser above Bremen. A canalized stream, about 80 ft. in width, formed the main defence obstacle behind the flooding. Three roads on causeways crossed both floods and canal from the south and west. Running parallel with the south bank of the river a secondary road entered Bremen from the south-east. From Brinkum the main road from the south ran on a causeway, flanked by trees, across the floods into the suburbs at the eastern end of Bremen airfield. Extensive demolitions had been carried out on the road and railway leading into Bremen from Delmenhorst and the west. The plan formulated was for a two Bde. attack to be made, with the object of taking two strongpoints in rear, 185 Inf. Bde. to be on the right, using the secondary road as axis, and 9 Inf. Bde. on the left.

It is with the fortunes of 2 R.U.R. the battalion on the left, charged with capturing Kattenturm and its vital bridge intact, that 246 Fd. Coy's. operations in the attack were bound up.

During the battle for Bremen 17 Fd. Coy. R.E. were engaged in giving direct support to the "Buffalo" attack of 185 Bde. and in opening up the right hand axis into the suburbs of Bremen. 253 Fd. Coy. R.E. assisted 9 Bde. "Buffalo" attack, providing a Platoon to support the infantry in their attack on Kattenturm and were responsible for opening up the road from Kattenturm into Bremen.

From the engineer point of view, ground recce. by night to within 400 yds. of the bridge at Kattenturm combined with observation from the air O.P. and air photos, had disclosed information as follows:—Some 600 yds. beyond our F.D.L.'s in Brinkum, two holes had been blown in a reinforced concrete bridge leaving a ridge about 16 ft. wide in the centre. Preliminary classification gave the bridge as fit for Class 9 traffic. Some 50 yds. on the home side of this obstacle, a timber road block had been left in a partial state of construction. Some 600 yds. on, beyond the partial bridge demolition, was a massive three pier timber block, with 3 steel rails 11 ins. by 11 ins. spanning between the centre and each outer timber pier. On the bridge abutment itself, some 600 yds. beyond this steel rail block, stood a concrete road block consisting of three 8 ft. cube concrete piers, with twin 8 ft. diameter cylinders 8 ft. long, covering the spaces between the cubes on the home side of the block. Air photos also showed a large demolition chamber in the surface of the roadway over the enemy abutment of the bridge.

The unknown factor in the plan was, therefore, whether the bridge would

be blown or not by the time we reached it. The gap at that point was judged to be 50–60 ft.

The engineer plan was to deploy one platoon of 246 Fd. Coy. R.E. and one tp. of A.V.R.E. and to advance as far as Kattenturm bridge, and, if the latter was intact, to remove the charges, clear the concrete road block, and open up the whole road. If the bridge was blown, a second platoon would come up and tackle the bridging problem. Two Skid Baileys, normal Single Single bridges complete with nose, with ramps carried on the bridge and mounted on wooden, sheet metal-covered skids attached by chord bolts to the bottom chord, were constructed in the village street of Brinkum the day before the attack.

The leading bridge was 50 ft. and the second 30 ft. in effective length. Two A.V.R.E. tanks, one pulling, and the other pushing, manœuvred each bridge. The idea was for the leading bridge to cross the partially demolished bridge by the ridge between the two demolition craters. It was then to park well into the side of the road and be available for use on the Kattenturm bridge, should this be blown. If the span was over 50 ft. then the second platoon of 246 Fd. Coy. R.E. was to come up mounted in 4 " Kangaroos," each " Kangaroo " towing a sledge loaded with Bailey. The sledges between them carried enough material to produce an 80 ft. S.S. Bailey, including the leading 50 ft. Skid Bailey. Additional Panel lorries were held in readiness to come up as soon as the situation warranted.

The second 30 ft. Skid Bailey was to be pushed over the hole to the left of the ridge, thus forming a certain Class 40 bridge, with the doubtful dual carriageway value of the ridge itself, if this withstood the onslaught of the first bridge with its two attendant tanks. Should the ridge fail under the leading tank, the 50 ft. bridge was to be used to span the gap, bridging at Kattenturm then being carried out by normal means.

The platoon was organized into two sections, for mine clearance and carrying made up charges (mainly " General Wades "), for demolition of obstacles, both sections being mounted in two half-tracks and a carrier. The remaining two sections rode on the second Skid Bailey. The A.V.R.E. Tp. brought up the Commander's Petard tank, 4 tanks attached to the Skid Baileys and one A.V.R.E. S.B.G. bridge, which was left behind in Brinkum. One armoured D7 was available for the party. A gunner F.O.O. mounted in a carrier, for ordering immediate fire if the guns on Bremen airfield discovered our presence, completed the set-up. The greatest menace to the operation were the 20 mm. and 88 mm. guns mounted round the aerodrome.

By 2100 hrs., 24th April, the whole party was assembled in Brinkum. Shortly after, the A.V.R.E. Tp. Comd. was wounded in the leg by a shell splinter, but after the M.O. had bandaged him up he pluckily continued for the rest of the night. Two sappers were wounded at the same time. At 2300 hrs. the barrage started in earnest. The " Pepper pot " was sited to fire on the aerodrome, and streams of tracer shell passed just over the road at frequent intervals. The red and livid glare thrown on the surrounding floods made the scene far too light for comfort, but we hoped that the enemies' heads would be well down whilst the stuff was on its way over us.

At 0300 hrs. information came through that the R.U.R. had formed up after disembarking from the " Buffaloes " and were pushing on to cut the road behind Kattenturm. Permission came for our operation to start. On the causeway, with the full moon and the red glow of the 20 mm. tracers, it seemed impossible that the enemy could fail to observe us. On reaching the partially demolished bridge, the two leading sections, in half-tracks, together with the O.C.'s Scout car crossed successfully. Behind them trundled the leading bridge, sparks flying off the skids as it came. With a rush the pulling tank

roared across, then the bridge, and finally the pushing tank, all without a tremor from the long suffering ridge of reinforced concrete. The battle was half won already.

Meanwhile the armoured D7 was clearing the partial road block just short of the bridge. As soon as it had finished, it too crossed over the ridge, despite an anxious moment when it made a mad rush at one of the demolition craters instead.

The second bridge followed hard on its heels, the leading tank disengaged and the pusher tank duly positioned the bridge, unfortunately slightly overlapping the central ridge. However, time was too short to try and move it, especially as a steady line in airbursts about 50 yds. off the road started up about this time. The bridging sections, carried on the bridge, fitted the ramps as quickly as they could and the two tanks then crossed to resume their role as Petard tanks. Later in the night, the platoon officer of the reserve platoon took charge of these two sections and moved the bridge farther over to one side so as to clear the ridge for traffic.

While the bridging had been proceeding, the mine clearance parties had gone forward to the steel rail road block on foot. Word came back that they had found a disturbance in the road surface, and on digging down a few inches, two electric leads had been found. These they had cut, and on tracing back had found a peculiar shaped box, later found to be a battery of unusual design, buried in the ditch. Orders were given for a small party to excavate downwards while the rest of the party dealt with the road block. Made up charges were fitted to the girders and blown. Unfortunately the explosion set fire to some straw beside the block and this blazed up fiercely, making the area as light as day. The whole party drew back expecting enemy reaction, but in a few minutes the blaze went out, and no fire had been brought down. The armoured D7 set to work and soon rooted out the centre timber block and disposed of the cut lengths of girder.

About this time the excavation party reported finding a large barrel-shaped object enclosed in a square wooden frame into which the electric leads led about 2 ft. down. This turned out to be a Naval Magnetic Mine, the usual setting of which allows up to 12 vehicles to pass over before it explodes, as we discovered subsequently. Two more were found sunk in the roadway beyond the road block and excavation started on all three. An urgent message was sent for the Coles Crane to be despatched forward for lifting out the mines.

News from the infantry showed that they were being held up and we could see their battle in progress on the other side of Kattenturm. Permission was requested for a party to go forward and try to seize the bridge intact from our side. At 0400 hrs. this was granted. Two A.V.R.E. tanks and two half-tracks, covered by a mine clearance party on foot, moved off and reached the concrete road block without incident.

The leading N.C.O. looked through the block and saw three men by the far abutment. He challenged, thinking they must be our infantry, as sporadic firing was going on down the street. One of the men rushed into the middle of the road and lay down. The N.C.O. ordered his Bren gunner to fire a burst, and the man got up and ran off followed by his companions. Orders were then received to withdraw 800 yds. as the infantry wanted to bring down a " stonk " on the bridge area. This was done, and half an hour later contact was made with the R.U.R. on the bridge. It was then found that the firing point for three 500 kilo. bombs behind the bridge abutment was placed where the single Boche had been seen to lie down. Our arrival earlier had just saved the bridge from demolition.

The infantry were asked to clear the vicinity of the bridge and two Petard

tanks then tackled the concrete road block. 14 shots shattered two of the cylinders, and the armoured D7 cleared an 18 ft. roadway through the obstacle by 0630 hrs. Just as the Petards started to fire it began to get light. The F.O.O. was asked to bring down smoke on the aerodrome to cover operations on the road. This he did, but conditions were by no means ideal. About the same time, his driver looked in a house nearby and was somewhat surprised to take 20 prisoners who had been hiding in the cellar.

As the light increased, two A/Tk. guns firing solid shot, opened up. The Coles Crane, which was about to lift the third Magnetic Mine, was set on fire by the third shot and burnt merrily. One A.V.R.E. tank was hit and an officer wounded. Only at Kattenturm, where there was cover from observation, could work continue. However, a nasty series of air and ground bursts made life difficult here. Despite this increased activity the road was open to traffic throughout by 0630 hrs.

Later the R.U.R. Company Commander asked if he could use the two Petard tanks to help him shift some Boche who had gone to ground in slit trenches near the bridge. This the Tp. Comd. agreed to and with great gusto proceeded with his tanks to a favourable position where he opened fire with his Besas. A few minutes later a section of the R.U.R. advanced under this covering fire and captured about fifteen Boche whose heads had been kept well and truly down by this unexpected assault. Under cover of smoke the second Bn. of 9 Bde., with tank support, passed through at 0830 hrs.

The reserve platoon was ordered up at 0900 hrs. to provide grillages for the Skid Bailey, and the leading section came up at 0930 hrs. in a " Kangaroo " towing the grillage on a sledge. As they reached the site another A/Tk. gun from the aerodrome opened up and narrowly missed the " Kangaroo." Until 1300 hrs. the party was pinned to the ground by this gun. Thereafter, the bridge was finished off. The last Magnetic Mine was lifted, and three 500 kilo. bombs removed from the far abutment of the Kattenturm bridge.

So ended 246 Fd. Coy's. last major battle in Germany.

AN AMERICAN OFFICE AND ITS MANAGEMENT

By Major-Gen. A. G. B. Buchanan, M.Inst.C.E.

HAVING been employed in an American Army Office in London for nearly two years I think that some notes about it and American methods may be of interest to those who have not had this experience.

Naturally one must realize that an American office in London is not the same thing as its counterpart in, say, Washington. To begin with, the secretarial staff is mainly British, the rooms are British, and so (worse luck) is the telephone. But all the same the "atmosphere" and methods are quite different from those to which we are accustomed.

In the first place there is a pervading appearance of *neatness.* This is achieved by having plenty of drawers, filing cabinets and other receptacles, in which papers, drawings and office "junk" can be put when not in use. Every Saturday morning an inspection is meticulously carried out by a senior officer shortly after the office opens for work. At this inspection all receptacles have to be open and all the staff have to stand to their desks.

The following notice is displayed in offices:

"TO VISITORS TO THE ENGINEER SECTION.

We try to keep our offices and the hallways clean and neat at all times so that we may work in pleasant surroundings. Please help us in this endeavor. Do not throw cigarette ends or trash on the floor."

Secondly, there is much closer contact between officers and their clerks and secretaries than is normal in a corresponding British office. For example in a typical layout there are accommodated in one large room:

Chief of section (Lieut.-Colonel)
2 staff lieutenants.
2 secretaries.
1 draughtsman.

Telephones are "paralleled" between officers and secretaries. The advantage is that every telephone call receives an immediate answer, and also two people can listen in and notes can be taken of conversations.

Thirdly, an American office is more definitely "open" throughout office hours than a British one. Lunch hours are carefully staggered, and, at say 1.30 p.m., one can be sure of finding some one competent to deal with any particular problem.

It always appeared to me that the general atmosphere of an American office is a particularly friendly one. A visitor is welcome, and does not feel that he is an intruder.

Americans start earlier and finish earlier than we do. In London they have been in the habit of starting at 8.30 a.m. and finishing at 5.30 p.m. (in the country the hours are often 8 a.m.–5 p.m.)

Offices are well equipped with direction signs giving the location of particular rooms. The names of officials abound and everyone has his name in a prominent position on his desk. No one who uses his eyes should get lost in an American office.

Now for some remarks about working methods.

Filing System

The American War Department uses a universal filing system called the Decimal File System. In this, file 353, say, *always in every office* deals with Training. There are, of course, many subdivisions, e.g., 353·7 deals with musical training. Every office possesses a handbook giving the complete list with a most elaborate index enabling a file to be rapidly identified. The advantages of the system are obvious.

Presentation

The Americans go to enormous trouble in the matter of "presentation." An American "return" is usually a far more elaborate affair than its British counterpart, and often contains a mass of tables, graphs, and so forth. To take an example, I was particularly impressed by the voluminous work of the historical section. The same remarks apply to drawing office work.

The Reverse Side of the Paper

One thing that one has to get accustomed to is that the reverse of all papers is typed upside down according to our way of thinking. This is due to the fact that American files are clipped along the top edge of the paper, and consequently by this method the matter is readily visible at a glance. A file of mixed American and British letters is, therefore, not a thing of joy!

Language

Much has already been said and written about the differences in the meaning of words as used by Americans, so it is unnecessary to say anything further on the point. It is noteworthy and rather surprising that in correspondence, Americans tend to use longer words than we do. For example, where we should "start a job" an American would "initiate an undertaking." Rehabilitation is another "mouthful" in common use. The ordinary use of these long words tends to make American correspondence wordy, and sometimes lacking in clearness.

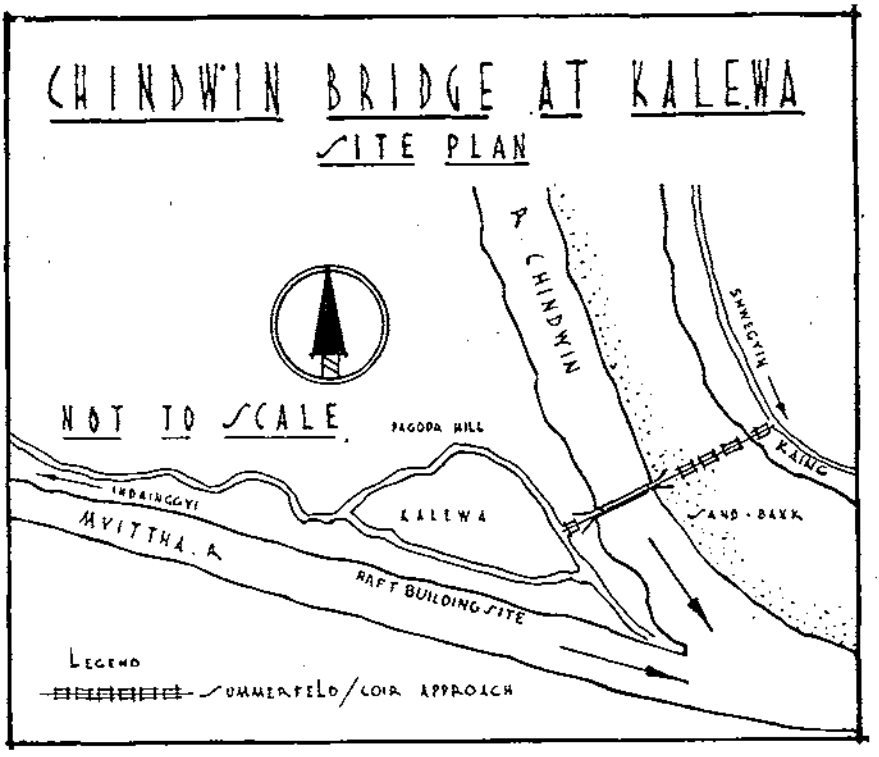
Office Equipment

I think that the average American office is better equipped than ours. Counting machines are supplied where needed, and there is no lack of the "tools" which go far to make things as easy as possible (paper punches, stapling machines, pencil sharpeners and so on).

