

# The Royal Engineers Journal.



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DECEMBER, 1926.

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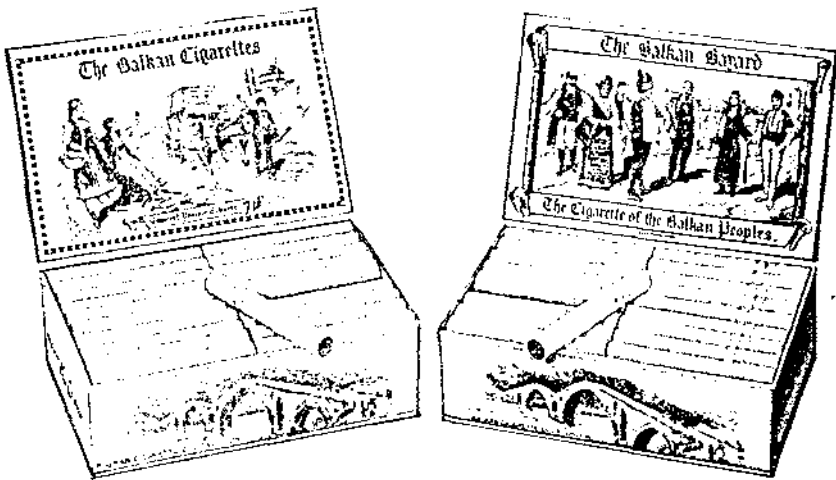
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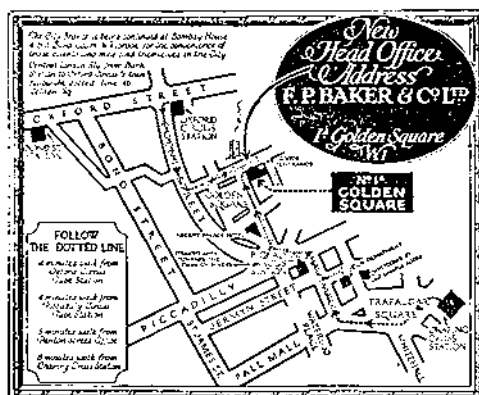


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# HISTORY OF THE 20th (FIELD) COMPANY; ROYAL BOMBAY SAPPERS AND MINERS.

GREAT WAR: 1914—1918.

By MAJOR H. W. R. HAMILTON, D.S.O., M.C., R.E.,

*“ Acti labores sunt jucundi ”*

## PREFACE.

This history has been compiled mainly from the War Diary of the Company, supplemented by the memory of the writer. The latter has been used only to clothe the bare skeleton of the Diary, and in no case to provide the facts themselves, unless they were of very minor importance. There was, however, nothing in the War Diary from which an account of the action of Neuve Chapelle (October 28th, 1914) could be compiled. The account of this feat of arms is based on reports made by Lieutenants Nosworthy and Rait Kerr, as they then were, within three months and one month respectively of the action, supplemented by notes written recently by Major Paris. Actual times of the various events of this action are, therefore, not entirely reliable, though the general sequence of events can be taken as being reasonably accurate.

The history is not intended to be anything more than a company history, and the actions of neighbouring units and of the larger formations have only been described in such detail as is necessary to make the account clearer. Only in one case does this strictly limited view lead to difficulties; that is in the account of Neuve Chapelle. In that instance, in order to provide a clear picture of what occurred, the actions of the 9th Bhopals, the 47th Sikhs, and of the 21st (Fd.) Company, 3rd Sappers and Miners, should have been included. These actions, though not mutually co-ordinated, were all part of one connected whole. On the other hand, the writer has had such difficulty in constructing any connected account of the action of the 20th (Fd.) Company alone, that he has despaired of ever being able to include the deeds of these other units within the scale of the picture provided by the material at his disposal.

It has been intended throughout to emphasise the part played by the men of the Company during the war, to record their gallantry and their determination, the dangers which they faced and the hardships which they endured, their never-flagging energy and their

abiding loyalty to their King-Emperor and to their officers. The work of the British officers has been left largely to speak for itself. But it should be recorded that of the thirty-three British officers who served with the Company up to the time of the Armistice, sixteen were temporary officers, either R.E. or I.A.R.O. Without the skill and technical knowledge which these latter officers brought to their work, without the ready way in which they immediately made themselves part of the Company, without their energy, loyalty and pluck, the work of the Company would not have been what it was.

It is not expected, nor is it the writer's intention, to add anything to the already voluminous history of the Great War. The main object has been to supplement, as far as possible, the briefer official history of the Royal Bombay Sappers and Miners. It is hoped that some at least of the incidents herein recorded may assist officers responsible for the teaching of Corps history, and also that this history may prove of interest to those who served with the Company during the Great War.

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## PART I. FRANCE.

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### AUGUST 1914: MOBILIZATION.

On the 10th August, 1914, the Company, at that time the 20th (Fd.) Company, Third Sappers and Miners, received orders to mobilize, and left Kirkee on the 16th August, under the command of Captain A. L. Paris, R.E. The following British and Indian officers and British N.C.O's. accompanied it:—Lieutenants F. P. Nosworthy, R.E.; E. J. B. Hayes-Sadler, R.E.; R. S. Rait Kerr, R.E.; Subadar Ganpat Mahadeo; Jemadars Shah Wali Khan and Baryam Singh; Corporals M. A. Sprinks and C. Harris, R.E. It may be added that Subadar Arjan Powar, who had been senior Indian officer of the Company since 1906, had been promoted Subadar Major of the Corps only a few days earlier, and would otherwise have proceeded on service with the Company. This fine Indian Officer was in no small degree responsible for the splendid spirit which the Company showed in its very first action in France.

### S. S. TAIYIBEH.

The 20th and 21st (Fd.) Companies embarked at Bombay in the S.S. Taiyibeh on the 17th August, and sailed on the 24th. This ship had been previously condemned as unfit to take pilgrims from Bombay to Jedda, and was manned by a scratch crew hastily collected by the Naval authorities. It soon appeared that the

condemnation was based on reasonable grounds. The ship was in a thoroughly insanitary condition; and as soon as she left harbour, and met the monsoon, it was found that the lower deck ports could not be closed, except by using canvas caulking on the dead lights. Before this could be done, however, the troop decks were flooded, and while this makeshift kept out water to a certain extent, it had the effect of making the ship very dark; and in spite of all efforts there were never less than six inches of water in the officers' cabins. To crown all, the engines broke down. The Commander later told Lieutenant Nosworthy, that, if he had not had Sappers on board, he would have been very doubtful of making port. This shows a somewhat touching confidence in the capabilities of the Corps.

#### EGYPT.

Eventually the ship reached Suez, where the Company disembarked. The Company then proceeded by rail to Cairo, where the whole of the 3rd (Lahore) Division was concentrated to take the place of the British Garrison, which had gone to France. Five days were spent here under canvas at Heliopolis, on one of which the Division carried out a long and tiring demonstration march through the streets of Cairo.

Having re-embarked at Alexandria the Company finally disembarked at Marseilles on the 26th September, and went into camp on the Parc Borely racecourse. Entraining again on the 28th September, it reached Orleans on the 1st October. It is believed that the Company was the first Indian unit to pass through France.

The whole of the 3rd (Lahore) Division, less the Sirhind Brigade, which had been left in Egypt, was now concentrated at Orleans, and partly re-equipped for European warfare. Though all were eager to commence active operations, little was known of the type of warfare into which Indian troops were now about to be plunged. While the standard of training of our troops was rightly valued, the strength of the Germans was by many sadly underestimated.

#### THE COMPANY PROCEEDS TO THE FRONT. *Map 1.*

The Company entrained at Orleans on the 17th October, detrained at Wizernes on the 18th, and billeted at Esquerdes until the 21st. Marching thence with the 3rd (Lahore) Division through Bailleul and Estaires, it reached La Gorgue on the 23rd, and went into billets.

*General Situation.*—The scope of this history is limited, but it may be here mentioned that at this time the B.E.F. was holding the general line Givenchy—Armentières—Ypres, and repulsing the attacks of superior numbers of German troops, many of them fresh formations. The Indian Corps, composed of the 3rd (Lahore)

and 7th (Meerut) Divisions, less the 7th (Ferozepore) Brigade, which had been lent to the British Cavalry Corps, and the 9th (Sirhind) Brigade, which was still in Egypt, came up behind the British 2nd Corps, on the general line Festubert-Neuve Chapelle, and gradually relieved it. The Lahore Division, which had, as will have been noticed, only one Brigade at its disposal, was more immediately concerned with the neighbourhood of Neuve Chapelle and the Rue du Bois; but the troops of this Brigade were to a great extent sent into action as individual units, wherever reinforcements were required, and often under the command of British formations.

Meanwhile the 20th Company was employed from October the 24th to the 27th digging second-line positions near Fauquissart, Le Touret and Lacouture. Company billets were at Le Touret.

NEUVE CHAPELLE: *October 28th. Maps 1 and 2.*

During the morning of the 27th, the Company billets were moved to Bout de Ville. At about 4 p.m. on that day, just after the Company had finished work south-east of Lacouture, orders were received for the whole Company to concentrate at Richebourg St. Vaast. Captain Paris thereupon ordered up the company transport and all available men under Lieutenant Rait Kerr. These arrived at 6.0 p.m. As the situation was uncertain, and conditions were those of open warfare, a standing patrol of No. 4 Section under Lieutenant Rait Kerr was placed at the cross roads of Richebourg L'Avoué, and remained in position until relieved by a cavalry patrol at 7.30 p.m. At about 8.15 p.m. the situation was explained to Captain Paris. This was, in general terms, that the troops of a British Brigade had been forced to retire from Neuve Chapelle, and a re-entrant had thus been driven into the British line. The Company was ordered to dig itself in on the left of the 9th Bhopals, who were in the vicinity of Port Arthur (at the junction of the Rue du Bois and the La Bassée road), while the 21st (Fd.) Company, 3rd Sappers and Miners, which was also being ordered up, were to prolong the line to the left. Both Companies were placed under the orders of the commander of a British Infantry Brigade. These dispositions would have the effect of forming a new battle front west of, and excluding, the village of Neuve Chapelle. The Company was ordered to proceed to Pont Logy, where a Staff Officer was to be met who would direct the Company to the proper position.