Summing up, I think that the Americans regard an office as a mental "factory," and see to it that it is furnished with all the equipment necessary to ensure a good output. We can undoubtedly learn from them especially as regards equipment and neatness.

BRIDGING THE CHINDWIN AT KALEWA, DECEMBER, 1944

By Col. F. Seymour-Williams, D.S.O., O.B.E.



Introductory

In October and November of 1944, 33 Corps drove the Japanese southwards from Imphal, down the Kabaw Valley and over the River Chindwin; they were then faced with a full scale assault crossing of the river, before the advance could be continued to Shwebo and Mandalay. This is the story of the Engineer work which took place in the course of that assault operation.

The requirement was normal enough; light ferries for the assaulting troops, shore loading rafts for immediate support, and a Bailey pontoon bridge for subsequent maintenance purposes. But lest the project be judged by European standards one or two unusual circumstances must be mentioned at this stage.

In the first place the Chindwin is a very wide river. Comparable in size with the Rhine (which was crossed some 3 months later), it is over 1,000 ft. in width at Kalewa where the crossing was required. Secondly the operation was mounted under very severe limitations of equipment (and more especially transport), which necessitated the most stringent economy throughout. And finally all equipment had to be transported to the site on wheels from railhead at Manipur Road, 310 miles away, over some of the worst hill roads in the world. Under these circumstances it was proposed to erect the longest floating Bailey that, up to that date, had been built in any theatre of war.

Planning

Planning for this operation was started by the writer on arrival at 33 Corps H.Q. (Imphal) on 7th October, 1944.

Site selection was of necessity done from air photos. Unfortunately the photographs were very bad, and (having been taken in August) showed the river at a higher level than that anticipated at the time of the operation. However, an alignment which appeared to be suitable was chosen and measured up from the photographs. The interpretation showed a water gap of from 950 to 1,000 ft., with road access on the near side to a steep bank about 30 ft. above the water, the far approach being over a gentle slope of soft sand some 500 yards wide, bounded inshore by a 20 ft. high bund carrying the Kaing-Shwegyin road. Shore space on the near bank was very restricted, and the raft building site was accordingly located on the Myittha river (confluent with the Chindwin at Kalewa) 800 yards upstream (see diagram), where there was more room and better cover for vehicles.

Equipment for the operation could then be allocated. To the assaulting division (11 East African) were given two sets of F.B.E. and the Assault Platoon from a Bridge Coy. I.E. for use by the Divisional engineers. The remaining equipment was kept under 33 Corps for building and operation as follows :—

3 sets Bailey Tripartite Pontoon equipment (two sets on wheels at once).
4 sets of 130 ft. D.D. Bailey Bridge (two sets only on wheels at once),
and 4 Class 40, shore loading Bailey Rafts (all on wheels).

In order to allow for possible losses in transit two alternative bridges were designed to fit the gap ; one Class 30 bridge (997 ft.) to be erected if possible, and a standby Class 12 bridge (1,001 ft.) for use if wastage of equipment precluded the former design. By this means it was hoped that a reasonable margin of safety would be ensured.

The allotment of troops is given in Appendix A.

Approach March

Unquestionably the most difficult phase of the operation was that of carrying the equipment in two lifts from railhead to a marshalling area near Indainggale (21 miles from Kalewa) and thence forward to the bridge site. The work of the bridge companies and R.I.A.S.C. drivers during this period was beyond praise ; although several pontoon lorries went down the hillside every pontoon was recovered and repaired in time for the operation. All the equipment and troops were marshalled at Indainggale by 1st December, 1944.

From there forward they were faced by a narrow road, cut into the cliffs of the Myittha Gorge, which had been battered by the traffic of previous months into a state of almost complete disruption. Nine Bailey and twenty-two timber bridges had to be constructed before the road became usable at all, and after that it remained extremely precarious.

The first field company moved off on the 4th December, and the remaining troops, plus the first lift of equipment, followed on the 5th. Progress was very slow and spasmodic because, although bridge vehicles all carried a distinctive sign, traffic for the Assault Division was given first priority. One major disaster was averted at this stage by the action of a Bridge Company sergeant, when a distributing girder lorry was held up by petrol trouble on a narrow stretch of road. A very senior officer promptly appeared who ordered the lorry to be pushed off the road down a 30 ft. cliff. This the sergeant refused to do, and fortunately, while he was being put under arrest, the stoppage was cleared and the vital girders saved.

Ground Reconnaissance

On the morning of the 5th December, a reconnaissance was carried out on the ground by the writer, his F.E. 2, and an officer from the Corps Survey Coy., I.E. The site proved to be very similar to that reckoned from the air photos, except that the banks were lower and the water gap wider. During the reconnaissance, however, enemy artillery was registering on the site and it was decided to shift the centreline to a position 100 yards downstream, which gave only a slightly longer gap. The final design for the bridge was then worked out, the composition being as follows :—

Two 100 ft. D.S. landing bays.
Two 41 ft. 6 in. end floating bays.
Nineteen 42 ft. floating bays.
One 32 ft. floating bay.
Two 20 ft. ramps.
Overall length—1,153 ft. (including ramps).
Load—Class 30.

and it was to this specification that the bridge was actually built.

Building

Equipment did not arrive on the site for unloading before midday 6th December; at 13.30 hours on that day the Divisional Commander gave permission for building to begin and work was started simultaneously on rafts, bankseats, and floating bays.

The three Class 40, shore-loading rafts were completed by 18.00 hours 6th December.

Bankseats were constructed of 9 in. × 3 in. timber in four layers, and revetted with 6 in. piles driven by a Bangalore Pile Driver. The latter was very useful, especially on the farside where the bankseat had to be raised in order to give clearance for the landing bay. The near and farside bankseats were both finished on 8th December at 11.00 and 17.00 hours respectively.

Meanwhile construction of the floating bays was proceeding satisfactorily on the Myittha River. At 06.30 hours on 9th December the first bays were ferried down to the Chindwin and across to the far bank, with stores for the landing bay and long approach on that side. Navigation down the Myittha River (current 4 knots) was made very hazardous by shallows and rocks. In spite of excellent work by Utility power boats several rafts went aground, but the damage was limited to the loss of a few anchors. Both landing bays were complete by 18.00 hours 9th December.

The far approach over 500 yards of soft sand entailed a certain amount of work. The surfacing was composed of double coir matting, Sommerfeld track, double coir matting sandwich, finished with another layer of Sommerfeld on top. No Sommerfeld track pins were available and the Field Park Coy. worked for 24 hours on end to improvise the eight hundred that were required from 5 ft. angle iron pickets. This and the near approach were completed by midday 10th December.

At much the same time the last bay was being rafted into the bridge by motor boat. The gap was found to be 6 in. too short, but against this eventuality the bearings and baseplates had been greased and hauling tackles provided. The necessary adjustment was made and the final pin driven at 14.50 hours 10th December. The troops worked magnificently, and in straightforward circumstances would have finished the bridge in 36 hours. In this case, however, the bridgehead was expanded slowly so that the bridge was not urgently required; moreover, Bridge lorries coming down to the

site and returning to refill continued to be held up by guns and other vehicles moving forward to the battle; and finally the nearest spare pontoon was several hundred miles away in India. Under these circumstances economy was more important than speed; no work was done by night and deliberate methods were adopted throughout.

Performance

Grub Bridge, as it was christened, accepted its first vehicle at 15.01 hours 10th December, 1944, and remained in virtually continuous use for 2½ months subsequently.

It was built without enemy interference. On 11th December, however, the B.B.C. announced that a floating Bailey had been put across the Chindwin at Kalewa and early next morning five Zeros came over to bomb it. Three Zeros were shot down by A.A.—one small bomb hit the bridge. Casualties were one man killed and two wounded; two stringers and a few chesses wrecked, three bow sections damaged. The bridge was closed twenty minutes for repairs and no further efforts were made to destroy it.

The 3 in. cordage anchor cables were replaced with 1½ in. S.W.R., which stood up easily to the Chindwin's 2 knot current. As the river fell the bridge was shortened, once by removing the 32 ft. bay and again by removing a 42 ft. bay. Fresh bankseats were made on the far bank, but as most of the preliminary work could be done without interruption to traffic, the bridge was only closed for four hours on each occasion.

Before the monsoon a specially designed floating Bailey (Falls Bridge) was built 2 miles upstream. Grub Bridge was dismantled and floated off southwards for further use.

Conclusions

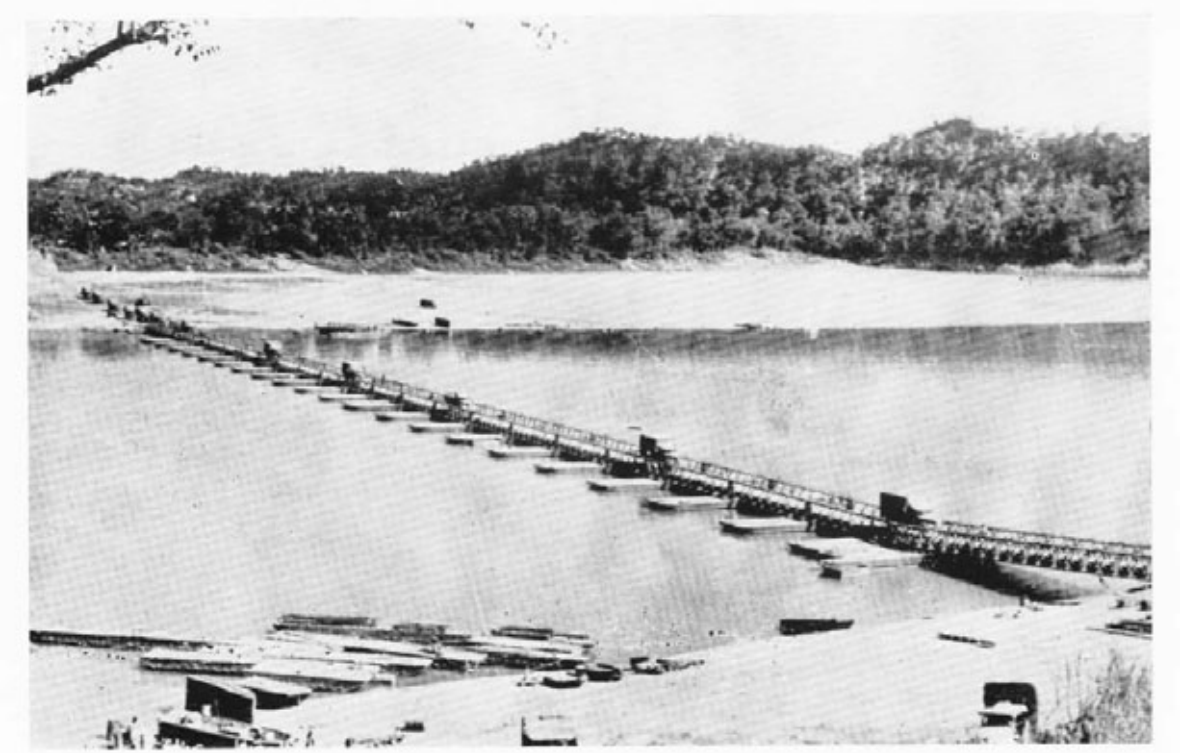
The actual construction of this bridge was straightforward enough and calls for no special comment. It was the transportation of equipment that set unusual problems and was the limiting factor in speed of building.

In this connexion two factors are considered to be of particular interest. Firstly that success in planning and movement is dependent upon adequate training of all people concerned. A full scale bridging exercise, with all equipment on wheels, had been carried out in India some months previously and provided invaluable experience for the operation. Secondly that speed in building cannot be achieved unless bridging vehicles are given road priority by the formation commander. In this case the over-riding priority of other traffic made normal building speed quite impossible; and though the delay could in this case be accepted, in other circumstances it might well have proved disastrous.

Appendix "A"

Engineer troops involved :—

H.Q. 33 Corps Troops Engineers, R.B.S. and M.
67 (Bengal) Field Company I.E.
76 (Bengal) Field Company I.E.
361 (Bengal) Field Company I.E.
322 (Bengal) Field Park Coy. I.E.
1 Coy. 10 Pathan Engineer Bn. I.E.
1 Platoon of Pioneers.
852 Bridge Coy. I.E.
854 Bridge Coy. I.E. less one Assault Platoon.



GRUB BRIDGE.

Bridging the Chindwin at Kalewa

Lieut - Gen Sir George F Gorringe KCB KCMG DSO

MEMOIRS

LIEUT.-GEN. SIR GEORGE FREDERICK GORRINGE, K.C.B., K.C.M.G., D.S.O.

LATE COLONEL COMMANDANT, ROYAL ENGINEERS

GEORGE GORRINGE was born on 10th February, 1868, the second son of Hugh Gorringe, Esq., J.P., of Kingston-by-Sea, Sussex. He was educated at Lee's School, Brighton, and Wellington College, passed in 1886 into the R.M.A., Woolwich, where he gained the riding prize, and obtained his commission in the Corps on 17th February, 1888. While at the S.M.E. his strong personality and military ability attracted the notice of the authorities, who correctly expected for him a distinguished military career. To contemporaries of his own age his light hearted enjoyment of all sports and pastimes tended to conceal his ambitions, if at that time he had any, for military distinction. The writer of this memoir remembers asking him which branch of Corps activity—service in a field company, or in India—he intended to apply for on leaving the S.M.E. At that time Egypt had not come to be the great theatre of adventurous life for young Sapper officers that it became later, and India was the country where sport and interesting work could best be looked for. His reply was that his only desire was to be stationed where there was no work and lots of hunting. His passion for hunting remained with him till the end of his days but his subsequent career was a total antithesis of his dream of doing no work.

He was posted from Chatham to the 11th Field Company at Aldershot. Having been brought up with horses he soon showed himself to be a first class horseman and horse master and a capable amateur vet. He also impressed all around him with his strong personality, and when Kitchener went down to Aldershot to look for R.E. officers to help in the development of his plans for the reconquest of the Sudan, it was natural that he should take Gorringe as his first selection.

In 1895 Gorringe was appointed to the Egyptian Army and posted to the charge of the Military Works Branch at Suakin. Among his tasks during the next few years were the construction of a causeway from the port of Trinkitat to the mainland, which was later used as the bed for a railway to Tokar, the inception of a piped water supply for Suakin, and various military and civil buildings. During this period he acquired a reputation for obtaining from Egyptian and Arab labour the maximum output of work at the minimum cost. This capacity raised him greatly in the estimation of Kitchener, whose campaigns in the Sudan had always to be carried out with the minimum of expense.

When the Dongola expedition was about to start in March, 1896, Kitchener appointed Gorringe to the headquarter staff as D.A.A.G. In this appointment he was employed entirely on "Q" staff duties, namely, in superintending the movement control of all supplies and stores by river, rail and camel transport. Although but a subaltern, he was the only officer engaged on these duties. He had at one time to organize all boat transport on the Nile, at another to arrange for the transport of water for a desert march. He was also in liaison with the Navy over the building and servicing of gunboats. All the time he was Kitchener's intermediary with the directors of transport and supply. In view of the limited transportation available by railway, boats and camels, it fell to him to decide what supplies and stores should

or should not be sent to the front, and he was empowered by Kitchener to issue orders to all commanders of depots on the line of communication north of Wadi Halfa, and to control what came by rail—a most responsible charge for a junior officer, and one which was executed with remarkable precision and ability. These activities lasted all the summer of 1896, till Dongola was captured in September of that year. For his services in this campaign Gorringe received the Egyptian medal, with two clasps for the battles of Firket and Hafir, and the D.S.O.

Early in 1897 Gorringe was employed for a time, during the temporary absence of Girouard in England, in supervision of the laying of the first 25 miles or so of the desert railway from Wadi Halfa towards Abu Hamed. When Girouard returned from England in May, 1897, Gorringe relinquished this work and devoted his whole attention to the Works department, building a bridge and sinking a well on the Kerma railway, and sinking a well at one of the stations on the desert railway. In July, 1897, he handed over this work to Micklem, who had just arrived from home, and resumed his staff duties. When General Hunter's expedition started up the Nile towards Abu Hamed at the end of July, Gorringe accompanied the column in the capacity of provost marshal, and when Abu Hamed was occupied he constructed there, in accordance with Kitchener's orders, a fort to accommodate a battalion and a battery. After the battle of the Atbara, Gorringe also designed and constructed the fort at the junction of the Atbara river and the Nile, which later was developed into a strong system of defences. For his services during the above operations Gorringe received the promise of a brevet majority, which came to him on his promotion to captain some eighteen months later, also clasps "1897," Abu Hamed" and "Atbara," to the Egyptian medal which he had received after the Dongola campaign.

When the great advance on Omdurman began in August, 1898, Gorringe was again employed as D.A.A.G. on the duties of allotting steamers, barges and boats for the advance up the Nile, and for the necessary accumulation of supplies for the whole force at the advanced depots for the final advance on Omdurman, and for use there until they could be replenished from the rear. These duties occupied him fully till the actual morning of the battle for Omdurman, when, all the necessary preparations for the further advance having been made, he joined Kitchener and accompanied him throughout the day. For his services in the operations leading up to the capture of Khartum, Gorringe received a clasp for Khartum to the Egyptian medal, also the British medal and the Egyptian order of the Medjidieh, 4th Class.

Gorringe's next activity was to accompany General Rundle's expedition in October, 1898, to relieve the British force under Colonel Parsons at Gedaref and to clear the dervish forces out of the Eastern Sudan. Before the end of these operations, for which he subsequently received the Gedaref clasp to the Egyptian medal, he was recalled by Kitchener and ordered to undertake at once the reconstruction of Khartum, beginning with the palaces. The general lay-out of the roads for the new Khartum was designed by Kitchener personally and they were constructed by Gorringe, who had at his disposal the "Works Battalion," about 1,000 strong, under Egyptian officers, also about 2,000 *Jehadia* (ex-followers of the Khalifa) employed in road making, brick making, lime burning, wood cutting, etc., and as time went on more local labour was recruited and organized. With these resources such rapid progress was made that by February 6th, 1899, all the roads had been laid out, 7,000 trees had been ordered for avenues, and the construction of the Government offices had begun. The designs for the new palace were prepared by Gorringe himself. He obtained from England books on Italian and other architecture, and with the help of the plans, elevations and architectural

details they contained he designed the first and second floors, with the staircases and verandahs, of the palace, everything being submitted to and approved by Kitchener. The building is solid and handsome, and in design and style well suited to the climate. Its construction proceeded so rapidly that it was ready for occupation in the autumn of 1899, when Lord Kitchener returned and took up his residence in it. Gorringe also designed the Government offices which were built at the same time.

In February, 1899, Gorringe was promoted Captain in the Corps and on the following day was gazetted brevet major in accordance with the promise made after the Atbara campaign. When operations were resumed in November, 1899, against the Khalifa, who had escaped after the battle of Omdurman, Gorringe was given the command of the Irregular Sudanese Battalion, composed of *Jehadia* taken from the works at Khartum. The campaign was conducted by Colonel Sir Reginald Wingate, and Gorringe's unit took part in the actions at Abu Aadel and Umm Debeikerat, at the latter of which the Khalifa and his leading Emirs were killed. For these operations Gorringe received two more clasps to the Egyptian medal, and on 14th March, 1900, he was promoted brevet lieut.-col., having been advanced to this rank from that of lieut. R.E. in thirteen months.

In December, 1899, less than a month after the conclusion of the campaign against the Khalifa, Lord Kitchener was ordered to accompany Lord Roberts to South Africa after the reverses at the opening of the war in that country. He took Gorringe with him in the capacity of A.D.C., but some months later he was appointed D.A.A.G. on the Headquarters Staff in South Africa. Early in 1901 he was given by Lord Kitchener the task of organizing and commanding the Colonial Defence Corps, a body of Cape loyalists formed for the purpose of preventing the invasion of Cape Colony by enemy commandos and of preventing uprisings of Boer sympathizers within the Colony. This Corps was at first composed of about 1,000 mounted men, with a regular battery of field artillery, but before it was broken up in the following June the strength had risen to over 3,500. With this force Gorringe spent the first half of the year 1901 in counteracting the movements of a Boer leader named Kritzinger, who was bent on stirring up disaffection in northern Cape Colony, and in mercilessly chasing him and his commando whenever and wherever they made their appearance. When the Colonial Defence Force was broken up in June, 1901, Gorringe immediately organized a fresh force of Tasmanians, Cape Police and Nesbitt's Horse. With this force he continued his pursuit of Kritzinger, being reported in August as being hard on his trail. Having chased Kritzinger to the north of the Orange River, he took up the trail of (Field Marshal) Smuts when that leader, escaping from the net of British columns on the Orange River, between Bethulie and the Basutoland border, pushed south-west through the Midland region of the Cape Province with the intention of joining hands with Scheepers in the extreme south. Gorringe's column was one of those which harried and chased him all the way. The deadly perseverance with which Gorringe tracked Smuts from near Dordrecht to the Prince Albert region east of the main Cape Town railway, without once losing track of him, was acknowledged by Haig, under whom Gorringe was operating, as being a record of which any column might justly be proud.

This was the finish of Gorringe's services in South Africa. For some time past he had been pressing for permission to return to the Sudan. The war in South Africa was nearing its end and he had been offered by Sir Reginald Wingate, who had succeeded Kitchener as Sirdar of the Egyptian Army and Governor-General of the Sudan, the appointment of Mudir (Governor) of the Blue Nile province of Sennar. He left South Africa in the

middle of October, 1901. For his services there he received the Queen's medal with three clasps and the C.M.G. He also at the time of leaving received telegrams from all the commanders under whom he had served—from his immediate commander, General Haig, also from General French, Lord Kitchener, and Lord Roberts (who at that time was in England) warm expressions of their appreciation of the many successes gained by his column.

Unfortunately during Gorringe's operations in Cape Colony he had found it necessary to take the measures against espionage and evasions of requisitions which are usual in occupied territory. After his departure complaints regarding his actions were made in the Cape Parliament, followed by questions in the British House of Commons. Suggestions that he had exceeded his powers as the commander of an isolated column were not sustained, but the outcry undoubtedly affected his subsequent career and even for a time his relations with Lord Kitchener.

On his return to the Sudan early in 1902 Gorringe was appointed Governor of the Sennar Province and held this appointment till 1904. He organized and got into order the civil administration of the province, and at the beginning of 1904 commanded an expedition against a notorious slave trader named Ibrahim Wad Mohamed. He captured his stronghold at Jebel Jerok, annihilated most of his followers, and pursued and hanged the slave trader himself. For these services he received a clasp "Jerok" to the Egyptian medal, the Egyptian order of the Osmanieh, 3rd Class, and the brevet of colonel. In September, 1904, Gorringe returned to England, having completed ten years service with the Egyptian Army, which under the prevailing rules was the limit permissible. His long service in the Sudan had had effects on his health and he was overstrained and in want of rest.

When he got home his regimental rank in the R.E. was still that of captain though he was a colonel in the Army by brevet. The War Office apparently felt themselves unable to employ him in any grade higher than that appertaining to his regimental rank and he was appointed Division Officer, Lands, Aldershot. He continued in this occupation till April, 1906, when he became Staff Officer to the Chief Engineer, Aldershot. This treatment was similar to that accorded to General Gordon who, on return from commanding the Ever-Victorious Army in China, was sent to be Division Officer, R.E., Gravesend, and to Col. Sir Percy Girouard who after having been Kitchener's Director of Railways, was appointed Staff Officer to the Chief Engineer, London District.

In June, 1906, Gorringe was appointed Director of Movements and Quarterings at the War Office, promoted to the substantive rank of colonel, and shortly after to the temporary rank of brigadier-general. He continued to fill this appointment, the sedentary nature of which cannot have been agreeable to a man of his type, till 1909, when he was given command of the 18th Infantry Brigade at Lichfield. He was promoted major-general in September, 1911, and three months later was placed on the unemployed list. Thus the rank of major-general came to him at the early age of thirty-three.

His period of unemployment lasted only till May, 1912, when he was appointed to command the Bombay Brigade. He was awarded the C.B. in June, 1912. The responsibilities of the Bombay Brigade headquarters were mainly of an administrative nature, being concerned with the shipment and disembarkation of troops and stores and their despatch overseas or up country. The actual military garrison was small.

Early in March, 1915, he was sent in command of the 33rd Infantry Brigade to reinforce the Indian Force "D" under Gen. Barrett, which was engaged in driving the Turks and their Arab allies out of Lower Mesopotamia. In April he was given command of the 12th Division which was then in process of

formation. With this division, then composed of two infantry brigades and divisional troops, and with a cavalry brigade in addition, he was given in May the task of reopening communications with Ahwaz on the the Karun river and clearing Arabistan of the enemy. This he did very effectively in spite of terrific heat and great natural difficulties. His operations greatly assisted the impending advance of General Townsend up the Tigris. They also safeguarded the Anglo-Persian oilfields and pipeline, the latter of which had been breached in an attack by local tribesmen in the previous February.

On the completion of the above task Gorringe was entrusted with the operation of capturing Nasiriya, a point of great strategic inportance at the junction of the Euphrates and the Shatt-al-Hai. The force put at his disposal consisted of an infantry brigade and some artillery, sappers and miners and pioneers, with a few field and mountain guns mounted on river steamers and rafts. To reach Nasiriya it was necessary to move the force by water from Qurna, a distance of 68 miles, through an old channel of the Euphrates and the Hammar Lake. This entailed opening up the waterway between the Hammar Lake and the main channel of the Euphrates, forcing a dam and some other obstructions made by the Turks, and overcoming the resistance of the enemy in several entrenched positions on the banks before Nasiriya was reached. A small naval flotilla accompanied the force and co-operated in its movements. Starting from Qurna on 27th June the force, despite the intense heat, overcame all the difficulties and obstacles and captured Nasiriya on 25th July, taking 950 prisoners, 17 guns and much booty. This striking success elicited from H.M. the King the following message:

"The splendid achievement of General Gorringe's column, in spite of many hardships and intense heat, fills me with admiration."

Gorringe was also later awarded the K.C.B.

In September, 1915, Gorringe took over the command of the Line of Communications Defence Troops with his headquarters at Amara, and continued in that position until the end of January, 1916, when he was appointed Chief of Staff to General Aylmer, commanding the Tigris Corps, which was engaged in operations for the relief of Kut. In February, while carrying out a personal reconnaissance, he was wounded. During the major operation, early in March, for the capture of the Dujaila Redoubt and the Ess Sinn position, he carried on the duties of Chief of Staff, being carried about in an ambulance tonga, since he was still unable to ride on account of his wound.

After the failure of this operation Gorringe was selected to succeed General Aylmer in command of the Tigris Corps. He at once set about planning another attempt to relieve Kut, an object of great urgency as the end of the food supplies of the garrison was in sight. The operations began on 5th April, 1916, with attacks on the Turkish positions on both banks of the Tigris. On the north bank the strong entrenched lines at Hanna and Fellahiya were captured in succession, but an assault at nightfall of the same day against the Sennaiyat lines, a few miles farther west, was repulsed with heavy loss, and no further progress could be made. On the south bank good progress was made in spite of large flooded areas, and the Turkish posts were overrun as far as the Abu Ramman Mounds, nearly opposite the farthest point of advance of the north bank operations. From now on increasing difficulties were met with from the wide spread flooding caused by overflowing of the Tigris. Heavy fighting continued till the 22nd April, but by that time Gorringe, whose confidence had up to then never failed, was forced to the conclusion that his troops had reached the limit of their offensive powers and were not capable of further effort without a rest. This condition had been brought about by extreme exhaustion due to the intense heat and the almost impassable condition of the flooded ground, also to insufficient rations and other

supplies due to shortage of transport, and to casualties, which had amounted to twenty-five per cent of the effective fighting strength. This was the end of the military operations to relieve Kut, and the failure on 24th April of the heroic effort of the Julnar to run a shipload of supplies by river into Kut made inevitable the surrender of the garrison, which took place on 29th April.

At the beginning of July Gorringe was relieved of the command of the Tigris Corps in which he was succeeded by Gen. Maude. The change arose out of serious differences of opinion between him and the Army Commander in in Mesopotamia, Gen. Sir Percy Lake. Under the general instructions regarding the policy to be followed by the Tigris force the Army Commander was desirous in June of undertaking a limited offensive up the Tigris. Gorringe was of opinion that the troops had not sufficiently recovered from their losses in action and from disease during April and May to be fit to undertake such an operation, for which moreover transport was insufficient. He had for some time been pressing for the provision of matting and tentage to shelter his troops from the burning sun of the hot weather season, and for additional transport. He had also been pressing for the construction of a railway up the Tigris line of communication. A light line from Sheikh Saad, the advanced landing point on the river, towards Ess Sinn had been begun, but was progressing slowly owing to delays in supply of materials; the projected line from Basra to Amara had not been begun. In June correspondence between Gen. Gorringe and the Army Commander revealed irreconcilable differences of opinion between them regarding the manner in which troops and stores could be conveyed with less delay from Basra to the front, and the steps necessary to maintain the morale of the troops. Gorringe's disappointment at the *impasse* thus disclosed, and his impatience at the slow realization of his demands, together with the intensity of his desire to relieve the sufferings of his troops, led him to take the unusual step of appealing direct to higher authority with a view to getting matters expedited. This led to his being relieved of his command of the Tigris Corps and sent home.

This result was probably inevitable even if Gorringe had not taken the irregular step mentioned above. When the two leading commanders of a force in the field hold views irreconcilably at variance with each other, it is inevitable that one of them—usually the junior—should go. The break arose entirely out of the circumstances described above and had no relation to the result of the battle in the previous April for the relief of Kut. In the latter the troops under Gorringe displayed the utmost gallantry and resolution in their repeated attacks on the Turkish positions under conditions of extraordinary difficulty. There is every reason to suppose that they would have succeeded in getting through them had it not been necessary to begin the attacks and repeatedly press them without adequate preparation on account of the very short limit of time before which supplies in Kut would fail.

The appreciation of H.M. the King was expressed in the following telegram to Gen. Gorringe :—

> "Although your brave troops have not had the satisfaction of relieving their beleaguered comrades in Kut, they have, under the able leadership of yourself and subordinate commanders, fought with great gallantry and determination under the most trying conditions. The achievement of relief was denied you by floods and bad weather and not by the enemy whom you have resolutely pressed back. I have watched your efforts with admiration and am satisfied that you have done all that was humanly possible and will continue to do so in future encounters with the enemy."