On arrival at Pont Logy this Staff Officer was found, but he could do no more than recapitulate the orders previously received. The Company had, therefore, to locate the left flank of the 9th Bhopals without assistance. The night was dark and the position was hard to find. First a British Battalion, with officers reduced to two 2nd Lieutenants, was located, and then the right flank of the 9th Bhopals. The movement of the Company along the line of the latter unit

was not facilitated by the sudden bursts of fire, which are not uncommon in difficult and uncertain situations. It was not until 11.0 or 11.30 p.m. that a position was reached, beyond the left flank of the Bhopals, where the Company dug in.

An officers' patrol was sent to look for the 21st (Fd.) Company. The latter had had a similar experience of wandering in the dark, and was finally found entrenching away to the left, with an unoccupied gap of some 600 yards between the Companies. The British Brigade, under whose orders the two Companies were acting, was informed of this, and the gap was filled just at dawn by two Companies of the 47th Sikhs. During the night two casualties occurred, the first in the Company.

Dawn broke at 5.30 a.m.\* and found the Company still digging. The trenches, though incomplete, afforded cover, and were occupied, officers and men lying down to a well-earned rest.

*Orders to Attack.*—At about 5.0 a.m. Captain Paris had been called back to Pont Logy for orders. These were that an artillery bombardment of the village would start at 7.0 a.m., would continue for half-an-hour and would be followed by a general attack. These orders were subsequently cancelled, and the attack was postponed until 11.15 a.m., but the bombardment took place at the earlier hour, causing considerable damage to the village and bringing down the church steeple. It is presumed that this postponement was ordered so as to obtain the co-operation of the 4th D.G's., who were not expected before 11.0 a.m. Actually the latter had not arrived at 3.30 p.m., and were unable to assist.

The following is a copy of the written orders for the attack:—

“An attack against Neuve Chapelle road from about the L of Les Brulets to the road junction La Bassée—Neuve Chapelle road, with the object of regaining trenches previously held by 9th Brigade Infantry, is to be made to-day. It will commence with the bombardment of our guns, assisted by a French Battery.

On the attack being ordered the movement will be from the right in a south-easterly direction. Troops should not move further forward than the trenches originally occupied by the 9th Brigade, except on the left of the line, where the advance should be made sufficiently far to allow of the houses south-east of the road triangle north-east of second E of Neuve Chapelle being burnt.

The 2nd Cavalry Brigade will support the right of the attack with their left directed on Neuve Chapelle church. The North Staffords and Royal Scots and the French chasseurs and cyclists at Rouge Croix under General Shaw will have orders to support the left of the attack with their right on Neuve Chapelle church. Com-

\* Lieutenant Rait Kerr's account. Sunrise is at 6.45 a.m.

munication centres have been established at the road junction south of first E of Chapelle and at the farm just north of the O in Logy.

At 11 a.m. a general bombardment of the position to be attacked will be commenced, and at 11.15 a.m. without further orders a general advance will be commenced, units taking care to connect up on their right and left.

From 7th Infantry Brigade.

RICHEBOURG ST. VAAST. 10 a.m."

At 11.0 a.m. on the 28th, a second and heavier bombardment began, 18 prs., French 75's., 4.7's and 60 prs. all taking part. This bombardment lasted half-an-hour. When it ceased, our troops were seen to be attacking in succession from the left, and Captain Paris decided to co-operate. He ordered the Company to attack in echelon of sections from the left, and informed the nearest company of the 9th Bhopals.

*Description of the Village.* Neuve Chapelle was at that time a small, pretty, somewhat straggling village, with a conspicuous Church, forming the junction of several radiating roads. Timber and orchards concealed it to a certain extent from our lines, but on the east of the village the ground was more open and extended for 500 to 600 yards up to the Bois de Biez. The Germans were thus able to fire down the roads leading into the centre of the village, the village itself being masked from our lines, except for the fact that from Port Arthur a limited view could be obtained of its western outskirts.

*The Attack.* Three hundred yards of plough separated the Sappers from their objective. This distance was covered with little loss; but the 9th Bhopals, who at first advanced in touch, were unable to make further progress, and the 20th Company came under heavy fire from the right flank. Lieutenant Nosworthy and No. 3 Section, however, changed direction and succeeded in charging a trench at A., which was causing some of the trouble, with the bayonet. Meanwhile the 9th Bhopals, though this was not known at the time, were heavily engaged further to the right, and except for a small party under Major Jamieson, were not able henceforward to spare any men to take part in the actual fighting in the village itself.

The four sections of the Company succeeded in penetrating the village, and reached the main street, where they suffered losses from the fire of Germans occupying the houses, and of machine-guns, east of the village, raking the streets. Some confusion ensued, but eventually, after hand-to-hand fighting in houses and cellars, the whole street was captured as far as the eastern outskirts of the village. Lieutenant Hayes-Sadler then headed a party in a gallant effort to charge one of the enemy machine-guns, but he was killed and the attempt failed.

*Captain Paris wounded.* Meanwhile, Captain Paris, seeing that the right flank was exposed, and that the Bhopals were not advancing, went back and collected a few of them under a havildar from the nearest trench, where at the moment none of their officers could be seen, and moved with them and one or two stragglers of the Company towards the southern houses of the village. The party suffered some loss, and just before reaching the houses, Captain Paris fell severely wounded. He was eventually picked up by the enemy after dark, and remained a prisoner until the end of the war. As the Company did not know where he was, and did not retire over the ground where he lay, they were in no way to blame for not picking him up. Captain Paris had commanded the Company for over seven years, and it was a hard blow that he should have been lost in this its first, though its most glorious, action.

The Company was now scattered on a wide front, and only about 20 men remained with Lieutenants Nosworthy and Rait Kerr in the centre of the village; while other parties had attached themselves to the 47th Sikhs on the left. At about the time that Captain Paris was endeavouring to obtain reinforcements, as has been stated above, Lieutenant Rait Kerr was sent back by Lieutenant Nosworthy to obtain help. He returned to the south-western edge of the village, where he found Major Jamieson, with about six men, firing on a strong German counter-attack, which was working round our right. Collecting three or four Sappers he went to their assistance, but on the way he was hit in the arm, fell into a ditch, and fainted. Here he lay for some considerable time.

Lieutenant Nosworthy was thus left alone in the village, except for the 47th Sikhs further to the left. Two further messages for help produced no result. His party had by this time barricaded the main street, which was continuously enfiladed by German machine-guns, and felt themselves reasonably secure. He later gave it as his opinion that, had help been forthcoming, he would have been able to hold on to the village, as his men were now ensconced in houses from whence they could reply to the enemy's fire.

*The Withdrawal.* At about 3.30 p.m., Major Jamieson of the 9th Bhopals, and a few of his men, entered the village by the road which the Sappers were holding. One more attempt was made to charge a machine-gun, but only failure resulted; and, as Major Jamieson said that the attacks on both flanks had failed completely, it was determined to fall back.

Lieutenant Nosworthy and thirteen others, including Subadar Ganpat Mahadeo retired out of the village, and though fired on in doing so suffered no further loss. Lieutenant Rait Kerr was met on the way. The latter, having recovered consciousness, had picked up a naik in the 9th Bhopals and Sapper Dalip Singh of the

20th Company, and, seeing that the Germans appeared to be attacking on the north of the village, had proceeded with these two men in that direction. All three took cover in a shell-hole, covered by some peastakes, at a point west of the church and not far outside the village. Lieutenant Rait Kerr then ordered the two men to open rapid fire on the enemy who could be seen on the edge of an orchard. This had the effect of causing the Germans to withdraw. Lieutenant Rait Kerr then seeing that our troops were retiring, returned to the trench from which the attack had started that morning, and met Lieutenant Nosworthy as stated above.

Having collected as much equipment as could be carried, the whole party moved to near Pont Logy, where an officer of the 4th D.G's. asked for help in holding the houses at that point. This was given, but orders were soon received to proceed to Rouge Croix, and thence to Estaires, where Lieutenant Nosworthy reported to the C.R.E. at 8.0 p.m. The remainder of the survivors of the Company drifted back and rejoined that evening and during the course of the next day.

#### LOSSES.

The following is a list of casualties :—

|                             |       |  |
|-----------------------------|-------|--|
| <i>Killed</i>               | .. .. | Lieutenant Hayes-Sadler and 21 Indian other ranks.                                     |
| <i>Wounded and Prisoner</i> | ..    | Captain Paris.   |
| <i>Wounded</i>              | .. .. | Lieutenants Nosworthy and Rait Kerr<br>Jemadar Baryam Singh and 32 Indian other ranks. |