Shortly after his return to England Gorringe was appointed command of the 47th (London) Division on the Western Front. With that division he took part in the following major operations :—

Battles of the Somme, 1916 :
Battle of Transloy Ridges (1st–9th October), including the capture of Beaucourt L'Abbaye (1st–3rd October) and the attack on the Butte de Warlenburg (7th–8th October).

Battle of Messines, 1917 (7th–13th June).

Battle of Ypres, 1917 :
Battle of Pilckhem Ridge (31st July–2nd August).

Battle of Cambrai, 1917 :
Capture of Bourlon Wood (28th November).
The German counter attacks (30th November–3rd December).

First Battles of the Somme, 1918 :
Battle of St. Quentin (21st–23rd March).
First Battle of Bapaume (24th–25th March).
Battle of the Ancre (5th April).

Second Battles of the Somme, 1918 :
Battle of Albert (22nd–23rd August).
Second Battle of Bapaume (31st August–2nd September).

Final Advance in Artois :
Operations in Artois (2nd October–11th November).

On the 28th October the 47th Division took part in the official entry into Lille and on 10th November, the last day of the war, the divisional advanced guards had reached the line Frasnes-les-Buissenel-Moustier (north of Leuze). Gen. Gorringe laid down the command of the division on 6th April, 1919, on its demobilization.

For his services on the Western Front he received the British War Medal, the Victory Medal, the K.C.M.G., the French War Cross with palms, and the order of the Star of Rumania with swords, 2nd Class.

In July, 1919, he was appointed to the command of the 10th Division in Egypt, which he held till the 17th December, 1921, when he was placed on the unemployed list. During the period of his command there was much political unrest in Egypt, accompanied at times with disorder and rioting. He was promoted Lieutenant-General in August, 1921, and placed on the retired list on 18th December, 1924.

His army career had been exceptionally full of war service and he had held many important commands in the field. It had looked at one time as if he might reach the highest ranks in his profession, and had he been successful in bringing about the relief of Kut this would probably have resulted. But his star was not in the ascendant there and no further rise in command came to him after he left Mesopotamia.

After his return from Egypt he took over his father's farm at Kingston Buci, Shoreham-by-Sea, Sussex, where he was engaged for many years in dairy farming with a large herd of Jerseys. During this period he kept up his hunting and polo, which had been his recreations throughout his life whenever opportunity permitted. About 1936 he moved to Norfolk, where he purchased a farm, but in 1939, a little before the outbreak of the second world war, a portion of his land was requisitioned for an aerodrome ; he then sold the major portion of his dairy herd and returned to Kingston Buci, Sussex, where he farmed about fifty acres till his health failed. In July, 1943, his condition necessitated his going into a nursing home, gangrene having set in in one foot owing to a blocked artery. He remained there until he died in October, 1945. He never married.

It is probable that Gorringe's outstanding characteristics were his strong

constitution and physique and his indomitable will and determination. These gave him an unbounded capacity for sustained hard physical and mental work over long periods, under all conditions of climate or hardship. Always very hard on himself, he exacted, sometimes by harsh methods, an equally high standard of efficiency and output from every one under him. The sluggish or weak got short shrift, the energetic and industrious were strained to their utmost capacity. The rapidity and efficiency of all his measures were the results.

He showed, even from the beginning of his career in the Sudan, and especially in his operations in Mesopotamia, a very high capacity for organization. The measures he had conceived and put in hand in preparation of for the advance up the Tigris, though they had not matured before he vacated the command, were approved and adopted by General Maude, who succeeded him, and contributed in no small measure to the success of the latter's operations.

In all such plans Gorringe's skill and experience as an engineer were of great value. These he acquired mostly in his early days under Kitchener in the Sudan, where his versatility was tested when he was turned from superintending the movement control of supplies and stores by river, rail and camel transport to the construction of the Khartum roads and the design and building of the palace and government offices. His services during his long employment in the Sudan were greatly appreciated by Lord Kitchener and Sir Reginald Wingate, and his labours left a strong mark on the development of that country.

Like other masterful men he spoke his mind freely to his superiors whenever he disagreed with their proposals, without regard to the possible effects on his own prospects. He was the very antithesis of a yes-man. This practice at least once brought him to grief. It may also have been the reason why during two years in command of a division on the Western Front he was not promoted to the command of a Corps.

Few will disagree with the conclusion that he was a most efficient and reliable subordinate and a very able, determined and hard-driving commander in the field. His special capacity lay in the organization of all the measures preparatory to battle, in which he excelled. It is probable that he derived this capacity mainly from the experience gained in his early days in the Sudan under his great leader and model, Lord Kitchener.

H.F.T.

BRIG.-GEN. JOHN CHARTERIS, C.M.G., D.S.O.

THE death on February 4th, 1946, of John Charteris has added yet another name to the list of distinguished R.E. officers who have passed away during and since the Second World War. He was born in 1877, was educated at Merchiston School, whence he passed into the Shop, eventually gaining his commision in the Corps in March 1896.

Having a naturally ambitious character and disliking the prospect of peace-time soldiering at home, like many other young R.E. officers of his time, he decided to begin his career in India, where scope for initiative was wider and financial prospects brighter for those with limited means. After spending a few years on the N.W. Frontier in the Military Works Services, he was appointed to the Bengal Sappers and Miners in which Corps we served together for the next six or seven years and formed the basis of a lifelong friendship. It was during these years that I got an insight into his character; he was generous to those in real need, and not many of us realized that from his subaltern's pay he was sending help to his family. He cared little for outward appearances, he set himself a very high standard of achievement which at times warped his better judgment, and he demanded the same high standard from those under his command.

In 1907 he passed into the Staff College at Quetta, thus setting an example to the rest of us who were so happy in our regimental life (which was a very full one in those days) that few of us seriously contemplated a wider career. I joined him at Quetta in the following year and we spent the next twelve months together. It was interesting to watch his character developing still further; and, far better mentally equipped as he was than most of the fellow students of his batch, he showed a tendency to become impatient with those who did not think quite as quickly as he did. He was the outstanding man in his division and Sir Douglas Haig selected him to fill the job of G.S.O. 2 in the Operations Section of the General Staff at Simla, a big lift indeed for a Sapper Captain without any experience of staff work with troops.

He soon justified his selection and Haig used him more and more as a personal assistant, thus starting a friendship which was loyally maintained by both until the death of the elder man. When Haig went to Aldershot in 1912 as G.O.C.-in-C. he took Charteris with him on his staff, and, two years later on the outbreak of war, Charteris accompanied his Chief who had been given command of the 1st Army Corps of the B.E.F. It was at this juncture that he first turned his mind to intelligence work, and he served Haig in this capacity at 1st Corps Headquarters, at 1st Army Headquarters and finally at G.H.Q. It was a very great pity that his health, which had never been really good even in his earlier career, had deteriorated to such an extent as to prevent his being able to serve actually with the troops. He suffered a good deal, but his indomitable spirit overcame the weaknesses of the flesh and he drove himself and his subordinates remorselessly in the task of obtaining information as to what was happening "on the other side of the line." Many of us thought that "Intelligence" was not his proper line; he was fully endowed with imagination, but he was not always successful in drawing his conclusions. One was sometimes tempted to think that with him the wish was too often the father to the thought. He was accused of over optimism, but he was certainly nearer the mark than many of his critics at that time in estimating the casualties suffered by the Germans during the Battles of the Somme and of Passchendael; nevertheless he undoubtedly over-estimated the drop in enemy morale towards the end of 1917. At the same time it is

evident that he was not entirely happy about Haig's decision to launch the attack on November 20th, 1917, which is now known as the Battle of Cambrai. He wrote in his book *At G.H.Q.* " for the first time in the war ' I ' has been for holding back and ' O ' has been for going on." He warned Haig that " within 64 hours they (the Germans) can have as many troops as we have." The German counter attack which followed fully justified the cautious advice he had given.

In the beginning of 1918 Charteris was transferred to the Transportation Directorate, which was his last active service appointment in the war. After a short spell in England, he went to India, first as Director of Movements at Army Headquarters and then as D.A. & Q.M.G. Eastern Command. He retired from the Service at the end of 1922.

On leaving the Army, Charteris embarked on quite a different career. Being a man of strong convictions, and equipped with powers of speech and writing well above the average, it was not unnatural that he should seek an outlet for his energies in politics and in writing. As a true Scot, he returned to his native land and sat as Conservative M.P. for Dumfriesshire from 1924 to 1929, when he enjoyed to the full the cut and thrust of Parliamentary debate and piloted through the House the Bill for the humane slaughter of animals. Unfortunately he failed to be re-elected at the subsequent General Election, but this gave him the more time to devote to writing and he published three war books, *Field Marshal Earl Haig* (1929), *At G.H.Q.* (1931), and *Haig* (1933). He also wrote a great deal for the Press, especially in *The XIXth Century and After*, the *Manchester Guardian* and its allied provincial newspapers.

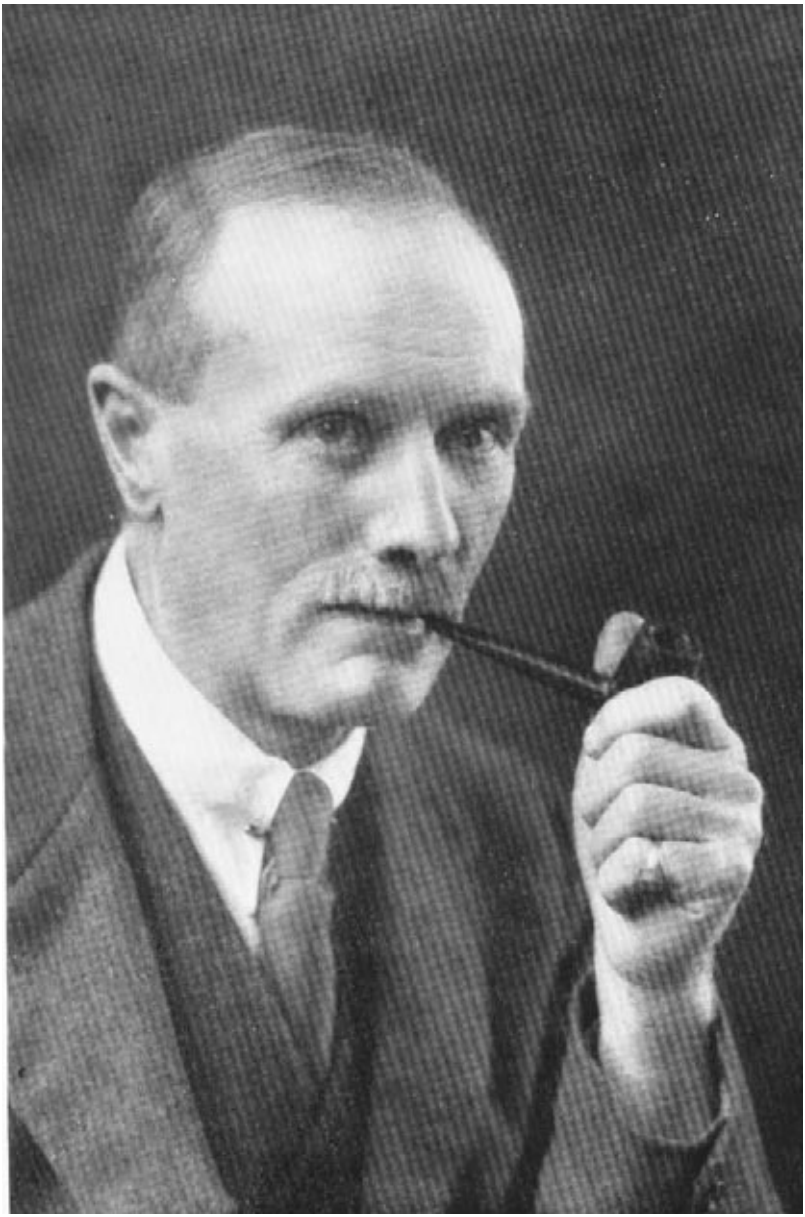
In the years preceding the outbreak of the second world war he joined one or two industrial undertakings. These expanded considerably when the war broke out and gave great scope for his leading characteristics of quick decision and of drive. One of his colleagues writes of him, " Possibly the greatest tribute I can pay is to refer to the happy way he had of endearing himself to those with whom he became closely associated and to his tenacity in holding on to a conviction in which he truly believed." Other tributes to the respect and esteem in which he was held have come from such widely divergent interests as Scottish farmers, the British Legion and colleagues in his political life.

In 1913 Charteris married Noel, daughter of the late Mr. C. D. Hodgson, and their married life was all the happier because of the three sons that were born to them. Two of their sons (both Sappers) survive the war, but the third was killed in action with the 2nd Parachute Battalion in Tunisia in 1942.

Until almost the day of his death Charteris continued to work hard ; it was not in his nature to be idle. Looking back over his career one can see this urge to be doing something asserting itself all the time ; it showed itself by his preference for service in the inhospitable surroundings of the N.W. Frontier of India ; his two periods of leave when a student at the Staff College were spent in short and unconventional sea journeys to places few other people had visited ; in 1912 he went as an unofficial war correspondent to report a Balkan war. His was a life of unbounded energy and long sustained effort, hampered by poor health which he would admit to nobody. Judged by ordinary military standards he did not attain the position which some less well equipped men of his generation succeeded in reaching. But he lived his life to the full, he feared no man and was deterred by no obstacle in following the road to what he conceived to be his duty.

J.R.E.C.

Brig-Gen John Charteris CMG DSO



Col James M Colvin VC

COLONEL J. M. C. COLVIN, V.C.

JAMES MORRIS COLQUHOUN COLVIN was born in India in August, 1870; he was the son of Mr. J. C. Colvin of the Bengal Civil Service, who had earned the Mutiny Medal for gallant service as a Volunteer. Colvin was educated at Charterhouse and passed direct into Woolwich, taking 10th place in a batch of 120 in March, 1888. He passed into the Royal Engineers, top of his batch, in July, 1889, having been S.U.O. and taking the Sword of Honour and the Pollock Medal. In 1891 he served with the Bridging Battalion at Aldershot, till he went to India in 1894 to join the Bengal Sappers and Miners at Rawal Pindi. With the 4th Coy. of this Corps, then commanded by Bt.-Maj. F. J. Aylmer, V.C., he went through the Chitral campaign. This company did excellent work in road making and bridging with the advancing troops and Sandes records in the *Military Engineer in India* that when they reached the "unfordable Panjkora River," Aylmer designed a form of suspension bridge, using telegraph wire, over a 98 foot gap, which was completed in three days.

In 1897 occurred what was called the "Pathan revolt" on the frontier which resulted in one of our most extensive frontier wars. A full division was mobilized, called the Malakand Field Force, and the command was given to Maj.-Gen. Sir Bindon Blood. Colvin, who was on leave at home, was recalled and joined the 4th Coy. in the Swat Valley. The force having defeated the enemy at a strong position at Landakai broke up into punitive columns and it was while these columns were withdrawing that Colvin earned his V.C. One of the columns, which included the 4th Coy., was commanded by Brig.-Gen. P. G. Jeffreys and in the course of the withdrawal the Brigadier with a small party including four mountain guns, two R.E. officers, T. C. Watson and Colvin, and 35 other ranks of the 4th Coy. and some men of the Buffs, were caught by darkness and tried to take shelter in the walled village of Bilot for the night. But the village which was on fire, was occupied by the enemy and the party had to bivouac outside the walls and were fired on from inside the village. T. C. Watson at once collected a few men of the Buffs and made two sorties in both of which he was wounded, the second time severely. Colvin then took a small party of eight men of the 4th Coy. and worked his way into the village by a lane and continued the struggle. There was fierce hand-to-hand fighting in the course of which Colvin's helmet was crushed by a lump of rock hurled by one of the enemy, and Lieut. F. A. Wynter, R.A., who had joined in, was shot through both thighs, but Colvin was able to keep the enemy at bay till reinforcements arrived from the main body. For this gallant action Watson and Colvin were awarded the Victoria Cross. Colvin served through the rest of the campaign including the operations in the Bunerwal country four months later. He was twice mentioned in despatches. A little later he went to England on leave when he received his V.C. from the hands of H.M. Queen Victoria. On return to India, he was given the command of the 4th Coy., with which he had served so gallantly.

He was promoted Captain in April 1900, and soon after was ordered to South Africa, where he became A.D.C. to Sir Bindon Blood during the operations in the Eastern Transvaal, and was later Staff officer with Fortescue's column. He was mentioned in despatches, and promoted brevet-major in the *Gazette* of August, 1902, and was also noted as qualified for the staff. From April, 1903, to March, 1906, he was staff captain for mobilization at Simla, and was specially selected for a course at the Staff College at Camberley, which

he completed in 1909, having been promoted Major on the regimental list in December, 1908.

In 1911 he was appointed G.S.O. 2 with the 4th Indian Division on the frontier at Quetta. This was the only division retained on the frontier, which was by no means quiet, during the 1914 war, and the work was strenuous; Colvin earned the approval of the General officers under whom he served and he was one of three officers recommended for accelerated promotion by the G.O.C. Southern Command in India. But in 1915 he contracted a germ—bacillus coli—which caused him to be invalided home in October, 1915, and eventually brought his military career to an end. He recovered sufficiently to return to India at the end of 1916 just before his promotion to Lieut-Col. in January, 1917, but the Medical Board would not pass him fit for active service, so he was given the command of the Bombay Sappers and Miners at Kirkee. In common with the other Indian Corps the Bombay Sappers and Miners had expanded very largely not only in the number of units, but in different kinds of units, so the work was exacting, but in spite of frequent attacks of illness, Colvin stuck to his job till the end of 1919, when he was again invalided and eventually retired in July, 1921, at the early age of fifty-one and a few months after he had completed the qualifying period of four years for promotion to Colonel.

After retirement he settled down in Stanway, near Colchester, where he interested himself in local affairs. He was for some years County Controller for the Voluntary Aid detachments, and during the war just ended started and ran a very successful National Savings group. He passed away in December, 1945.

Colvin was one of those fortunate people, of whom the Corps has produced many instances, who combined more than average brain power with marked proficiency at games. At the Shop he was Captain of the Soccer team and also was runner up for the saddle; at Chatham he played football for the Corps and also for the Army. His brain power is shown by the above record of service; at the Shop his contemporaries noticed how he reached the top without any intense study. He was a natural leader without any suggestion of side, and earned the respect and affection of all those under him, from his fellow cadets at Woolwich to "other ranks" in India. W.H.B., one of his batch, writes "his nickname of 'Towzer' at the S.M.E. was characteristic of his cheerful tenacity of purpose."

Colvin married in 1904 the daughter of Colonel J. A. Way, C.B. who survives him. They had three children, the eldest son, James Bazett, is now Major and served as 2nd in Command of the 2nd West Yorkshire Regiment; the second son, John Alexander, is a Squadron Leader R.A.F., both did good work during the last war in the Middle East and Mediterranean theatres, their daughter, Camilla, is the wife of Lieut.-Gen. Sir Noel Beresford-Peirse, K.B.E., C.B., D.S.O., now serving in India.

W.B.B.

BRIG.-GEN. A. C. PAINTER, C.M.G.

ARNAUD CLARKE PAINTER was born on 27th September, 1863, the eldest son of Richard Painter of Ryde. Educated at Clifton College, he passed into the R.M.A. in July, 1881, passing out second in his batch in July, 1883. He went through the course of Submarine Mining in 1885 and after service with the S.M. companies at Cork and Devonport was ordered to India in 1887 to command the section of the Indian S.M. company at Bombay. Returning home in 1892 as a Captain he served at Portland until he joined the Ordnance Survey in 1896. Always very careful and conscientious in everything he undertook, the work must have suited him and he remained with the Survey for eight years, serving at York, and Redhill, where he commanded the 16th (Survey) Coy. being promoted to Major in April, 1900. In 1904 he was ordered to Hong Kong to command the local S.M. Coy. (later the 40th Coy.) and to take charge of the Submarine Mining Defences, Electric Lights and Telegraph and Telephone work in the fortress. When the S.M. defences were withdrawn in 1905, he became O.C. R.E. of the two large companies at the station in addition to his other duties. While on leave from Hong Kong he visited Japan, Korea and also Pekin, Shanghai and other places in North China. He came home in 1907 to command the 33rd Coy. at Cork Harbour, and on promotion to Lieut.-Col. in November, 1907, was appointed O.C. Depot Battalion at Chatham. Here his attention to detail and his popularity with all ranks were again noticeable. After two years at Chatham he was made C.R.E. Plymouth district where he remained till he completed his service as Lieut.-Col. in August, 1912. He was selected for promotion to Col. with the usual antidate to August, 1911, but remained on the half-pay list until, on the outbreak of war in 1914, he was appointed Chief Engineer, Plymouth Fortress.

In July, 1915, he was selected as Chief Engineer of the IX Corps, and was ordered to the Dardanelles with the rank of Brig.-Gen. On the 24th July this Corps of five divisions began to arrive on the island of Imbros, which was the Headquarters of the Naval and Military Administrative Services. It was intended to use the new Corps for a surprise landing at Suvla Bay to the north of the position of the Anzac Army Corps. It was realized that one of the most difficult problems for the attacking force was the supply of water, so special water boats and other stores were sent out from England with the troops. Four wooden lighters, holding between them enough water to last for 48 hours, were filled at Imbros by the Director of Works and handed over to the Royal Navy for transportation to Suvla Bay; each lighter was supplied with a wooden tank, to be landed on the beach, fitted with taps for filling bottles, and with a pump on board and a length of hose to connect the lighter with the shore. A mixed bridging train of pontoons and barrel piers, in charge of an Australian unit, was allotted to construct landing piers. Painter was in charge of the work on shore at Suvla.

The force started from Imbros the evening of the 6th August, and Painter with a Field Company of the 11th Division landed with the troops at "A" beach on the south end of the Bay at 7 a.m. on the 7th August. But no lighters or equipment for piers arrived at the beach during the whole of the 7th. The *Official History* states "that the destination of the piers was changed at the last moment to the north end of the Bay, but Painter who had left Headquarters before the decision was arrived at, was not informed." This does not, however, cover the movement of the lighters which were wanted where the troops had landed, it was found later that one had been wrecked on the rocks when leaving Imbros, two turned up, during the 7th,

some miles north of the original landing and the fourth reached Suvla Bay on the 9th. But Painter's work had come to a sudden end on the afternoon of the 8th when he had to report sick, and the next day he was transferred to a hospital ship and then to England.

When he recovered from his illness he was appointed Chief Engineer, Malta, which position he held till 1919. The island was prepared for defence but was never attacked, it gradually became a base for sick and convalescents from all parts of the Mediterranean, the total accommodation reaching 20,000 beds. Painter had also to complete the new military hospital which had been started in 1912. He received the C.M.G. in 1918. On completion of this appointment he retired in July, 1919, and settled at Charlton Kings and later at Cheltenham, where he passed away in November, 1945.

Painter was happy to take life as he found it, he gave the best of himself to any work he had to do and was noted for his kindness to everyone and the interest he took in all under his command. He was a charming companion and in early submarine mining days used to enliven many a dirty day on the Medway by some cheerful joke and by his unfailing good temper. On retirement he was able to practise his taste for archæology and contributed several pamphlets to the Proceedings of the Bristol and Gloucestershire Archæological Society.

He was twice married, first in December, 1886 to the youngest daughter of T. Whistler-Smith Esq. of Sydney, N.S. Wales and sister of Bt.-Maj. H. Whistler-Smith, R.E. (afterwards Smith-Rewse); they had two children. Mrs. Painter died in 1895. He married for the second time in 1905 the daughter of Col. H. F. Turner C.B. (late R.E.) who survives him.

The son is now Brig. G. W. A. Painter, D.S.O. (later R.A.) who was captured by the Japanese in Malaya in 1942; his daughter is the wife of Captain R. W. M. Lloyd, D.S.O., R.N. (retired).

W.B.B.

COLONEL D. M. FITZG. HOYSTED, C.B.E., D.S.O.

DESMOND MURREE FITZGERALD HOYSTED was born at Murree in India on 7th August, 1874, third son of T. N. Hoysted, Esq., afterward Surgeon General to the Madras Presidency. Educated at Rugby (Michell's House) and the Royal Military Academy, he was commissioned in the Corps on 27th February, 1894. After the usual Chatham Course he joined the 26th Field Company on the Curragh and remained with that Company until he brought it back home from South Africa as Company Commander in 1904; for his services in the South African War he received the Queen's Medal (three clasps) and the King's Medal (two clasps) taking part, amongst others, in the following actions—Coleskop, Colesberg, Modder River, Paardeburg, Bloemfontein, Abraham's Kraal, Nicholson's Nek, the Capture of Pretoria and Vereeniging. Soon after his return to England he married, on 11th October, 1904, Sybil Christine, second daughter of Colonel Hoysted, R.A.M.C. (retired).

After five years at home, spent mostly at Aldershot and Dublin, the Hoysted's went out to Egypt in 1909 for a five-year tour in the Alexandria Garrison; always interested in Archæology, he was able to put in some amateur digging in Egypt, to his great content. Promoted to field rank in February, 1914, the outbreak of the 1914–18 war found him Staff Officer, R.E., London District, a post which carried with it a Mobilization appointment on the L. of C., this took him to France at once; he landed at Le Havre on 6th August, 1914—the second man ashore of the British Expeditionary Force.

On 11th September, 1914, to his great delight, more active service came his way and he joined the 9th Field Company in the 4th Division as Company Commander, vice Major J. B. Barstow who had been killed during the retreat. I was the junior subaltern in the Company and I well remember Hoysted joining us at Montigny, between the Rivers Marne and Aisne; we had just lifted our Marne bridge at La Ferté sous Jouarre and were pushing forward hard to catch up the Division in time to bridge the River Aisne. From those early days of 1914 I date an affection and friendship which I have always highly valued. Without any fireworks, for he was no self-seeker, Hoysted was a real Company Commander, to him his officers and men were always his first consideration; no youngster could have had a better early training than I had under him, we were helped, guided and backed up. I always remember it as a very happy and contented Company. Remaining in command until September, 1915, he led the 9th Field Company during the River Aisne bridging operations at Venizel, the move round to Armentières, the difficult and arduous days of Ploegsteert Wood and the 2nd Battle of Ypres. For his good work over this period he was given the Brevet of Lieutenant-Colonel in June, 1915. From the end of 1915, for two years, he was C.R.E. 22nd Division in Macedonia, where I had the good fortune to meet him again, but not to serve under him. A combination of Salonika, Lake Doiran and the Struma Valley proved too much for his health and he was invalided home but not before he had been awarded a D.S.O. to add to his 1914 Star. A period as Chief Instructor at the Engineer Training Centre, Deganwy, followed, but he managed to get out to France again as C.R.E. of an Army Defence Lines for 1918–19.

After the War, Hoysted was an Instructor at the Senior Officers' School, Woking, until he was promoted substantive Lieut.-Col. in February, 1921. He spent his Lieut.-Colonelcy as C.R.E., West Lancs. Area, being ultimately

promoted full Colonel; then followed the customary period of enforced half-pay until in 1926 he was posted to the War Office as Chief Technical Examiner for Works Services. He finally retired in February 1930, having been awarded the C.B.E. for his good work in the War Office.

Colonel Hoysted soon found a congenial job as Secretary of the Royal Asiatic Society where he found much opportunity for his own leaning towards Archæology; he served the Society from 1930 to 1940 when he offered his services once more to the Country, for the next two years he worked in the Research and Experimental Branch of the Ministry of Home Security. He and his wife were a most devoted couple and her death in December, 1942, was a terrible blow from which he never fully recovered; he himself died on 3rd October, 1945; there survive two sons and two daughters of the marriage.

It has been my privilege both to meet Colonel Hoysted at fairly frequent intervals since 1914 and to have retained his friendship; he was always the same and hardly seemed to change—interested in one's doings and always making one think that you were the one person who most mattered. I shall never forget the tremendous interest I evoked when I was able to tell him that the 9th Field Company, of which we were both so proud, was being converted into the first Airborne Field Company and of the fact that I myself had had some hand in this selection.

The Corps and his friends are the poorer by the loss of a true friend, a charming and courteous gentleman, a gallant soldier and leader, a worthy servant of his Country, and last but by no means least, a real family man.

B.K.Y.

COL. A. H. VAN STRAUBENZEE

COL. ARTHUR HOPE VAN STRAUBENZEE who died on the 16th January at the age of 84, was one of the first two graduates of the Royal Military College, Kingston, Canada, who came into the Corps. In September 1881 he and T. Mackay (who died at Mombasa in 1890), joined at Chatham and were attached to Lieut. J. E. Edmonds's batch. Descended from Philip van Straubenzee, a captain in the Dutch Guards, who came to England in 1745, married an Englishwoman and was naturalised, his father, Lieut.-Col. van Straubenzee was given a commission in the 32nd Foot (Duke of Cornwall's L.I.), by the Duke of Wellington, a cousin on his mother's side. After serving in the Crimea as A.D.C. to his brother, Maj.-Gen. Sir Charles van Straubenzee (see the *Dictionary of National Biography*), Lieut.-Col. van Straubenzee settled down in Canada, his last garrison, and his three sons Arthur, Bowen, (Major in the South Wales Borderers) and (Sir) Casimir, (Maj.-Gen., Royal Artillery), were all educated at Kingston and all obtained commissions in the Regular Army.

Both " Straw," as he was soon called, and Mackay were very serious in their outlook on life, and set an example of hard work and simple living which greatly impressed—and benefited—their Woolwich contemporaries, by whom they were much liked; both were total abstainers and non-smokers, and " Straw " an earnest Churchman.

On the conclusion of the two years' course " Straw," who was good at games and had played a good deal of cricket, was selected to go through the Submarine Mining Course, a service then officered, as it was said, by Pollock medallists and eminent cricketers; later being discovered to be " non-medalliferous " although it afforded wonderful opportunities for learning all about the rapidly growing science of electricity and the development of internal combustion engines, it fell in grace. In " Straw's " case it certainly brought him no medals, as he was never on active service.

After submarine mining at Gosport, Devonport and Pembroke Dock, in 1886 he was sent as instructor to the Royal Military College, Kingston, where he remained seven years, marrying in 1887, Mary, the daughter of the late George Rosher of the Knowle, Higham. Their son is Brigadier Arthur Bowen van Straubenzee, D.S.O., M.C., R.A.

On his return to England in 1893 he was posted to the depot Submarine Mining Company at Chatham, with which he stayed until 1901, when as a major he was sent as O.C. Royal Engineers and D.O. to the submarine mining station Trincomali, remaining there four years. After a year as D.O. in the Isle of Wight he was promoted Lieut.-Col. in 1906 and was for two years C.R.E. in Bermuda, and then C.R.E. at Portsea. He was advanced to Col. in 1909; but on the completion of five years as C.R.E. in 1911, having had no active service, was not further employed, and he retired in 1912. He served again during the great war as C.R.E. of Salisbury Plain, and when he retired for the second time in 1919, he went to live at the Knowle, Higham. He became Lay Secretary of the Church of England Zenana Missionary Society for five years.