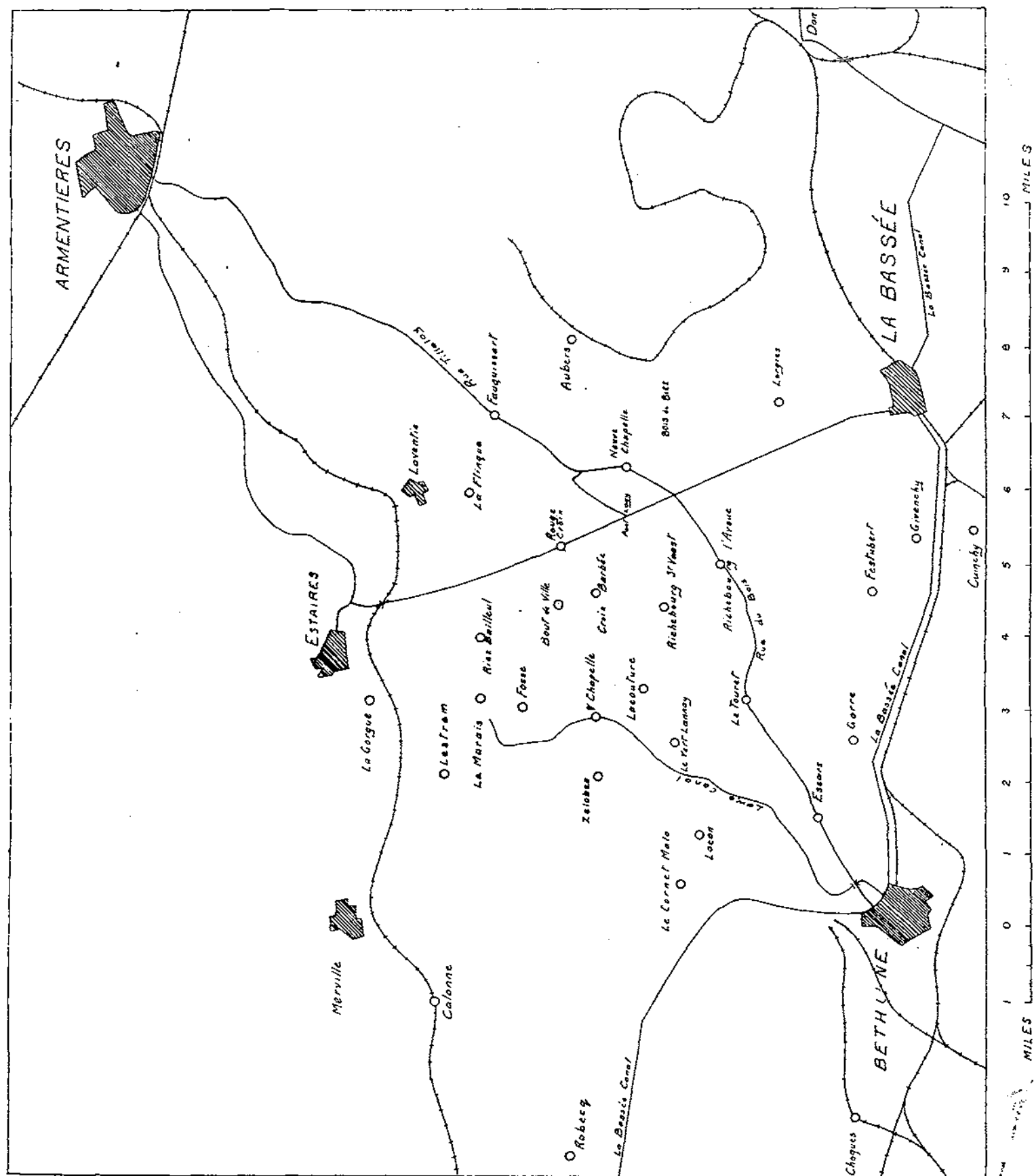
Thus the casualties in British Officers were 100%, and in Indian ranks 30% of the total strength of the unit, including drivers and others who were not closely engaged or who did not go into action.

*Acts of Gallantry.* Many acts of gallantry were performed by men of the Company in this affair, which, owing to casualties among British officers, were never recorded. It must be remembered that the Company was acting on a very extended front, and that other parties, besides that with Lieutenant Nosworthy, fought in the village and maintained themselves there the whole afternoon. Those who fought alongside the 47th Sikhs covered themselves with glory. The strong bond of comradeship between the 3rd Sappers and Miners and that fine corps, which dates from the day of this action, bears witness to the deeds done that day in company.

Three decorations were awarded to men of the Company for work done this day. Havildar Muhammad Khan, who was mortally wounded, and Sapper Dalip Singh both received the Indian Order of Merit, for conspicuous gallantry. Naik Shah Nawaz also was noticed for conspicuous gallantry in street-fighting by Major Davidson of the 47th Sikhs, who, however, was unaware of his name. This Naik was wounded later in the action, and did not receive his

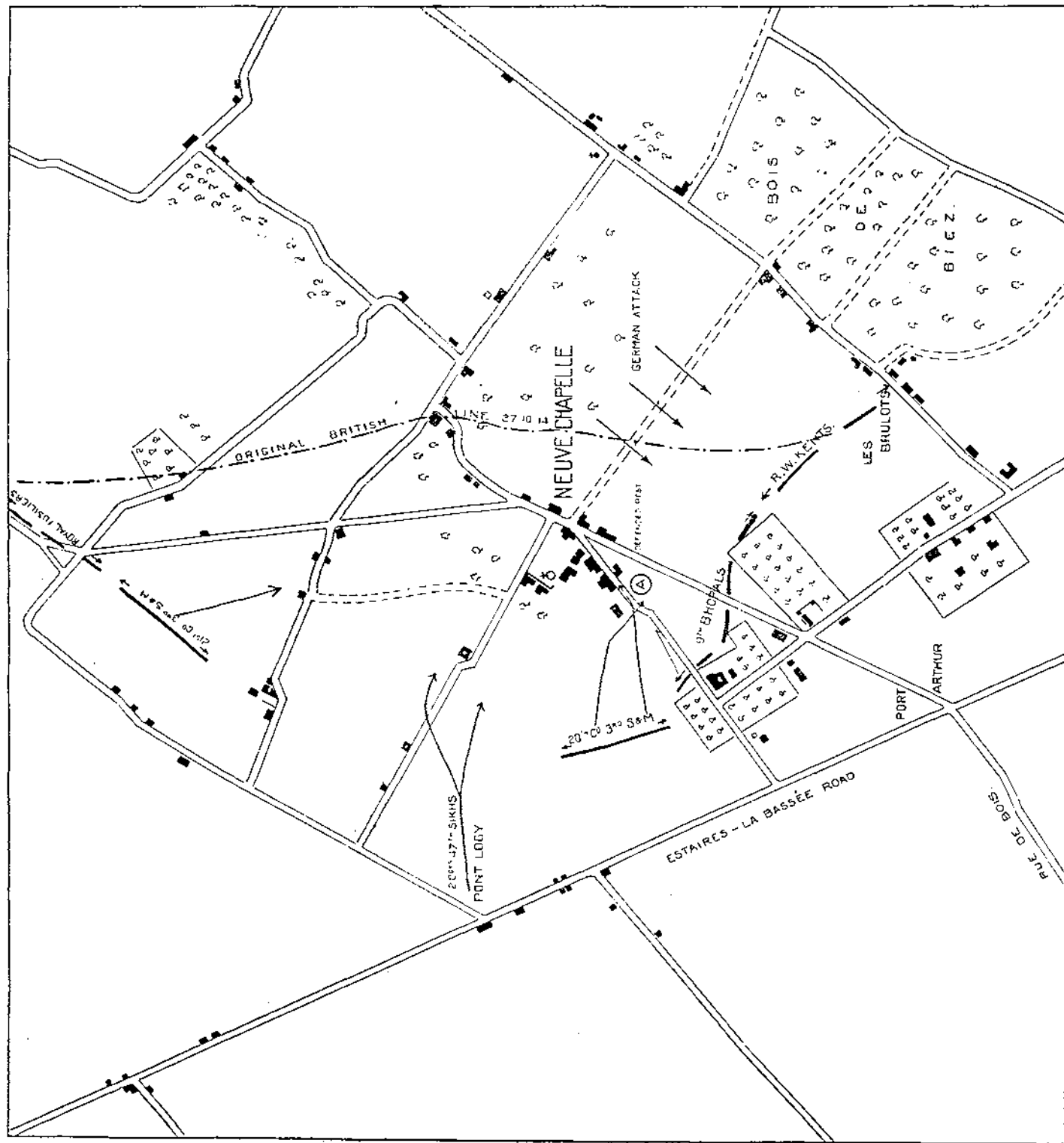


## GENERAL MAP I

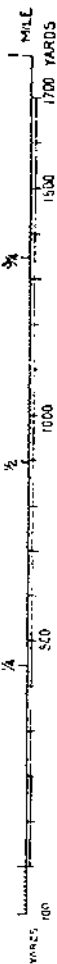


NEUVE CHAPELLE

MAP 2.



SCALE



reward until five years later, when, having been transferred as an Indian Officer to a Pioneer Battalion, he was on parade for inspection by General (late Major) Davidson. The latter recognised him, and asked where they could have met before. On hearing that it was at Neuve Chapelle, the General remembered the circumstances, and immediately recommended him for the I.O.M., which was granted.

These three decorations were the only ones given to the unit for the action, but the work of the 20th and 21st (Fd.) Companies was noted by General Sir John French in his despatch of the 20th November, 1914, which reads:—

“On the 28th October, especially, the 47th Sikhs and the 20th and 21st Companies of the 3rd Sappers and Miners distinguished themselves by their gallant conduct in the attack on Neuve Chapelle, losing heavily in officers and men.”

The following is an extract from the history of the 59th (Fd.) Company Royal Engineers which appeared in “The Sapper” of July, 1921, referring to this action:—

“A Staff Officer of the 3rd Division told me that it was one of the most gallant feats he had ever seen, and regretted that the circumstances should have been such as to necessitate the use of engineers on such a service.”

The Company now went into billets at Sailly, and Captain Stack, R.E., field engineer to the Lahore Division, took over temporary command.

#### NOVEMBER 1914. TRENCH WARFARE. *Map I.*

On the 1st November, Captain Birney, R.E. and Lieutenant Robson joined the Company, the former assuming command, and on the 2nd November Lieutenant Hamilton, R.E., also joined.

During the ensuing fortnight work was carried out sometimes by day and sometimes by night on the front and second line trenches in the Rue Tilleloy area. Second line trenches which were 600 to 800 yards behind the firing line were usually dug by day, though they were under observation from Aubers ridge. The importance of concealment was not sufficiently appreciated at that time, and the Company used to march on to work taking little care to remain concealed. The Germans occasionally shelled the working parties with shrapnel without effect, but on the night of the 4th-5th they dropped a bouquet of howitzer shell right in the working party, killing 3 men and wounding Jemadar Shah Wali Khan and 2 others. Subadar Ganpat Mahadeo was now the only survivor with the unit of the seven officers, British and Indian, who had left Kirkee with the Company.

On the 14th, the Company moved into billets two miles north-west of Estaires, but it was turned out again at 7.30 p.m. and

marched  $6\frac{1}{2}$  miles to the trenches to dig a new length of fire-trench connecting the lines held by the 47th and 15th Sikhs. Much time was wasted in the dark finding officers who knew the location of the work; but, after stumbling through interminable trenches over prostrate forms,\* both British and Indian, the Company eventually started operations in a field of roots, and quickly finished a passable trench. The men were not back in billets until 7.45 a.m. on the 15th.

On the 16th, the Company moved into fresh billets near Lacouture and rested that day and the next. On the 17th, it was reinforced by a pontoon section consisting of 10 British drivers R.E., 19 horses and 3 wagons, which remained with the unit until it landed in Mesopotamia. The N.C.O. in charge, Corporal Clark, R.E., however, was with the Company until he was demobilized in 1919.

On the 17th, the following Officers arrived and took over duties :—

Major A. R. Winsloe, D.S.O., R.E.,

Captain W. P. Pakenham-Walsh, R.E.,

Lieutenant H. G. Greswell, R.E.,

Lieutenant M. Everett, R.E.

Captain Birney was ordered to railways, Lieutenant Robson to the 1st (K.G.O.) Sappers and Miners, with the Meerut Division, and Lieutenant Hamilton to military works on the L. of C. The latter, however, delayed his departure, and a few days later was re-posted vice Lieutenant Everett, who had injured himself riding.

#### FESTUBERT. *Map 3.*

*Manufacture of Bombs.* On the 18th, the Company moved to Gorre, a somewhat squalid village some two miles behind the Givenchy-Festubert Sector, which was held by the Meerut Division. Here a factory for hand-grenades (jam-tin bombs), trench mortar ammunition, and charcoal braziers, was started; and the work on these articles was continued at high pressure and without intermission until the 24th. The grenades and mortar bombs were somewhat crude affairs, and the latter were extremely apt to explode at the muzzle of the mortar, which was either a wrought-iron tube or a hollow wire-bound piece of timber. Classes of Infantry were instructed in the art of throwing the hand-grenades, but pupils generally were not enthusiastic!

On the 23rd November, the Germans attacked and captured the trenches held by the 34th Sikh Pioneers in front of Festubert. Heavy losses were inflicted on counter-attacks across the open; and the situation was critical until Lieutenant Robson, now with the 1st (K.G.O.) Sappers and Miners, took a leading part in a bombing

\* It says much for the spirit of the British Soldier that not once did a sleeper utter any of the expletives peculiar to his calling. "Hullo Johnny!" and "Thik Johnny!" were the only words that were heard."

attack from the flank. The Germans were driven out and some 100 prisoners taken.\* It was thought at the time that this was the first instance of the tactical use of bombs during the war, but a British Division claims to have earlier originated the idea of bombing from traverse to traverse. After this, hand-grenades became more popular with the infantry.

It was about this time that the Indian Corps copied the "Hair-Brush" bomb from the Germans, and that Captain Battye, R.E., commanding the 21st (Fd.) Company, 3rd Sappers and Miners, started the manufacture of Battye bombs in Béthune.

On the evening of the 24th, the Company, less 2 Sections, was ordered at short notice to clear ammunition urgently required in the trenches from a shell-wrecked house in Festubert. The work was hindered by shell-fire, three men being wounded, and Captain Pakenham-Walsh, in spite of his girth, propelled some distance by a bursting shell. Ammunition had, however, been brought up from Gorre, and 13 boxes were carried up to the front line by the Sappers.

On the 24th November, work in the trenches of the Festubert sector was taken over from the 1st (K.G.O.) Sappers and Miners. The situation here was somewhat difficult, as the Germans had sapped up to within 5 or 10 yards of our trenches in five or six places, and had completed a parallel about 50 yards away along the whole front. In two places their saps had broken into our trenches during the fighting of the 23rd. The enemy had distinctly the upper hand in bombing; and their trenches were far better drained and constructed than ours. They had good loop-holes from which they harassed our observation posts and communication trenches; and a few snipers had managed even to get through our lines on the 23rd, and maintained themselves in hay-stacks and houses behind our lines, whence they fired at single men at night, and they were very hard to locate. One of these enterprising individuals was thought to use a .22 rifle by day with disconcerting effect.

The general line of trenches can be followed in Map 3. It should be noted that on the 24th November our line had no depth. Support, communication and reserve trenches hardly existed, and there were no dug-outs worthy of the name. The firing-line was cut off from the rear by day and men slept in the open at night, crowded in the front line trenches, with waterproof-sheets as their only shelter from the frequent rain.

From the 24th November until the 3rd December, the Company, reduced in strength as it was, worked hard to improve the position,

\* For a good account of this action read the "History of the 39th Royal Garhwal Rifles." Although the 20th Company took no part, this action has been mentioned in some detail, as Lieutenant Robson was a Sapper Officer and had served in the Company.

digging communication and support trenches, and endeavouring to devise means to strengthen those portions of our position threatened by the German saps. The only measures which could have been any use would have been counter-sapping, for which our Sappers were all too few, and bomb-throwing, for which our bombs were still insufficient. The use of bombs was still not very popular with the infantry. A few bolder spirits, like de Pass of the Cavalry,\* obtained a temporary superiority over the Germans in bombing, and where they did so, the situation was greatly eased. One of the Sapper Officer's duties throughout this period, therefore, was, if he had the time, to give practical exhibitions of bombing into the German sap-heads, and there is no doubt that a few good shots by Lieutenant Robson or Greswell did much to encourage the embryo British grenadier.

*The Piquet House.* One of the most useful pieces of work was carried out by Captain Pakenham-Walsh and detachments of the 20th Company in the Piquet House near Hell Corner (vide Map 3). This building was within 10 or 15 yards of the enemy's advanced parallel, and was subjected to continual bombing. It was important to hold it, as it flanked a large part of our line and overlooked the enemy trenches. Working by night, frequently under bomb and rifle fire, the Sappers improved the defences of this building; when the work was finished, this house thus fortified formed a very useful "point d'appui" in our line.

In addition bomb-making was continued during the day-time. On the 24th, for instance, as many as 450 jam-tin bombs were made.

On the 28th November, Lieutenant Greswell was wounded while returning from the trenches, and evacuated next day.

#### DECEMBER, 1914.

*Rest.* On the 3rd December, work in the trenches was handed over to No. 3 Company, 1st (K.G.O.) Sappers and Miners, and the Company had a period of rest, but was still employed in turning out bombs, loop-hole boxes, and other trench stores. Infantry squads were exercised almost daily in bombing, and some pontoon drill was carried out.

On 3rd December, Lieutenant Johnstone, R.E. joined the Company.

#### FESTUBERT AGAIN.

On December 12th, the Company again took over the Festubert sector, and work was continued as before. Our bombers, however, were by this time dominating the German sap-heads; and the enemy, finding further progress therein impossible, were now engaged in driving a series of Russian saps, or shallow mines, towards our trenches. Although the Infantry reported suspicious noises,

\* Awarded a posthumous V.C.

listeners specially sent to the trenches heard nothing, and the report was unfortunately not credited.

On the 13th, Captain A. R. C. Sanders, R.E., took over command from Major Winsloe, but on the 15th he was slightly wounded by a bomb, while accompanying a reconnaissance attack on a German sap. Two Sappers were also wounded on this occasion. Captain Pakenham-Walsh took over command, and handed over again to Major Winsloe on the 17th.

On the 16th, troops on the right were conducting a minor operation, and the Company moved up to a position of readiness; but no further move was ordered, and the men were back in billets at 1.0 p.m., where they immediately set to work and made 150 hair-brush bombs, which were urgently required.

*Action on the 19th.* On the 18th and 19th, our counter-saps were driven forward without intermission. On the latter day an abortive attack was made by the Indian Corps on the Givenchy front. A section of the 20th Company was detailed to accompany an isolated attack by a company of Gurkhas on the Festubert front at dawn on the 19th, but the Gurkhas were not ready to attack at zero hour. However, the company commander of the Gurkhas considered that his orders were to attack as soon as he was ready, and he asked Lieutenant Hamilton to join up our sap with the German sap as soon as the attackers had taken the German trenches. No covering fire of any sort was arranged, with the result that the Gurkhas were mown down by the fire of many machine-guns before they had gone a few yards. Two very gallant British officers were lost in this mistaken endeavour, together with many men. The Sappers then naturally found it impossible to work in the open at joining up the saps, but work was continued below ground.

*German attack on the 20th.* At an early hour on the 20th, the Germans exploded a number of small mines under our trenches, attacked on the whole front from Givenchy to the left of the Piquet House, and succeeded in capturing our front and support lines after confused fighting.

Lieutenant Hamilton, who was billeted in Festubert with a section, was ordered by the Brigade Commander of the Sirhind Brigade to take up a position in reserve just in rear of the village. The Germans however, did not make any further attack on our very weak line, and later in the day the section was ordered back to Gorre.

The Manchesters later succeeded in driving the enemy out of Givenchy, and, the 1st Division having arrived, the line was stabilized after a series of costly counter-attacks.

*Some Remarks.* The failure of the Indian Corps to retain the line which it held for two months was due to the following causes :—

(1) The small number of technical troops available. The Lahore Division had only two Field Companies, both more than 30% under strength; and the pioneer battalion, having been used as Infantry, had been very much weakened during the fighting of the 23rd November.

(2) The general ignorance of trench warfare and bombing.

(3) The packing of the front line with troops.

(4) The complete lack of engineer stores. The rise of the sub-soil water in the low ground in front of Festubert, converted the trenches into quagmires, and caused great suffering to the troops. Timber for dug-outs, trench-boards and revetments was unobtainable.

(5) The failure to realize the key position of Givenchy. The latter might have been made impregnable and the low, swampy ground in front of Festubert lightly held. Trenches along the general line of Festubert village and its road would have been comparatively dry and concealed from observation.

In this connection it should be noted that Captain Sanders, R.E., had personally sited two machine-gun positions on the northern slope of the Givenchy spur, which raked the line of our trenches, but these posts were unfortunately observed by the Germans, and put out of action by shell-fire before the attack.

On the 21st and 22nd, the Company remained in a state of readiness at Gorre. On the latter day the billets were shelled, and, as nearly a ton of guncotton was stored in them, a move was necessary.

Driver Tanner, R.E., was badly crushed between two heavy draft horses while removing them to safety under shell-fire. He later received the D.C.M.

#### THE COMPANY MOVES TO MARLES.

On the 23rd, the Company moved to rest billets with the Ferozepore Brigade in Marles-Les-Mines, and on the 24th, Captain Pakenham-Walsh took over command from Major Winsloe.

Thus ended the Company's share in the operations of 1914, which have been described in some detail, owing to their novelty and, it is hoped, their interest.

It was in these operations, at any rate, that the Third Sappers gained their reputation for hard work and gallantry, a reputation which they have never lost. Under a continual succession of new officers, the men carried out their duties, whether in the line or nominally at rest, to the satisfaction of their superiors, and to the admiration of many who had never seen them at work before and were ignorant of their esprit-de-corps, and splendid traditions.