During his years of retirement he was able to follow his inclinations as an active member of the Officers' Christian Union and student of the Bible. He founded the Higham Branch of the British Legion, and was its President until his death; he took up gardening and did a certain amount of research into the careers of the graduates of the Royal Military College, Kingston.

Few officers have passed through life doing so unobtrusively and quietly so much good and with such influence on those with whom he came in contact.

J.E.E.

BOOK REVIEWS

OUR ARMOURED FORCES

By Lieut.-General Sir Giffard Le Q. Martel, K.C.B., K.B.E., D.S.O., M.C.

(Faber and Faber, Ltd., 24, Russell Square, London) Price 21s.

ARMOURED forces played such a decisive role in this war that a description of their achievements is very largely a history of the war on land. In this volume General Martel gives a concise and interesting account of their action in the battles from Arras to the capture of Berlin, together with chapters on the growth of the Royal Armoured Corps and a description of the operations in Russia from the autumn of 1942 till the spring of 1944.

His production of the book so soon after the end of the war is a *tour de force*, and due to much of it having been compiled in the air during his long flights to the various theatres of war.

The author's close connection with tanks from their inception in 1916 till the outbreak of this war is well known and it was not surprising that in December 1940 he was appointed by the C.I.G.S. (General Dill) as the first Commander oft he R.A.C. In September 1942 he was sent to Russia as head of our Military Mission to size up the situation there, and the post of Commander of the R.A.C. lapsed. A heavy task confronted General Martel on assuming command of the R.A.C. He had to select, enlist and train the personnel needed by the enormous expansion of the Corps, to formulate a doctrine and evolve, by means of exercises both indoors and with troops, a technique for their employment in close co-operation with the other arms, and lastly he had to take a long view and anticipate our requirements in tanks in the future. Good progress was made, and the technique evolved, in eighteen months, though somewhat modified as the result of our Libyan experiences, required few changes from 1942 onwards.

The responsibility for the equipment of the R.A.C. did not rest with General Martel, but with the War Office and Ministry of Supply (formed in 1939). In spite of their exertions we suffered throughout the war from the false economy in peace time that grudged money for thorough tests of experimental tanks. It was not for example till early in 1944 that the successful Cromwell tanks appeared in numbers.

The two points most stressed in this book are the evils resulting from the suppression of R.A.C. Headquarters and the necessity of a heavy tank for infantry support, as well as the cruiser tank for mobile warfare.

The abolition of the Commander R.A.C. led to deterioration in the tank doctrine and insufficient forethought in armoured forces problems, as for instance the best method of supplying tanks with petrol etc. when advancing rapidly, and so forth. The presence of heavy tanks it is claimed would have saved many casualties and much time at El Alamein, the Mareth line, Caen and in the Ardennes. It is however improbable that the heavy infantry tank will be introduced into the service, as the C.I.G.S. in a lecture at the R.U.S.I. on 3rd October 1945 reaffirmed his predilection for one capital tank.

In the Russian chapter, General Martel explains how he established

excellent relations with the Russian army chiefs by treating them rough. He claims that as the result of telling them the lessons we learnt in North Africa, the Russians altered their original intention of attacking the German Panzer divisions in July, 1943 from the Kursk Salient and awaited their assault. The Russians then used their reserves to strengthen the haunches of the break-through and the German attack petered out. On his recall in February 1944 his successor tried a policy of appeasement and was kept in complete ignorance of the movements of the Russian armies. This lasted throughout the advance on Berlin and this secrecy seems to have caused some surprise.

When however a nation has been under a Tcheka, Ogpu or N.K.V.D. for a quarter of a century, it is only to be expected that they should have learnt to keep their mouths shut.

In his numerous journeys to the various scenes of operations, General Martel had unrivalled opportunities of discussing the action of armoured forces and their equipment with commanders on the spot. Consequently this book is a most valuable contribution to the history of armoured warfare and it can be warmly commended not only to serious students of war, but also to a wider public. C.G.F.

MALTA STRIKES BACK

By Major R. T. Gilchrist

(Published Gale and Polden Ltd., Aldershot. 6s.)

Apart from its historical value, this little book is an outstanding example of how training, discipline and leadership, when properly applied, not only breed and bring out all the latent fighting characteristics of the British Soldier, but will also create and weld into one coherent responsive fighting machine a number of individual units which will, as a result, still go on doing the right thing even when orders fail to arrive and conditions are at their worst. This Brigade's ground work or basic training was achieved too under great difficulties, just compare the facilities available for formation training in England in 1942–43 with those that had to be accepted in Malta between 1939 and 1943; remember too that the majority of the personnel of these three Regular Infantry Battalions had in fact been in Malta continuously since the outbreak of War and in many cases for even longer—conditions well calculated to sap the morale of the best.

It soon becomes obvious that the Malta Brigade did develop and always retained a tremendous pride in itself, its achievements and its ability to meet anything in the future, this pride stood it in great stead when the real test came at their second landing near Pizzo in Italy—for this the credit must go to Brigadiers K. P. Smith and R. E. Urquhart. The author's personal devotion to the Brigade, in which he was Intelligence Officer for so long, can be read between every line and he is to be congratulated on presenting such a readable and fascinating story of the Malta Brigade, a formation which has since proved by results that it was one well worth belonging to.

If Major Gilchrist strays once or twice he can be forgiven because he has told us so well something of Malta throughout the Siege, just what the total elimination of the Axis Forces from North Africa meant to movement by sea in the Mediterranean, what the planning and training for the Sicily landings involved, how well their own Marzamemi landing worked out, about the fighting in Sicily and finally—and in this he is not so happy—of their landing in Italy. Major Gilchrist is evidently no great admirer of Commandos, he says of the Malta Brigade troops that they " can do everything which commandos can do, and more " (page 123). The reader will hardly agree with another statement (page 132) ". . . we gave a perfect demonstration of how a brigade group in a mobile role, when boldly handled, could do the work of a whole division."

Apparently Major Gilchrist left the Brigade before the Pizzo landing, the narrative suffers as a result and it is a real pity that the last two chapters were ever added, the happy note of the rest of the story is missing, and they are out of tune with the remainder of the book. Frankly, one is left wondering just how well did the Brigade really perform at this Pizzo landing. Granted that the last minute change in plan imposed by higher authority was a tremendous hazard, but what actually was the opposition which the Brigade met and how was it that the author was able to walk into Brigade H.Q. at 20.30 hours on the day of the landing, 8th September, 1943 ? The Malta Brigade was too good a one to be left at the end of this little book surrounded by so many unanswered questions.

Nevertheless, this is a fine book and well worth reading and studying, there are many lessons to be learnt, not the least being that of co-operation, without which the modern battle is quite impossible. The author is forgiven Chapters 13 and 14, if only for the following on the subject of discipline (page 134) :—

> " There is no logical reason why an army should not function without the thing which is called discipline. It has been argued that the human race has reached a stage in its development where drill is no longer necessary for the conduct of a mass movement, and that the combination of independent and intelligent minds, each playing its own part, would produce better results. Theoretically this seems irrefutable, but up to the present this has never worked out in practice, and in the Malta Brigade is seen a perfect example of how strict discipline and the insistence on the perfect performance of tasks, which at times seemed trivial and an unnecessary drudgery, produced over a period of time a most formidable fighting force."

Taking the story on from where the author stopped, the Malta Brigade Group was incorporated, as 231 Infantry Brigade, into the 50th (Northumbrian) Division to replace the Brigade lost in the Western Desert in May, 1942. The whole Division returned to England in November, 1943, to train for the Western Front. On " D " Day they made their third assault landing in Normandy, and added further laurels to their already high reputation. When 21st Army Group was " thinned out " towards the end of 1944, the three Infantry Brigades of the 50th Division came Home and acted as training formations until the end of 1945, when they were broken up. The 1st Dorsets then went to Germany to replace their 4th Battalion in the 130 (Wessex) Infantry Brigade ; that brings up just one point of detail in the book, in the photo facing page 13, are we looking at two men of the 2nd Devons or 1st Dorsets ? The 2nd Dorsets were many thousands of miles from Malta.

B.K.Y.

THE REVOLUTION IN WARFARE

by B. H. LIDDELL HART

(Faber and Faber price 5/-)

In this booklet of 93 pages the author sets forth his views on the technique and the manner of warfare. In the first chapter he describes the growth of firepower from Napoleonic times to the evolution of the tank, the bombing aeroplane and the flying bomb. He considers that the advocate of the last-named makes "nonsense of the soldierly idea that success in war is a proof of a people's virility and virtue. They have reduced men to the status of rabbits in a laboratory experiment." This hardly accords with the experience of those who fought in the last war.

In the second chapter he argues that in warfare an unlimited aim with an unlimited method are wrong, and that history shows that a peace of true moderation is the only method of ensuring a lasting settlement. He deems our "starvation blockade" of 1914–18 to have been inhumane, and that we started bombing attacks on Berlin in 1940, before Germany bombed London. He implies that we should have signed the convention proposed by Hitler in 1935–36 to restrict air bombing to the fighting zone. No mention however, is made of the numerous treaties with Poland, Belgium, Holland, Russia and broken by Germany, when it suited her purpose, nor is it stated how we could have ensured that Hitler would have carried out a peace of moderation.

In the concluding chapter Capt. Liddell Hart advocates a world federation as an antidote to war, but he rejects it as unattainable. To revive a code of limiting rules for warfare also seems to him vainly optimistic. His only hope is that a reaction from the disorders of the last thirty years may see a twentieth century revival of reason sufficient to produce self-control in war, if not the abolition of war. An epilogue on the atomic bomb does not throw any light on that perplexing problem.

C.G.F.

MAGAZINE REVIEWS

THE ENGINEERING JOURNAL

(Published monthly by the *Engineering Institute of Canada*)

November, 1945.—The first article is on *Radar as an aid to Navigation and Meteorology*. The author describes equipment with a range of 160 miles only, but the maximum range at which a target can be detected is stated to be about 323 miles.

Anti-Malaria Drainage in Trinidad forms the subject of the next paper. The author deals mainly with the extensive drainage systems provided, but in some places the clearance of bush was necessary as well.

A further interesting article appears on *Rural Electrification. Development and Post-War Plans in Canada.* The author considers the economic aspects of harnessing hydro-electric power to improve the amenities of farm life and the mechanization of agriculture.

A further paper is given on *Flame Priming Steel Surfaces for Painting.* The author gives the latest information on the practise of using the oxy-acetylene flame for removing rust and mill scale and forming a surface with increased resistance to corrosion before protective painting.

The concluding article in this issue gives the text of an address by General A. G. L. McNaughton on *Canadian Engineers Contribution to Victory.*

The December, 1945 issue opens with an article on *Atomic Power.* The writer traces the development of our knowledge of the subject from the discovery of radio-activity by Becquerel in 1896 to the atomic bomb in 1945. He explains " Uranium fission " and " chain reaction " and discusses future possibilities.

The next paper is on *Aircraft Performance Testing and Reduction by the " i w " method.* This paper explains the method of deducing analytically the standard performance of an aircraft (standard weight, standard (sea-level) atmosphere, etc.) from actual flight tests taken under non-standard conditions (various altitudes, angles and rates of climb, wind speeds, propeller speeds and pitches, etc.). The performance under non-standard conditions generally can then be predicted by a reverse process.

Articles also appear on *Column Formula for Materials of Variable Modulus, Developed by the Theory of Limit Design* and on *Field Decay Characteristics of large Hydro-Electric Generators.*

January, 1946.—The first article is entitled *Permanently Frozen Ground and Foundation Design.* This is the first part of a paper dealing with the theory of frost action in soils and presents results of tests in permanently frozen ground in Northern Canada and Alaska.

A New High-Efficiency Linear Amplifier. This paper describes a new type of amplifier which operates by dividing the wave into sections, amplifying each section separately and recombining the sections in the output to produce a larger wave of the original form.

Gas Turbine Fundamentals.—Gas turbines are considered as being in two classes, " Static " and " Dynamic," the former used in stationary work and the latter in aircraft. The Static type is described first as a basis for comparison and the effects of speed and altitude are then considered, both for propellor and pure jet propelled aircraft.

The concluding paper in this issue is on *The Winter Temperature Cycle of the St. Lawrence Waters.* W.M.

GEOGRAPHICAL JOURNAL

(Published by the Royal Geographical Society, London)

July–August, 1945.—The province of Szechwan played an important part in the war between China and Japan. Densely populated, fertile, remote and difficult of access, the Chinese Government transferred their headquarters to this region and were thereby greatly aided in their resistance. H. L. Richardson gives a comprehensive account of the province, of its primitive conditions, and of the effect on it of the impact of war. Mrs. Richardson adds interesting domestic details.

F. W. Oliver supplies a detailed investigation of the incidence and character of dust-storms (not sand-storms—the distinction is important) in the western desert of Egypt, and of the marked effect thereon of military operations during the late war.

In 1942 the question of food supply to the copper-belt of Northern Rhodesia became important, while at the same time road transport became increasingly difficult. W. V. Brelsford gives an interesting account of the cutting of a channel from Lake Bangweolu to the River Luapula, for which he was responsible, and which enabled food stuffs to be transported by water. The cutting was through dense papyrus swamp, and owing to war conditions had to be done without survey of any kind, and entirely by hand. The difficulties, which were many, were overcome, and it is expected that the permanent waterway now operating will have important effects on the future of Northern Rhodesia. E.M.J.

EMPIRE SURVEY REVIEW, January, 1946

(Published by the Crown Agents for the Colonies)

Sir E. Dowson and V. L. O. Sheppard conclude their account of the Cadastral Survey of Egypt. In this article they describe the gradual building up by Lyons, from inadequate foundations and in extremely difficult conditions, of a well organized and efficient survey. This interesting series of articles is a tribute, not only to the organizing powers of the late Sir Henry Lyons, but also to the ability of the authors in dealing in a small space with a most complex and difficult subject. At the conclusion they forecast consideration at a later date of the lessons to be learnt from this Cadastral Survey; a consummation to which readers of the E.S.R. will look forward.

N. B. Favell contributes a *Plea for the Expansion of the Scope of Survey Departments*, his object being to show that greater efficiency would be obtained if all types of survey work in a country (with certain special exceptions) were carried out by one Survey Department. The author gives numerous instances of the waste that occurs owing to the lack of adequate preliminary survey, or to the multiplicity of Survey Departments, and makes out a well reasoned case for his thesis.

C. H. Menzies concludes his discussion, begun in a former number, of the *Mean Square Errors of Point Determinations* and adds a note on the object of his investigation.

J. H. Cole gives a simple and rapid method of obtaining the length of long arcs for radio purposes.

There is a review of a valuable work by V. Liversage on *Land Tenure in the Colonies;* and an obituary notice of Colonel Dudley Ryder, formerly Surveyor-General of India. E.M.J.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA

(Published by The Civil and Military Gazette, Ltd., The Mall, Lahore)

October, 1945.—*Air Trooping to England* is the story of a flight from Poona to England in four days, with a brief description of what London looked like to a returning exile in August, 1945. The R.A.F. Transport Command comes in for well deserved praise.

Auspex in *An Airman views the World* postulates a globe similar to our earth, but with seas and oceans which will support nothing—everything sinks; the inhabitants have, however, learned to fly. This engaging parable leads on to a thoughtful review of world politics and strategy, bearing in mind the enormous difference that air power has brought about.

61 *days' leave in South Africa* contains useful hints for casual visitors as well as for retired officers contemplating settling there. We get a brief resumé of the characteristics of the various races composing the Union. The author is optimistic about the future.

In *The Rehabilitation of Japan*, an officer who has been a language student in that country for three years discusses measures to be taken to prevent the resurgence of militarism there. Part of his proposals, for example, the stripping from Japan of all territories she has acquired since 1895, are already in hand. Education must play a great role in national reformation and stress is laid on the necessity for unexceptional behaviour by the personnel of the occupying forces.

How the Fourteenth Army was reinforced.—War establishments provided inadequate staffs for the depots, and until each division had its own training facilities, not much progress was made. After that, in spite of the extreme complexity of the business, reinforcing was carried out well. Some of the depots at Kohima and Imphal came in for a good deal of stiff fighting. Not a single life was lost in air transport.

A Two-Penny Ha'penny Show is an amusing account of operations ending in the capture of Taungup in April, 1945. The author, who commanded the brigade group which carried out the task, pays a great tribute to the 72nd Field Coy., which "got nearer to perpetual motion than anything he had seen." In spite of a good jibe at the use of initials in the Services, he does not explain the meaning of "C.O.P.P."—defined as "an invincible partnership of sailor and sapper, who spend their time recce-ing enemy held waters in unarmoured craft."

How the Channel Islands fared.—An officer returning to Guernsey soon after VE day describes his experiences. On the whole, the Germans adhered to International Law, but were adepts at finding subterfuges. The island was transformed by means of subterranean batteries, passages and stores into a fortress of immense strength. In the end, owing to shortage of food, the Huns were feebler than the Islanders.

Military Training in India's Universities, pre-war, was none too good; only between 10 and 20 per cent of the students joined the local corps, most showing a preference for the less combative branches. Things should now improve; there is more and better equipment. Instructors must be the best available.

The Production and Protection of Oil is a vivid description of life and work in S.W. Persian oil fields. One paragraph must be quoted in full. "The 'Fields' Manager was a sapper officer in the last war. Being honest he is more popular with his juniors than his seniors, but everyone likes him. He knows the whole area really well and is always interesting to talk to."

What of the Indian Ex-Soldier's Future? contains proposals for the planting of colonies in Government waste land. Such land is naturally not of the best quality, and spadework, both literally and metaphorically, would be required to make the proposition feasible. Something has, however, already been done in this direction. The scheme is remarkably like that put forward by Lt.-Col. H. A. Macdonald in the September, 1945, *R.E. Journal.*

Put the Madras Soldier on the Map Again.—The title explains itself. From 1927 to World War II the only representatives of the old Madras Army were the Q.V.O. Madras Sappers and Miners, to which the author pays well deserved tribute. There is now a regiment of Infantry, with five regular battalions, which have fought well and earned high praise. There are, too, many Madrassis in the R.I.A.S.C. and other formations. Language is a difficulty as very few recruits speak Urdu, the lingua franca of the I.A.

Man Management compares the methods laid down for horsemastership with those usually adopted by Os. C. towards their men, rather to the detriment of the latter. The closing sentence is worthy of note, " When your men subconsciously smile as they salute you, you have accomplished something great which the officer round the corner has not."

Water-supply for Assault Landings.—The author's experience in Burma, in landings on the Arakan coast, has produced valuable suggestions; there the rise of spring tides is unpredictable even by naval experts, and the problem is to put sufficient water ashore in a safe position to meet the force's requirements until the next high tide. Water holes near the shore produce brackish water and wells further inland may have been destroyed or contaminated. But the article should be studied at length and no summary is of much use. F.C.M.

THE INDIAN FORESTER

(Published by The Civil and Military Gazette, Ltd., The Mall, Lahore)

October, 1945.—The theme of *Land Improvement and Forests* is that, while Nature takes a thousand years to make an inch of soil, man can, and often does, lose a foot in a single year by careless means of cultivation. The article stresses the value of strips of woodland to prevent wind erosion on ploughed fields.

Although it is an extract from Forestry, a very interesting article on modern methods of fire-fighting deserves mention. No block between rides should be more than five acres in extent. Rides in difficult country can be efficiently made by bulldozers and graders. Low-consumption, high-pressure, light-weight pumps, can often deal successfully with a small fire. It is essential however to get the party early on the spot, and adapted Bren-carriers may be the answer. The " walky—talky " will be a most useful adjunct to fire-fighting in woodlands.

November, 1945.—At the annual convocation of the Indian Forest Ranger College at Dehra Dun, the Director thanked the K.G.O. Bengal Sappers and Miners for continuing to give the class instruction in field works in spite of war pressure.

December, 1945.—Various suggestions to use demobbed soldiers of the I.A. on land reclamation are taking definite shape in the Bombay Presidency, where, under the " Sir Cusrow Wadia Trust Fund " (to which Government is largely contributing) a vast scheme has been begun, the main features of which are dry-farming and the construction of immense numbers of small bunds to conserve water and preserve the soil. F.C.M.

THE MILITARY ENGINEER

(Published by the Society of American Engineers)

November, 1945.—*Port Construction in the Pacific* by Lt.-Col. J. A. Riley. An interesting account, illustrated by some good photographs of the raising, organization, and work, carried out in the Pacific Theatre of operations by Port Construction and Repair Units. In the American Army these specialist Units are not rated as Combat Troops. They carry out normal engineer tasks when not engaged on Port Construction.

A Design for Bridging, by Col. Francis X. Purcell, Jr. A stirring account of a magnificent engineering achievement—the construction of a 1,060 ft. Class 70, two-way 26 ft. wide bridge across the Rhine at Oppenheim. The bridge was supported on double bents of 12 timber piles, with spans of 50 ft. except for one navigational span of 90 ft. The river was flowing at 4 to 5 ft. per sec. The Engineer Regiment carrying out the construction said it could be completed in 15 days—it was actually completed in 13 days (working night and day), from the time of starting construction. The difficulties which had to be overcome, and the ingenuity exercised in improvising a second floating pile driver (so that work could go on from both ends simultaneously) and a floating workshop, are all vividly described, and go to make up an epic tale of achievement.

"Friendship Bridge" over the Elbe, by Major Burt R. Kramer. An interesting account of an unusual type of Military Bridge constructed at Magdeburg, i.e., a bridge of all steel welded construction. The piers consisted of two steel pile bents spaced 5 ft. apart, interbraced both longitudinally and laterally with steel channels, and capped with H beams welded directly to the pile flanges and the channel ribands. A point worthy of note was that the steam hammer used for the pile driving was operated by compressed air supplied by two 315 cu. ft. Ingersoll Rand compressors through a collecting chamber.

The bridge consisted of six 50-ft. central spans and two end spans of 52 ft. 6 in. each, and had a clear roadway of 22 ft. width with 3 ft. footways each side, being two-way Class 40 and one-way Class 70. Time of construction was 10 days—work being carried on continuously in three 8-hour shifts.

Spanning the Rhine, by Capt. Richard L. Malconian, and Lt. Robert L. Bryer of the Corps of Engineers. An account of the erection of two Pontoon bridges across the Rhine by men of the 181st Engineer Heavy Pontoon Battalion with assistance from other Engineer units. When construction started the river was running at 5 m.p.h. With rain during the night it increased to 10 m.p.h. and in the morning anchors began to give. The bridge had to be temporarily held with L.V.C.Ps. while additional anchors were dropped 600 ft. upstream.

The first bridge at Kripp, 969 ft. long, was completed in 30 hours. It utilized 60 pontoons and 6 trestles and took 10,000 man-hours.

The second bridge at Bad Godesburg, though longer (1,170 ft.) was completed in 16½ hours. It contained 77 pontoons and only 2 trestles, and took 6,500 man-hours.

An interesting point regarding both these bridges is that while the river was flowing fast they were declassed to Class 12 or Class 20, and subsequently raised to the normal Class 36 Classification.

December, 1945.—*Engineer Supply in the Continental Invasion*, by Major General C. R. Moore, Chief Engineer Services Forces in the European Theatre. The author of this article is the equivalent of our D.W. and as such speaks with authority on the planning for and provision of Engineer Stores

during the period from " D "-day to " V.E. "-day. He brings out clearly the necessity for planning well in advance to allow for time taken in ordering, provisioning and transport, and also that while operations did not, and never will, go strictly according to plan, stores provided for one contingency were made to do for something else instead. Hence it is inadvisable to attempt too great a refinement in estimating requirements of Engineer Stores, and it is necessary to limit the Engineer stock pile to the fewest possible items, each with the maximum flexibility of use. Interesting figures are given of actual consumption of Engineer Stores.

January, 1946.—*From Pearl Harbour to Tokyo*, by Col. G. E. White. A long but most gripping and vivid description of the Engineer task facing the Americans in their island hopping advance from Pearl Harbour to Japan and the methods by which this task was accomplished.

The only way to reach the objective was to seize one island after another—assault, consolidate, and assault again. For an assault to succeed it had to be supported by land based air power, hence each advance entailed the very rapid construction of an air base. The construction of an air base on an isolated coral attol, or in a malaria infested jungle, 1,000 miles from the nearest base is a major problem. It means heavy earth moving, paving, erection of workshops, hangars, stores, refrigeration, water supply, extensive P.O.L. storage, electric power facilities, bomb storage, and living accommodation, and, above all, those things must be accomplished at speed, for every minute lost in completing the air base means lives lost due to lack of air support. The author resolves the problem into 3 main headings.

(*a*) The Transportation Problem.
(*b*) The Construction Problem.
(*c*) The Utilities and Servicing Problem.

(*a*) The Transportation Problem.—The problem of unloading all the heavy equipment required by an aviation Battalion on to a soft sandy beach over a coral attol was one of great difficulty. It was solved by the production of suitable landing craft and steel pontoons capable of taking the heaviest wheel loads when grounded. An enormous increase was also required in crane capacity, both ashore and afloat. For the construction of airfields in the middle of jungle, as in Burma and China, it was necessary to develop the technique of breaking down construction equipment into parts which could be transported by air and rapidly re-assembled.

(*b*) The Construction Problem.—Here the first problem was to provide the Aviation and other Engineer Construction Battalions with earth shifting machinery and other mechanical equipment on a vastly increased scale, and to provide and train operators in a scale of three per machine so that work could be carried on day and night. Figures are given of the actual scale of equipment provided. The need for a portable surfacing for airfields was met by Pierced Steel Planking. The rapid construction of accommodation was met by pre-fabrication. Local materials were used to the utmost, and in this respect coral proved to be the answer to the Engineer's prayer for the construction of roads and airfields.

(*c*) Utilities.—The need for workshops for servicing aircraft and all the mechanical plant entailed production of electric power on a large scale. This was met by standard generators of varying size. Refrigeration on a large scale was necessary for preservation of food. Tank farms on a vast scale, pumps and pipe-lines were required for P.O.L. The only available source of water supply was frequently the sea and large capacity distillation units were required.

H.R.P.H.

INFANTRY JOURNAL

(Published by the U.S. Infantry Association)

Each of the three issues under review this quarter, namely, those for November and December, 1945, and January, 1946, contains a good article on the future problems of defence.

In the *November*, 1945, issue General Marshall, the American Chief of Staff, writes an article under the heading, *For the Common Defence*. He points out how America, like this country, has always neglected her defence problems between wars and has had to start each war completely unprepared. She has been saved in the past by distances and by the help of allies which have allowed time for her to improvise and build up her resources. Modern inventions will never give her this advantage in the future. She must, therefore, be prepared in peace.

A standing army of sufficient size to meet all eventualities is ruled out on account of expense, and the only answer is universal military training. Such training would enable the Regular Army, the National Guard and the Organized Reserve to expand immediately at the first sign of trouble. He anticipates that this force would be able to check the enemy while mobilizing, say, four million men in a year.

In the *December*, 1945, issue Robert Strausz-Hupé discusses Power Politics and Foreign Policy in an article entitled *The Value of the Chips*. He points out the tendency after a victorious war to go back to the system of agreements and alliances which were in force before the war, without much thought for changed conditions. The number of Great Powers has been reduced after World War II from eight to three, although France and Italy may be built up again in time. Small nations have not changed much in number, but the experiences of the war must tend to make them combine with the Great Powers, rather than act as independent buffer states as they did before.

The United Nations Organization gives all Nations an opportunity of voicing their feelings, but it is obvious that the Big Powers have got to work together and be prepared to pay the price for any action which may be necessary.

This article was written before the meeting of the United Nations Organization in London this year. It would have been interesting if the author could have expanded this part of his article as a result of the experiences gained from that Meeting.

In the *January*, 1946, issue Maj.-Gen. O. L. Nelson, Jr., writes an interesting article on *The General Staff and the Future*. He stresses the importance of having a combined general staff to deal with all three services, Army, Navy and Air Force. This is considered essential to deal with the questions of planning operations as well as arranging the correct allocation of both manpower and supplies to the various services. He points out the great savings which would be effected if various administrative and supply services could be combined. He also quotes the ill feeling caused between the services by having different scales of accommodation and rations for men doing similar jobs and working side by side. This complaint has been heard also amongst the British services. In fact the whole article might have been written for British instead of American readers.

An interesting point is the suggestion that civilian and military personnel should be more effectively intermeshed in the top positions of the General Staff. At present only clerical and secretarial assistants work together in the American War and Navy Departments. Many advantages might accrue in the British War Office if civilian and military officers could work together in the same branches.

C.C.P.

REVUE MILITAIRE SUISSE

(Published by Imprimeries Réunies, S.A., Av. de la Gare, 33, Lausanne)

November, 1945.—*How the New Chief of Staff views the Army of the Future*, by F. Gaudard. The new Chief of the Swiss General Staff, Colonel-Commandant L. de Montmollin, has expressed his general opinion with regard to the future of the Swiss Army.

Once again Switzerland has stood mobilized in the midst of belligerents and has come through without violation of her territory. The need for reform of her Army is apparent for two reasons: its organization is of pre-war date, and its equipment must be brought into line with recent developments.

Switzerland has maintained an Army which reached a strength of 850,000 combatants. This Army must be either reduced or trained to modern standards. The new Chief believes that it must continue to be composed of a highly-trained cadre, and a second " ban " or class. The country could not afford to maintain a large professional army.

Re-armament of the artillery is already in hand. Motorization of the whole Army is essential. On the atomic bomb question, there is no reason, at any rate for the present, to modify the traditional form of armies. An antidote may be found. But in the meantime, Switzerland will study all the aspects of the new situation created.

Aerial Warfare and the Battle of Britain, by R. Stoudmann. A translation from the *Portuguese Revista Militar*. The author has collected as much information as was available during war-time to a foreigner, and has written a general account of the types of aircraft with which the battle for the mastery of the air in 1940 was fought.

The German air policy at the outbreak of war was to establish mastery of the air and then utilize it to establish close co-operation between air and ground forces to enable the Army to do its work. The rapid successes in Poland, Norway, Belgium and France in 1940 confirmed the Germans in their view of the correctness of their policy, but the vigour of the opposition they met with from the Royal Air Force protecting the retreat of the British Army in France caused them losses on an unexpected scale.

The attack on Britain is described as consisting of four phases: (1) A systematic attack on the shipping in the Channel and the coastal defences of the southern shores. (2) From August 19th to September 5th a heavy attack on the aerodromes of Fighter Command. (3) From September 6th to October 5th the great daylight attacks on London and (4) The night attacks spread over the whole country.

The German failure to secure success in this struggle is attributed to their concentration on air-speed rather than air-armament. The superior gun-fire of the British, combined with the indomitable spirit of the pilots, caused such tremendous losses among Goering's air fleets that the price was too much for the Germans and the contest was called off.

The attack on Britain was continued by the ever-increasing intensity of the submarine war. Here again the defence was in great measure strengthened by the air vigilance and by the air attacks on the marauders.