## REST : CHRISTMAS, 1914.

The period from the 24th December to the 14th January, 1915, was one of rest and refitting, varied by such Christmas and New Year celebrations as could be arranged. On Christmas night the British drivers of the Pontoon Section gave an excellent "sing-song," which was attended in full strength by all Indian ranks, and apparently vastly appreciated. Much time was spent in teaching the Infantry the elements of trench design, as it was realised that the Sappers could not be expected to do everything for them. This instruction undoubtedly bore good fruit.

On the 26th December, a draft of one Indian Officer (Jemadar Ali Bahadur) and 39 Indian other ranks joined the Company.

On the 31st December, the Company paraded for inspection by the G.O.C. Indian Army Corps, Lieutenant-General Sir James Willcocks, who delivered a complimentary speech. The fluent Urdu of the General, though completely above the heads of most of those present, immensely gratified the men.

## JANUARY, 1915.

*Trench-work, Rue Du Bois. Map 1.* On the 4th January, Captain Sanders rejoined and took over command.

On the 15th January, the Company moved by 'bus to Zelobes, and marched thence to Richebourg Saint Vaast, where it remained until the 22nd improving the defences of the Rue du Bois. The front here was quiet, as both sides were engaged in combating the Flanders mud, and were too busy to engage in any offensive operation. Our front line east of the Rue du Bois was discontinuous and lightly held. The houses of this straggling village, which formed the main-line of defence, were still comparatively intact, and full of the property abandoned by the French owners. It was an amusing sight to see the Gurkhas, sitting on the door-steps, wearing seedy bowler-hats, and admiring themselves in cracked hand-mirrors. The weather was cold and wet and on the 18th there was a heavy fall of snow. Captain Nosworthy rejoined here, to the great satisfaction of all ranks.

*Rest at Marles.* On the 22nd, the Company marched to Chocques, and thence on the 23rd, to its former billets at Marles, where it lay at rest until the 1st February, when it marched with the Sirhind Brigade to billets near Calonne. It remained at Calonne until the 11th February, drilling, practising Field Works, experimenting with catapults and rifle-grenades, and pontooning.

## FEBRUARY, 1915.

*Trench work, Le Touret. Map 1.* On the 11th February, it marched to Le Touret and took over a sector of the position from No. 4 Company 1st (K.G.O.) Sappers and Miners. This sector lay to the north of our old Festubert position and was badly waterlogged.

Much work was done in making breast-works and in putting out wire. The former consisted of a parapet revetted by plank hurdles, which were turned out in large quantities in the Company workshops; the latter was usually composed of "knife-rests," which were sometimes of colossal size. These were carried down to the trenches and wired "in situ." On one occasion a regrettable incident was nearly caused by a carrying party of the 34th Sikh Pioneers, which missed our trenches and proceeded unconcernedly towards the German line, pursued with strange oaths by two R.E. Officers.

*Rest at Robecq.* On the 23rd February, the Company marched back to rest billets at Robecq, where it remained until the 4th March. The Brigade Commander of the Sirhind Brigade informed the O.C. Company, during this period, that the work of the Company had been brought to the notice of the Divisional Commander.

### MARCH, 1915.

*Preparation for the Attack on Neuve Chapelle. Maps 1 and 2.* On the 4th March, the unit proceeded to Le Vert Lannoy in order to assist the Sappers of the Meerut Division to construct bridges over the Lawe Canal, which were required in the forthcoming attack on Neuve Chapelle. Several bridges were constructed here, and other preparations and reconnaissances carried out. Captain Nosworthy, with his personal knowledge of the ground, was now greatly utilized by the staffs of higher formations, to whom he paid continual secret visits!

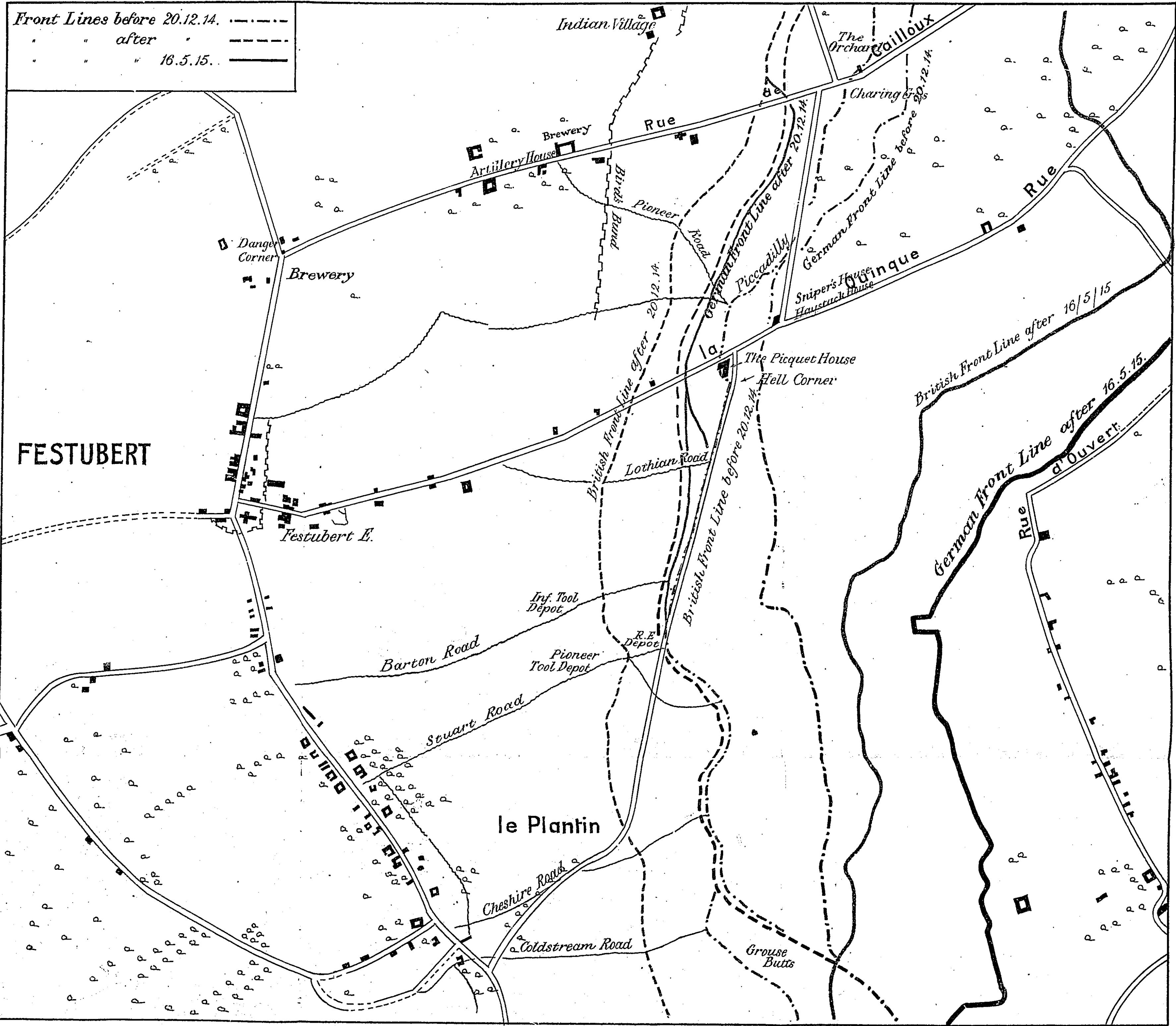
As is well-known, the First Army was about to attack the German line west of Neuve Chapelle and the Aubers ridge. A big advance was confidently expected. Maps and information of the country as far east as Lille were issued to the lowest formations, and a First Army Order of the Day, dated the 9th March, stated that 48 battalions were about to attack a locality held by 3 German battalions, and that at no time during the war had circumstances been so favourable to our arms. This estimate of the strength of the German troops did not, of course, include their reserves.

*Neuve Chapelle.* On the 10th, after a heavy bombardment, the attack was launched. The Meerut Division broke through the defences of Neuve Chapelle and the 4th Corps had a similar success on their left. Parties of the Meerut Division even penetrated the Bois de Biez, but were unable to maintain the ground won. The Lahore Division remained in reserve.

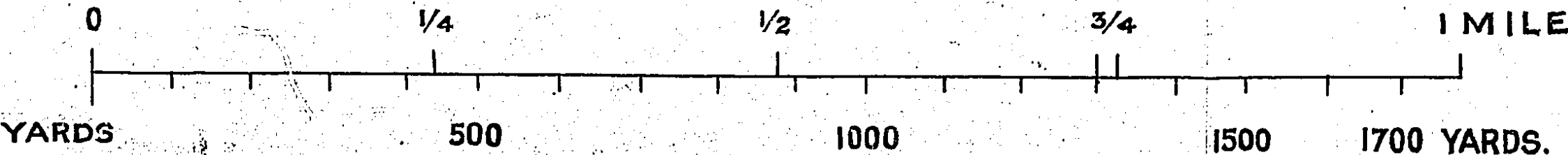
Meanwhile, the 20th Company, having moved on the 9th to billets between Fosse and Le Marais, marched on the 10th into close billets between Vieille Chapelle and Zelobe, leaving the 2nd line transport at Fosse.

FESTUBERT AREA.

MAP. 3.



SCALE.



On the 11th, the Meerut Division and the 4th Corps endeavoured to press forward, but the attempt failed. During the morning the Company moved to Richebourg Saint-Vaast, and the same evening proceeded with the Sirhind Brigade, taking the 1st line engineer equipment, into Neuve Chapelle, where it occupied a small ruined farm. The column came under shrapnel fire on the La Bassée road, and the Company lost three Sappers and one Sapper-driver wounded.

At dawn on the 12th, the enemy opened a heavy bombardment, followed by a strong counter-attack from the Bois de Biez. This attack was beaten back with severe loss. The Company was employed during this attack in carrying ammunition to the front line, and no consolidation work was done. The Sirhind and Jullundur Brigades then received orders to attack the Bois de Biez, but, as the 4th Corps had failed to advance on the left, this attack was countermanded, and the consolidation of our line east of Neuve Chapelle was commenced.

During the course of the day the following casualties occurred :—

4 Indian other ranks killed,

Lieutenant Hamilton, Sergeant Harris and 20 Indian other ranks wounded.