December, 1945.—*Rocket Artillery*, by Major Kuenzy. Discusses the advantages and disadvantages of rocket-propelled shells. The rocket-shell has certainly come to stay, but it will not oust the gun-propelled projectile. As a light field equipment, it certainly has many advantages, the chief of which the author enumerates as (1) simplicity of the firing apparatus; (2) lighter materials used in manufacture of the shell, no brass or copper used; (3)

greater mobility of the artillery; (4) the rocket can be fired even from an improvised rack and different sizes of projectile can be fired from the same apparatus; and (5) a greater concentration of fire is possible in a given time. The author omits another advantage—the economy in gun-teams. In fact, the complicated machine which the modern gun has become is replaced by a simple battery rack and the biggest part of the problem is the supply of the ammunition. But it is not quite so simple as all that. The greater part of the rocket-shell is taken up with the propellent material, which plays no part on arrival at the target. The propulsive charge must be much larger than the explosive charge. The flight of the rocket is plainly visible by its smoke and by its flame. Its range is only about half that of normal artillery of the same calibre. Its flight is subject to aberration to a much greater degree than that of the smaller shell.

Improvements will no doubt remove many of these disadvantages, but it is safe to say that the rocket will not displace the classic artillery; it will supplement it, and the author concludes that the Swiss Army must indubitably adopt the new weapon.

Esprit de Corps, by Major P. de Vallière. It is noticeable that Continental military writers pay much attention to matters of esprit de corps, morale and the psychological well-being of the soldier. With long experience of conscripted service, they devote considerable space in their journals to this important subject. In our services, esprit de corps has hitherto grown by itself, it follows the voluntary spirit and the general system of education, but in the future, if obligatory service becomes permanent, it may be necessary for us to emphasize this feature in our military training more strongly than we are accustomed to do.

January, 1946.—*The Fundamental Notions of Tactics*. by Colonel Du Pasquier. The principles enunciated smack somewhat of the skits on tactical treatises which appeared at the time of the South African War, notably General Dordle on Tactics, but they are perhaps a very good way of reducing tactics to their simplest forms and of reminding us that, after all, the problems can be simplified. The author learned at an early age that simple logical solutions could be reached with all tactical problems, and he gives a number of clear outlines to facilitate study, stopping short of all questions of morale, weapons or conduct of the battle.

The Army in Peace Time : the Russian point of view, by Lt. H. Juillerat. Based on a recent article in the *Kraznaia Zvezdia*. The author combats the theory beginning to arise that armies in the future will be redundant when the atomic bomb will do their work for them. The United States, at any rate,—possessors of the secret of the bomb—are not disposed to accept this dangerous doctrine, and the Red Army of Russia is not showing any signs of slowing down the process of modernizing its large forces. An overhauling of ideas as to fortifications and strong positions will be a natural result of the recent war.

The Swiss writer, viewing the question from the Swiss angle, is concerned that the soldier, and especially the officer, after several years of military discipline, should not lose that valuable experience when he returns to civil life. The control and restrictions of military life have a very real value in shaping the character, and the spirit underlying them should be carefully fostered. The Red Army—the latest example of a real people's army—is already alive to the necessity of a firm discipline from top to bottom.

W.H.K.

JOURNAL OF THE BUENOS AIRES ASSOCIATION OF THE INSTITUTION OF CIVIL ENGINEERS

No. 14 Session, 1944.

The Journal opens with the chairman's inaugural address on *Post-War Problems on Argentine Railways.*

The development of the country was almost entirely due to Railways up to the end of the last war and Road Transport did not become a serious competitor until the early thirties. Prior to 1939, Air Transport competition was negligible, but the phenomenal development of Aviation since that date has introduced another serious challenge to the Railways, particularly in a large country like Argentina where distances are great. The speaker considered various methods of improving the design and efficiency of rolling stock and the permanent way to meet the situation.

In the next paper entitled *Track Under Heavy Traffic*, a permanent way engineer of wide experience examines in detail all the factors involved in the construction and maintenance of the track, particularly with a view to increasing its carrying capacity. The rails (material, weight, lengths, joints, crossings), sleepers, chairs, ballast, etc., are all dealt with in an interesting and informative manner. The speaker considered that there was no real scientific basis for the design of railway track in the same sense that there is for a bridge, but this opinion was hotly challenged in the discussion. The speaker has invented a specialized slide rule with two slides and five scales (speed, traffic, substructure, rail weight and axle load) giving a result on a sixth scale which he calls " Maintenance Expectancy " this being divided into three zones, " Easy," " Normal " and " Difficult." The arrangement of scales is frankly empirical. The London–Brighton line in this country with a speed of 60 miles an hour, traffic intensity 10, good substructure, 95 lbs. rail and 15 tons axle load, comes comfortably within the " Easy " zone when assessed by this slide rule.

A third paper on the subject of Railways is entitled *Discussion on Modern Developments in the Railway Industry.*

To some extent the same ground is covered as in the two previous papers, but communication systems are dealt with and in addition some interesting particulars are given of the " quebracho " sleeper which has a life of 40 to 50 years without impregnating preservatives.

Another paper is on *Standardization as an Economic Factor in Post-War Reconstruction.* The author considers the subject under eight main sub-heads, basic materials, product specifications, range of sizes, production processes, testing, certification of consumers' goods, trade terms and safety standards.

A further paper deals with *Post-War Development in Commercial Aircraft and Post-War Airways.*

The author discusses generally the organization of Civil Air Lines and then considers in particular the prospects of Civil Aviation in South America.

The issue concludes with three short papers by students on the following subjects :—

(*i*) *Repairs to the Concrete Mole : Ingeniero White.*
(*ii*) *Repairing and Reconditioning of part of the main line Southern Railway in the Argentine.*
(*iii*) *Renewal of certain High Level Tracks in the Argentine.*

W.M.

CORRESPONDENCE

R.E. POST-WAR PLANNING

The Editor, *20th February*, 1946
The R.E. Journal.

Sir,

The anonymous writer of the article in the December, 1945, number of the *R.E. Journal* invites discussion of this subject. Below I give my views on some of the points:

As regards the R.E. officers' initial engineering training, I suggest that its foundation should be the training of a civil engineer and that it should take, as nearly as possible, the form of the training of the civilian engineer who becomes an A.M.I.C.E. or graduates in engineering at a University.

Officers who choose to specialize in another branch of engineering should be required to become A.M.I.M.E., A.M.I.E.E. or A.R.I.B.A., or obtain other approved qualifications in addition to their civil engineering ones.

The initial training of A.M.I.C.E. might be carried out entirely at the S.M.E., or for the B.A. degree partly at the S.M.E. and partly at a University.

I should prefer the second alternative because, in addition to receiving his engineering training, the young R.E. officer would have the opportunity of mixing with all sorts and conditions of men at the University. This would give him a much wider outlook on life and on the problems of mankind as a whole than he would get if he were segregated from the civilian world at a purely military establishment such as the S.M.E.

It is essential, on account of the large influx of civilians into the army in wartime, that the R.E. officer should be at least the equal in engineering qualifications of the "temporary" officers with whom he will have to work and many of whom will be his subordinates. His training and contacts at a University would prevent him losing the civilian touch too early in life.

The R.E. officers' military knowledge, both engineering and tactical, should be additional to his purely "civil" qualifications. It is that additional military training, and only that, which must distinguish him from his fully qualified civilian colleague.

In the past it has been much more difficult to provide the trained R.E. officer with sufficient constructional work to enable him to become an engineer or builder as experienced as his civilian counterpart, than to provide him with a good initial training. Very few R.E. officers have been able to get sufficient practical experience in peace time in the designing, execution or supervision of works on a scale such as may fall to their lot in war time.

In order to provide more opportunity for gaining such experience, I would suggest that R.E. officers and officers of the Public Works Services in the Colonies should be interchangeable for limited periods. This would not only enable R.E. officers to obtain wider engineering and "works" experience but, by making it a condition of service in the Colonial P.W.D. that its officers become R.E. Reserve Officers, trained in military engineering at the S.M.E., a valuable addition to the number of trained R.E. officers available on mobilization would be made.

All Colonial P.W.D. officers could, of course, not be withdrawn from the P.W. Service on the outbreak of war; but those who remained at their civilian posts would, on account of their R.E. training, be valuable colaborators with the R.E. if their colony became a theatre of war.

As the first C.R.E. Nigeria, in 1940, I found the enthusiastic co-operation

and the ready understanding of the needs of an army by the Deputy Director of Public Works, Nigeria, who had been a R.E. officer in the first world war, a great help, and what would have been an extremely difficult task, with the very limited means at my disposal, became a comparatively easy one.

Further fields of experience could be thrown open to R.E. officers at home. Instead of "civilianizing" the works services, against which such a great authority as Major-General A. G. B. Buchanan has ranged a formidable list of "cons" in his article, "Sapper or Civilian" in the March, 1945, number of the *R.E. Journal*, I would suggest that the Civil Works Services be militarized.

During the recent war the Ministry of Works carried out many Works Services at home for the army. At the same time the R.A.F. employed civilians at home and abroad to build aerodromes and barracks, while in the operational zones the R.E. built the airfields.

Instead of a wholly civil works service to carry out all the work for Government Departments, I would suggest the establishment of a works service, partly R.E. and partly civilian, to carry out all engineering and building work at home and abroad for the War Office, Air Ministry and Admiralty, and for other Government Departments if desired. The R.E. works service would then offer greater opportunities of practical experience to R.E. officers. It would enable them to learn more about its "customers'" needs, and in its civilian personnel there would be a further possible source of R.E. personnel in case of war.

Furthermore, retired R.E. officers could obtain employment as civilians in the Works Service and many of the excellent Clerks of Works and Mechanists trained in the Corps could also find employment there.

The employment of R.E. officers in the Colonial P.W.D. would give them more opportunities to gain experience in the execution of works by direct labour, in the use of mechanical equipment and in the organization of the supply of materials, all of which they have to do in war, and for which they should be trained.

Some of the above-mentioned points might also be advanced in favour of establishing a General Government Survey Service embodying the Ordnance Survey and employing R.E. personnel.

Yours faithfully,
C. J. KANE,
Lt.-Col. late R.E.

The Editor of *The R.E. Journal.*

Dear Sir,

Reference *R.E. Journal*, December, 1945, page 229, last three lines, let us apply a little logic. The alternative conclusions, avoiding compromise conclusions, from Anonymous' statement are :—

(*a*) The R.A.O.C. stores arrangements are scandalously inefficient—or
(*b*) The R.E. arrangements lead to scandalous neglect, unjustifiable risk, or regrettably slow handling—or
(*c*) R.E. stores are of a nature much simpler to handle—or
(*d*) The R.E. work three times as hard as the R.A.O.C. Good old Sappers! (but this is almost the same as (*a*) above, as not many Sappers die of "stores exhaustion.")

Now if (*a*), (*b*) and (*d*) (or any combination) hold good, then Anonymous has disclosed a sensational scandal, and we should ask our M.P. about it, or at least get somebody who is influential and fearless to take the matter up with our departmental chiefs! I pass that buck to Anonymous, in our best tradition!

If on the other hand (*c*) holds good, then his argument about overall economy failing to result from adding R.E. stores to R.A.O.C. responsibility falls to the ground—for the R.A.O.C. would NOT have to increase their manpower by more than the present R.E. staff which handles the stores. R.A.O.C. overheads might increase slightly—but R.E. overheads would be entirely eliminated, which would more than compensate.

Let it not be thought that a Sapper would *like* to hand over R.E. stores control to another department—as nothing will shake our conviction that nobody can handle them as efficiently as *we* can (and how beautifully independent it makes us of quintuplicates, or the whims of men to whom we cannot talk so rudely as we can to our own brother Sappers !) The burden of my theme is that the argument that there is no " economy " in handing over is not to my mind proven. Anonymous' counter would be interesting if he would care to respond.

Yours faithfully,

c/o Lloyds Bank Ltd.,
6, Pall Mall, London.

G. V. MICKLAM,
Lt.-Col., R.E.

SAPPERS IN SOUTHERN LATITUDES

The Editor of *The R.E. Journal.*

SIR,

In Capt. Vickers Todd's most interesting article in your March number, there is unfortunately a piece of muddled history. He states, " Thus the Royal Engineers had the privilege of providing the largest unit of the British Forces ever to set foot in Uruguay since the early nineteenth century, when Admiral Lord Beresford retreated through the country, after his unfruitful attempt to capture Buenos Ayres."

The facts, recorded in Fortescue's *History of the British Army*, Vol. V, and Porter's *History of the Corps of Royal Engineers*, Vol. I, are as follows :

In 1806 we were at war with Spain, then an ally of France. A small expedition went from the Cape of Good Hope, recently captured, to attack the Spanish in South America. Admiral Sir Home Popham was in command, with Col. Beresford in command of the troops. Beresford speedily captured Buenos Ayres, but on a rising of the colonists taking place was forced to surrender. Beresford subsequently escaped, but apparently took no further part in the operations in South America. As Marshal Beresford, he reorganized the Portuguese army during the Peninsular War, and is best known for his hard won victory at Albuera. He was subsequently raised to the peerage.

To return to the operations in South America, the British government had sent out a larger force which, having captured Montevideo by assault, failed dismally against the unfortified city of Buenos Ayres. As a result of the failure, the British commander agreed to evacuate the neighbourhood of Buenos Ayres within ten days and Montevideo within two months. I can find no record that any part of the force retreated through what is now Uruguay, and the probability is that they embarked direct into transports.

Marshal Lord Beresford seems to have left no descendant. The famous admiral, Lord Charles Beresford, 1846-1919, was descended from a near relative of his.

Yours faithfully,

F. C. MOLESWORTH.

Bideford,
Culworth,
March 21*st*, 1946.

R.E. WORK ON THE L. OF C.

Romney House,
War Office,
25th April, 1946

The Editor, *R.E. Journal.*

DEAR SIR,

In Brig. Perry's account (in the March *R.E. Journal*) of R.E. work on the L. of C. with the B.L.A. I am pleased to see the subject of Engineer Intelligence dealt with, as it tends to be overlooked in preparation for such work. The importance of adequate intelligence to the forward troops was always appreciated and the late war has emphasized it over and over again. Consequently all officers and many N.C.O.s of formation engineer units are, if training has been thorough, ardent collectors of information and ready-made intelligence agents, in addition to those officers on C.E.s and C.R.E.'s staffs whose particular role it is.

L. of C. engineer units, such as Works Sections, Artisan Works Companies and the like, do not have the same opportunities of training and, unless the necessity for regular and constant intelligence reports is impressed on them from above, do not realize their responsibilities in this connection. As an example—new bridges are automatically reported with full details, but how often does a C.E. or C.R.E. of L. of C. Tps. get from his units reports on existing bridges as to their condition, changes in classification necessary, and records of span, etc., in case replacement becomes urgent ? Brig. Perry has mentioned several other points of L. of C. engineer interest, to which may be added local resources of building materials, which may often save much time and transport.

Much information is also required initially, as Brig. Perry points out, before R.E. units reach the site of their labours. This must chiefly come from above and requires every bit of intelligence the forward troops can collect, however unrelated to their own immediate tasks, and probably specific reconnaissance. It also suggests that the otherwise excellent reports on foreign countries prepared by the General Staff should in future include much more engineer detail. This is particularly important in countries of the Middle and Far East, where conditions unfamiliar to the average R.E. officer, and peculiar local factors, abound.

In Persia, for example, in 1941 and 1942, R.E. planning for the Aid-to-Russia L. of C. was much handicapped by the inadequate engineer intelligence available on such points as local methods of road and building construction, water resources, local supplies of building materials, and seasonal behaviour of rivers.

It cannot be too strongly stressed that *all* engineer units require training in the collection and passing of intelligence. The subject can be made very interesting and, from my personal knowledge, can produce quite surprising results from, say, a Garrison Engineer with little military background or training.

Yours faithfully,
R. E. WOOD, *Brigadier.*