*Consolidation.*—A period of hard work now followed while the Sappers and Miners were engaged in improving the defences of Neuve Chapelle, in wiring, and in constructing shelters and command posts. On the 13th, one I.O.R. was killed and 10 wounded, but after this the Germans became quiescent, and no further casualties occurred. On the 14th, the Company occupied billets at Windy Corner in order to be nearer the work.

On the 15th, 2 Indian officers and 32 Indian other ranks of the Malerkotla Imperial Service Sappers and Miners arrived, and henceforward formed a fifth section, and, on the 20th, Captain M. Rawlence, R.E., joined the Company.

Much useful work was accomplished by officers of the Company, who reconnoitred the ground in front of our position almost every night; and Captain Nosworthy later received the M.C. for the good work which he carried out during this period. It is difficult, without going into too great detail, to give an idea of the hard work necessary night after night during these days. Suffice it to say that the Company was honoured by several letters of thanks, of which the following are examples :—

Extract from a letter addressed to the Officer Commanding Sirhind Brigade :—“ The G.O.C. wishes me to convey to you his appreciation of the good work done by all ranks of the party which reconnoitred the German trench near point B last night and demolished it.”

Extract from a letter from the G.O.C. Lahore Division to Major Sanders, R.E., commanding the Company—"I would, therefore, ask you in the meantime to assure all ranks how much the splendid qualities shown by all have done to uphold the highest traditions of our Army, as well as to gain a very brilliant and appreciable victory for the Allied Arms."

The G.O.C. Indian Army Corps also addressed a letter of thanks to his Chief Engineer for the excellent services of the Sappers and Miners and Pioneers,—". . . since the Army Corps arrived in France, and prior to, during, and since the fighting round Neuve Chapelle."

A curious incident which occurred during this period of consolidation may be mentioned here.

One night Major Sanders and Captain Nosworthy were out reconnoitring in No-man's Land, which was at that particular place about 120 yards wide. They were about 20 yards from the German line when they heard groans, and discovered a German who had been shot through the eye. He must have been there at least three days, as the whole of his face was gangrened. It is difficult to understand why he had not been picked up by the enemy, as he was so close to their trenches. Be that as it may, the two Sapper Officers decided that they would carry him back to the British lines. This was easier said than done, as every time Major Sanders tried to lift him on to Captain Nosworthy's back, the wounded man howled with pain, and hearing his cries the Germans opened fire, which was immediately replied to from our trenches. At length after three attempts the man was brought in.

About three weeks later, Major Sanders and Captain Nosworthy were summoned to Brigade Headquarters, where they were confronted with a civilian, who had been sent by the Geneva Convention authorities to enquire into the circumstances of an "atrocities" which had been vouched for by many Germans. It was alleged that at a particular place and at a particular time a German had been first crucified and then shot by two men of the Indian Corps. Both time and place left no doubt that the above mentioned two officers were the culprits!

They were made to give their statement of the true facts of the case on oath, and a full account appeared later in "The Times;" but it appeared to them that the task of bringing in any further samples of the Teuton was one not lightly to be undertaken.

*Rest.* On the 23rd, the Company left the line, and marched in pouring rain to Vielle Chapelle, and thence, on the 24th, to Le Cornet Malo, where it rested until the 1st April. It then marched back to Bout de Ville, and from there, on the 2nd, to Le Flinque, where a sector of the line north of Neuve Chapelle was taken over.

APRIL, 1915.

*Rue Tilleloy. Map 1. Trench Work.* The first four nights of this period were spent, in conjunction with the 34th Sikh Pioneers, in joining up across the mouth of a re-entrant in our line. The Germans were very active, and greatly impeded the work by close range fire. Sapping had to be resorted to in the most difficult places, but the parapet had to be breast-high on account of the water-logged condition of the ground. The Company received a letter of thanks from the G.O.C. Lahore Division for this work.

Captains Pakenham-Walsh and Nosworthy were evacuated sick with measles on the 6th and 7th April.

Ordinary work of trench improvement, and provision of fire-steps, traverses, and shelters, etc., continued until the 13th April, when the Company went into billets at Bout de Ville. Lieutenant Hamilton rejoined this day. Though this was a period of nominal rest, some work was done at night preparing the La Bassée road for armoured motor-cars,\* and one I.O.R. was wounded. Other work, such as the erection of an observatory in Vieille Chapelle Church, was also undertaken.

During this period Major Sanders handed over command of the Company to Captain A. D. Arbuthnot, R.E.; Captain K. Mason, R.E., joined; and Captain Nosworthy rejoined. Jemadar Ali Bahadur was transferred to the 21st (Fd.) Company, 3rd Sappers and Miners, with the rank of Subadar.

#### 2ND BATTLE OF YPRES. *Maps 4 and 5.*

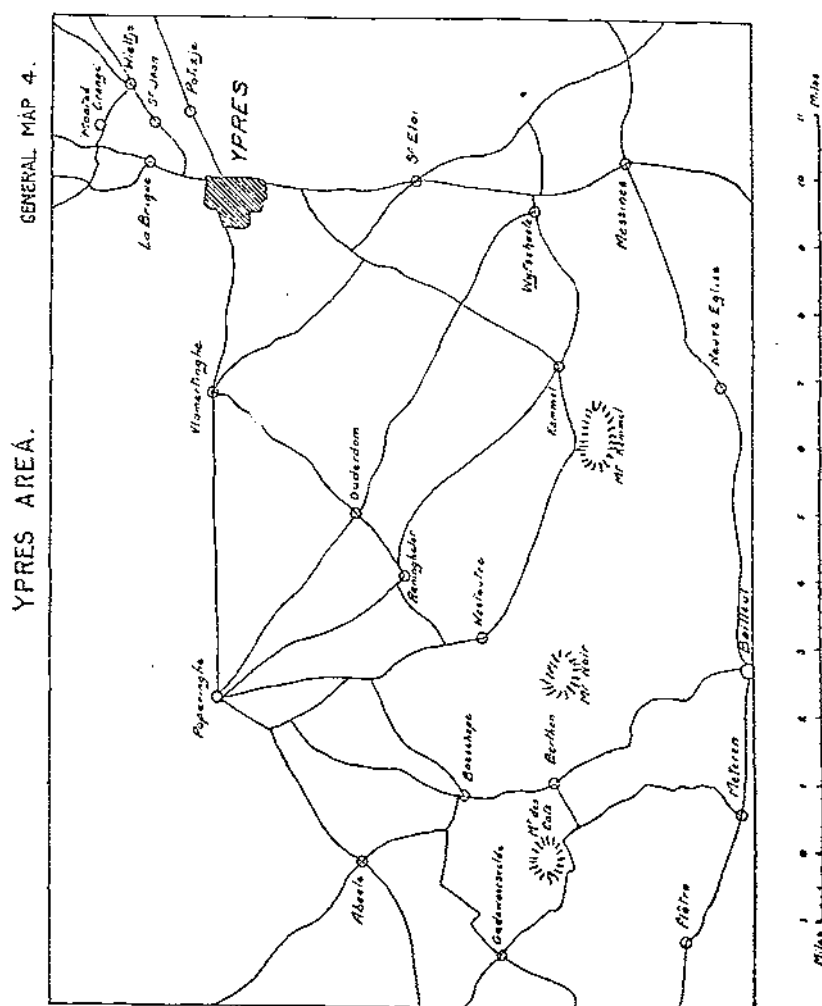
On the 23rd, heavy gun-fire was heard from the direction of Ypres, and on the same day orders were received to take up the pontoons, which were in bridge at Busnes, 15 miles away, and to bring them to Bout de Ville. The Company meanwhile was to hold itself in a state of constant readiness. The pontoons returned under the charge of Sergeant Sprinks, R.E., at 6 a.m. on the 24th.

*The Company marches north.* At 2 p.m. on that day, the Company marched north with the Lahore Division to Mont des Cats. On the march the news was circulated that the Germans had used gas at Ypres, that the Allied line had been breached and that the Canadian troops were in a difficult position. On the 25th, the Company marched to Ouderdom. The roads were bad, and completely blocked in places by wagons, especially by those of a Field Hospital, which had apparently bivouacked on the road. Arriving at 4.0 p.m., the unit billeted for the night in a farm occupied by a disagreeable woman and her three loutish Flemish sons. Orders were then received that next

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\* These cars were commanded by Wilding, the tennis champion. He was killed in action on the La Bassée road on May the 9th.

day the right half-company, with Captain Rawlence and Captain K. Mason, would be attached to the Ferozepore Brigade, and the left half-company, with Captain Nosworthy and Lieutenant Hamilton, to the Sirhind Brigade.



*The Company marches through Ypres.* At 5.55 a.m. on the 26th, orders were received that the Ferozepore Brigade was marching at 5.30 a.m. and the Sirhind Brigade at 7.30 a.m., and arrangements were made accordingly. Captain Arbuthnot proceeded with the pontoon section to a farm 1 mile west of Ypres. The remainder of the company marched at 6.30 a.m.

*Shell Fire.* The long column of the Lahore Division was observed by an enemy aeroplane as it passed through Ypres on the road to

St. Jean, and the rearmost troops, among whom were the 20th and 21st (Fd.) Companies, came under heavy and accurate fire. One shell fell on the roof of a house just above the left half-company as it marched through Ypres, causing several casualties, and almost immediately other shells fell on the cobbled street with even greater effect. After a short period of disorganization the left half-company got through, having sent the wounded to the rear, with a loss of 20 men killed and wounded. An officer's charger and an ammunition mule were also hit. The right half-company, however, was luckier and passed through unscathed. Having emerged from the narrow streets of the town, the right half-company proceeded to the Ferozepore Brigade Headquarters at La Brique, while the left half-company was ordered to report to the Sirhind Brigade at Potizje.

Meanwhile Captain Arbuthnot, having left the 2nd line transport and pontoon section in bivouac, bicycled with three orderlies through Ypres to find the Company and report to Divisional Headquarters. The road was under heavy shell-fire. One orderly was injured by a falling house; and Sapper Hira Singh took him and his bicycle back to a dressing station, returning himself later for his own bicycle.

*Counter-attacks.* At this time the Ferozepore and Jullundur Brigades were making gallant, but unsuccessful, efforts to oust the Germans from the position which they had reached. The counter-attack had to cross open, rolling, grass-land, and came under fire practically as soon as it debouched from St. Jean. When the firing-line had approached close to the German trenches, it was met by a discharge of gas, whiffs of which reached as far back as Potizje, and the attack failed.

However, it had the effect of preventing a further German advance.

*Dug-outs in Potizje.* *Map 5.* That night the left half-company settled down in rough shelter-trenches in the grounds of the Chateau of Potizje, while the right half-company made a defensible post in co-operation with the 34th Sikh Pioneers.

By the end of the day the following casualties had occurred :—  
*Wounded* . . . . . Jemadar Nur Alam, and 1 R.E. driver.  
*Killed and wounded* . . . . . 28 Indian other ranks and 1 follower.

Captain Rawlence was now transferred to the 21st (Fd.) Company to replace casualties.

*Results of Shell-fire.* At this time the buildings in and around Ypres were almost intact. The Cloth Hall had suffered, but otherwise the town and its suburbs were comparatively little damaged. To the west of Ypres the cottages, villas, orchards, and gardens, were strongly reminiscent of any English country town. The Chateau of Potizje, in the grounds of which the Company lay, was



almost intact. The rooms were as their owner had left them, with paintings on the walls and carpets on the floor, and the drawers full of feminine garments disordered in the last search for trifles easy to carry away. During the next week, buildings and churches crumbled before the men's eyes under the converging bombardment from north, east and south, which the enemy maintained by day and by night. The German gunners were using heavier shell than had hitherto been seen by the Indian troops; and one, a 420 mm. howitzer shell, was unmistakeable as it passed overhead, rumbling like a train, to fall either in Ypres or Poperinghe far in the rear. St. Jean, with its conspicuous church, provided an easy target for the German gunners, who soon found the range; and, before the Company left Ypres, both church and village lay in ruins.

*April 27th. Map 5.* On the 27th, another abortive attack was made by the Lahore Division, in conjunction with the French on the left. A party of the Company was held in readiness to assist if required. Though heavily shelled, the party suffered no casualties, but the Headquarters of the Sirhind Brigade, close at hand, had heavy losses. The right half-company meanwhile constructed dug-outs for the Headquarters of the Ferozepore Brigade.

That night the left half-company improved the trenches in the neighbourhood of F.—F., G.—G. The trenches had hitherto been somewhat embryonic, and a certain amount of work was carried out with the object of joining isolated lengths of fire trench, and providing communications. While work was in progress, Captain Nosworthy reconnoitred the line and "No-man's land," and explored the Moated Grange, which lay between the opposing lines. During the 27th, Captain K. Mason and 2 Indian other ranks were wounded.

Meanwhile Captain Arbuthnot had brought up trench stores to a point half-a-mile S.S.E. of La Brique. His party was heavily shelled, and Sergeant Sprinks and the British drivers distinguished themselves by their coolness in unloading the stores under fire.

*Night of 28th-29th: New Line Dug.* On the 28th, Captain Arbuthnot arranged to bring up stores for both Companies, leaving Captain Rawlence, of the 21st (Fd.) Company, and Captain Nosworthy to supervise actual work in the trenches. In default of a field engineer to co-ordinate work, this arrangement was essential. However, Major Boileau, R.E., and Captain Stack, R.E., field engineers, arrived unexpectedly that evening, and work was accordingly arranged for the Sappers and Miners and Pioneers. But at the last minute a weak Canadian Infantry Brigade was lent to the Lahore Division as a digging party, and a more ambitious programme was undertaken. The Canadians were put to work on a new trench.

H.—C.—K. by Captain Nosworthy and Lieutenant Hamilton. The Pioneers dug a communication trench ; while the 20th and 21st (Fd.) Companies worked in the Moated Grange, which was prepared for an all-round defence, wired, and provided with communication trenches to the cellars.

This new line joined the French positions at French Farm with our own, and ran in advance of our old front line for some distance. Lying below the German trenches, which were on rising ground, it was concealed from them to a certain extent by the convexity of the ground. It was heard later that when the enemy renewed their attack, after the Lahore Division had left Ypres, their gas cloud passed over the heads of the British Infantry in the front line trenches, and the attack was beaten off with heavy loss. The position, therefore, was happily chosen.

It was bright moonlight, and the Germans could be seen above against the sky-line, briskly engaged in wiring their position. Being themselves thus busy, they did not hinder the work to any great extent by their fire. Unfortunately, during the course of the night, Captain Nosworthy, who had gone with Lieutenant Hamilton to reconnoitre the French dispositions near French Farm, was shot through the breast by a Canadian of the covering party. It was some time before the man, a very raw recruit, could be convinced that his victim was not a German. A stretcher was not immediately available, and a long time elapsed before Captain Nosworthy could be taken to the rear. Badly wounded as he was, however, on meeting Major Boileau on the way back, he insisted on explaining the position of the French to that officer. Captain Nosworthy, though shot through the heart, eventually recovered, but never rejoined the Company. His loss was deeply felt. This day, in addition, one Sapper was killed and four wounded.

On the 29th, the front line trenches were handed over to the 13th (British) Infantry Brigade, and the Field Companies of the Lahore Division ceased work in the front line.

*April 30th.* On the 30th, the German bombardment continued, and eight more men of the Company were wounded. On the 1st May, the Company moved to trenches half-a-mile north of Potizje to avoid the shelling. It is unfortunate that they did not move before, as Potizje was little else than a death-trap. The ground between St. Jean and our front-line was not so heavily shelled, and a position could have been chosen where dug-outs could have been made concealed from the enemy's observation. The 21st (Fd.) Company occupied dug-outs in this area, and suffered much less, though their mules, which were in Potizje, were decimated.

*May 1st.* On the afternoon of the 1st May, the French made an effort to advance on our left, supported by the artillery of the Lahore Division, but failed to make progress.

*The Company leaves Ypres.* That evening the Company received orders to march to Ouderdom partly along the railway-line and partly by road, passing south-east and south of Ypres, in order to avoid the shelling. Very early on the morning of the 2nd, the Company reached Ouderdom, and went into its former billets there. Owing to casualties among mules, some equipment had to be left in Ypres, but this was recovered on the 2nd by Captain Pakenham-Walsh, who had rejoined the day before.

*Losses.* So ended the Company's experiences of Ypres. In six days it had lost nearly 60 of all ranks,\* all of whom, except Captain Nosworthy, were put out of action by shell-fire. Apart from the line dug on the night of the 28th—29th, little useful work had been done. This, perhaps, was unavoidable, as the French were confident that they could drive the enemy back; and it was not expected that the British position in front of St. Jean would be permanently held. No co-ordinated scheme of consolidation was, therefore, evolved.

These losses undoubtedly hit the Company very hard. Many of the best N.C.O.'s. and Sappers were permanently lost, and after this time a man who had come to France with the Company was almost as rare as he was in 1918.

After this fighting, Sir Horace Smith-Dorrien and Sir Herbert Plumer addressed letters of thanks to the Lahore Division for their work in Ypres.

#### RETURN TO THE NEUVE CHAPELLE SECTOR. *Map I.*

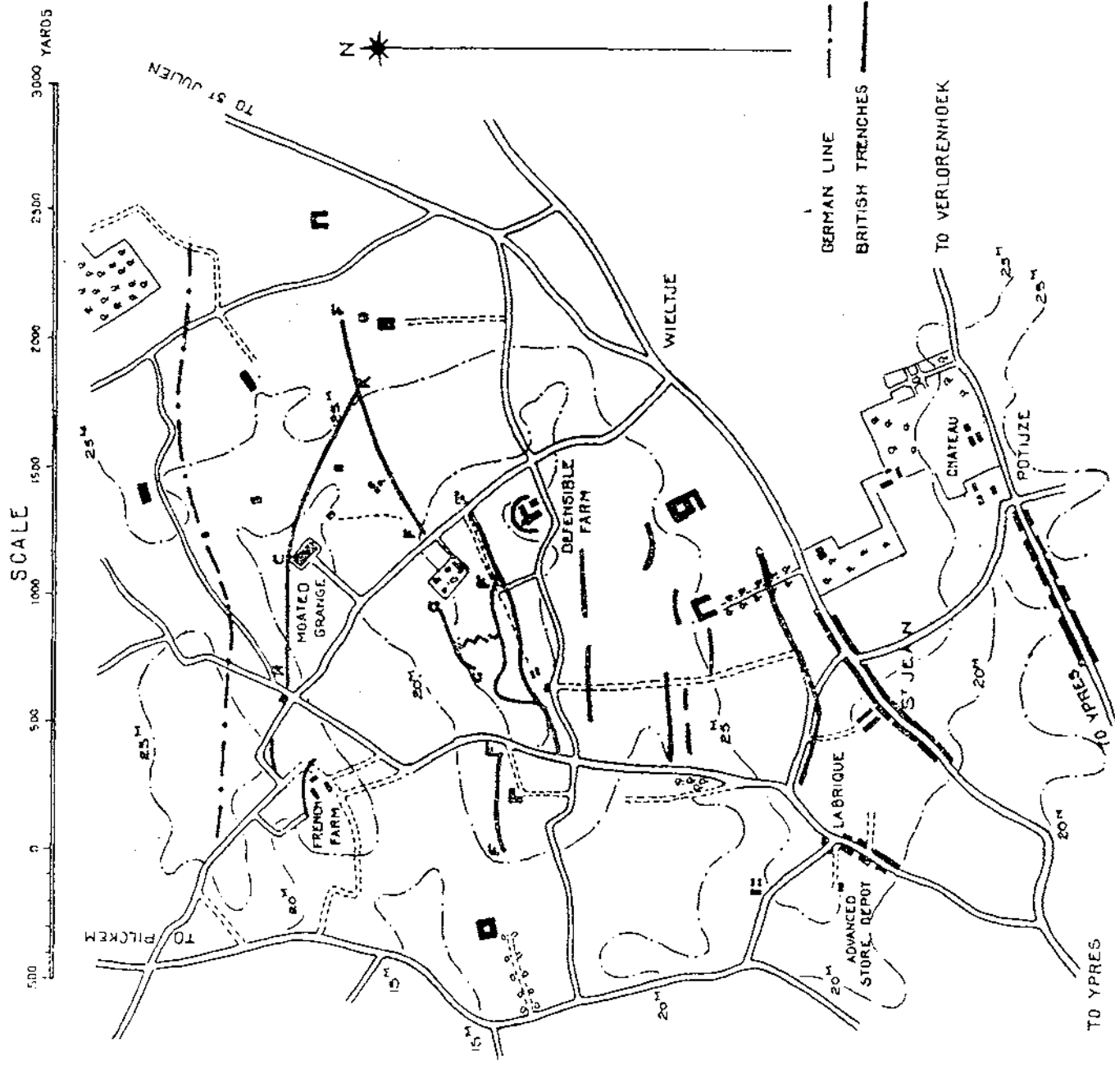
*Trench-work, May, June and July, 1915.* On the 3rd May, the Company marched to Metteren, and on the night of the 4th—5th, to Bout de Ville, where it remained until the 24th July. Lieutenant A. Mason, R.E., and 2nd Lieutenant Venables, I.A.R.O., joined about the 5th May. Captain Pakenham-Walsh had been evacuated sick on the 4th.

On the 9th May, an unsuccessful attack was made on a front extending from a point not far South of Neuve Chapelle to Givenchy, but the Company was not engaged.

During the ensuing period the Company worked hard by day and night on the defences in the Neuve Chapelle and Rue du Bois Sectors. The weather was pleasant, however; the enemy was inoffensive; and casualties were light. The work done need not be mentioned in detail. It is sufficient to note that materials were forthcoming in ever-increasing quantities, and that types of dug-outs, machine-gun emplacements, revetments, etc., were becoming

\* The War Diary, which was written after leaving Ypres, is incomplete as regards records of casualties. Captain Hamilton remembers that Captain Arbuthnot, when making out A.F.B. 213, mentioned that the casualties were nearly 60. Captain Rawlence, whose memory is to be trusted, gives them as 57 or 58, and 31 for the 21st (Fd.) Company.

# POTIJZE AREA - APRIL 1915.



standardised, and provided in bulk by corps workshops. The Sappers were no longer expected to manufacture bombs, nor to do non-technical work for the Infantry, which the latter had now learnt to do for themselves.

Amongst other work, Port Arthur, a ruined and conspicuous brewery or sugar-refinery, on the La Bassée road not far behind the front-line, was fortified as a strong point. It afforded an attractive mark to the German gunners, and the Company was lucky to suffer only a few casualties there.

*Rest at Le Forêt.* From the 24th July to the 2nd August, the Company, less 1 section, went into rest billets at Le Forêt. The detached section, having spent a few days at Berguette, constructing bomb-proof shelters for explosives, rejoined in time to participate in combined sports held by the 20th and 21st (Fd.) Companies. The weather was delightful, and a thoroughly enjoyable time was spent.

#### AUGUST, 1915.

*Trench-Work.*—On the 2nd August, the Company returned to Bout de Ville and its former work in the vicinity of Neuve Chapelle, and remained there until the 26th, when it moved to Lacouture, and started to put the village of Richebourg into a state of defence. This work continued until the 6th September, on which date the Neuve Chapelle sector was again taken over.

#### BATTLE OF LOOS: SEPTEMBER, 1915.

Preparations were now put in hand for the offensive of the 25th September: telephone cables were buried, observation posts constructed, sally-ports mined through our parapets, and an emplacement for a 3-pr. Hotchkiss gun, belonging to an armoured-car detachment, made in the front line trenches. Meanwhile officers reconnoitred, as far as they were able, the German lines, and studied the location of the strong points which would have to be constructed behind the German lines in the event of our attack proving successful.

On the 25th September, the two sections with Lieutenant Hamilton and Lieutenant Venables, were placed under the orders of the C.R.E. Meerut Division, and remained in trenches to the rear of the Rue Tilleloy. They were not required, however, as the Meerut Division, having broken through the German trenches under cover of a heavy bombardment, and the surprise effect of a mine, were driven back into our lines by a counter-attack from one or both flanks. The day ended in depression and pouring rain; and the two sections marched back to billets. The remainder of the Company had meanwhile stood in reserve at Pont Logy behind the Lahore Division, which was not used in the attack.

## OCTOBER, 1915.

*Smoke-Cloud.*—Work now continued as before.

On the 13th October, the Company co-operated with the Lahore Division in a feint attack, designed to assist the efforts of our troops at Loos. Thirty-two boxes, each containing 5 pounds of red phosphorus, were carried down to the trenches and placed in sap-heads. Disaster was nearly caused on the way when one box caught fire and was with difficulty extinguished. At zero hour the phosphorus was lit, and our guns opened a heavy bombardment. The Germans were very alarmed, evidently suspecting a gas attack, and put down a dense barrage, which did not cease until some time after the thick clouds of smoke had cleared away. This was in many ways quite an effective operation, but the losses among the Infantry, who held the front-line trenches in force throughout, were somewhat heavy. Two Sappers were wounded.

The Company had, on the 3rd October, moved to Riez Bailleul, where a peculiar occurrence took place. The company interpreter, a Frenchman named Carron de La Carrière, occupied a room in a billet by himself, and awoke one morning to find his wallet opened, and his identity papers abstracted. Four hundred francs in notes, which were also in the wallet, were untouched. Enquiries were instituted, and a succession of Intelligence officers, both British and French, visited the unit without apparent result. There is no doubt that at this time there were many spies behind our lines, and some French inhabitants were not above suspicion.

*Wet weather sets in.* The weather now became wet and cold, and the Indian troops looked forward without any great enthusiasm to another winter in the mud. The sub-soil water-level again began to rise, and raised trench-boards were, therefore, put down, and the drainage of the trenches taken in hand. In some places high-level communication trenches with revetted parapets were constructed to replace the low level ones which had done duty during the summer.

## NOVEMBER, 1915.

*The Lahore Division leaves the line.* As October drew to a close, the rain became more frequent and heavier; and it cannot be denied that all ranks were greatly relieved when they marched, on the 28th November, to Mametz and said "good-bye" to Neuve Chapelle for the last time.

The two Companies of the 3rd Sappers and Miners prided themselves somewhat on their work in and around Neuve Chapelle, and accordingly a notice was erected in the advanced R.E. Dump, drawing attention to *Ecclesiastes* II, 18 and 19, which accurately portrayed their sentiments.

On the 25th November, representatives of the Indian corps paraded, and were given the farewell message of His Majesty the King Emperor by H.R.H. the Prince of Wales, an honour which was much appreciated.

#### DECEMBER, 1915.

*The Company Embarks for Mesopotamia.* On the 1st December, the Company marched to Honenghem, where it was drilled and trained, and on the 13th, less the transport under Lieutenant Hamilton, it entrained at Berguette for Marseilles. At the latter place it embarked for Mesopotamia on the S.S. "Franconia." As will be seen, the transport did not rejoin the Company until many months later. This failure to send transport with the unit to which it belonged greatly handicapped the Company in its work in Mesopotamia.

The pontoons were left behind in France, but the R.E. drivers and their animals accompanied the remainder of the transport to Basrah, where they were attached to a bridging train. These drivers were a fine lot of men, and got on well with the Indians. Corporal Clark, however, an invaluable N.C.O. and excellent horse-master, was retained by some means or other. "Nabi" Sahib, as he was called by the men, did not leave the Company until after the Armistice, as has already been mentioned.

#### RESUMÉ.

Thus ended the Company's period of service in France, during which time 200% of officers and nearly 100% of men became casualties. In a strange country, and under conditions of which they had never dreamt in India, the men did their duty to the utmost of their powers. They left knowing that they had not tarnished the honour of the Third Sappers, and they hoped they had brightened it. Let their work be their witness, and the graves of their dead be not forgotten.

*(To be continued.)*

*"SHELL-FIRE VERSUS PERMANENT FORTIFICATION."*

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THE EVIDENCE OF VERDUN, 1916.

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By LIEUTENANT H. B. HARRISON, R.E.

Verdun, the old Virodunum of the Gauls, built on a spur overlooking the course of the Meuse for a distance of twelve miles, has been from earliest times essentially a military town, and, being an important link in the chain of French frontier communications, has undergone frequent sieges.

In 1870 the only defences the town could oppose to the Prussians consisted of the old fortifications of Vauban, but the re-organization of the French Eastern frontier after 1870 resulted in Verdun becoming the northern pivot of the great defensive line Toul—Verdun, and in order to enable the town to carry out its rôle a series of fortified positions was constructed from 1874 onwards, stretching further and further afield as the range of artillery increased.

Between 1874 and 1880 a ring of detached forts was built, the forts being at distances of from  $1\frac{1}{2}$  to 4 miles from the town. Those on the right bank of the Meuse being Belleville, St. Michel, Souville, Tavannes and Belrupt, and those on the left bank Dugny, Regret, La Chaume and Marre.

After 1880 this initial defensive system was completed by the construction of a number of new works built on dominating positions varying from 3 to 5 miles from the town. On the right bank were built Douaumont, Vaux, Moulainville, Rosellier and d'Haudainville, and on the left bank Landrecourt, Sentelles, Chana, Choisil and Bois Bourrus.

The protection of all these forts as originally built consisted solely of plain masonry covered with a thick layer of earth, but on the introduction of the high-explosive shell the earth, covering the masonry, was replaced by a layer of cement concrete about 8 feet thick with a cushion of three feet of sand between the concrete and the masonry. The process of this replacement was begun in 1885, and by 1897 the majority of the forts had been thus strengthened, while in addition the intervals between the forts were supplied with batteries in open emplacements and with fieldworks, of which several such as Froideterre, Thiaumont, La Laufée and Charny, were later converted into permanent works and considerably reinforced.



In 1900, owing to the increasing power of artillery, the forts were further strengthened and, from now on, reinforced concrete was the material used, the walls and roofs of the casemates being given thicknesses varying between 4 and 5 feet.

In 1905, work was begun on installing disappearing gun turrets, armoured observation posts and Bourges casemates.

The forts, then, in 1914 can be classified into three distinct categories :—

- (a) Those built before 1885 and not subsequently modernized, consisting of blocks of masonry 3 to 4 feet thick covered with a layer of 6 to 15 feet of earth.
- (b) Those built before 1885, and subsequently modernized, consisting of the masonry as before, strengthened with up to 8 feet of concrete with an intermediary layer of 3 feet of sand.
- (c) Those protected with reinforced concrete 4 to 5 feet thick.

When studying the effects of enemy shell fire on the forts we will consider the above three categories separately.

The total armament of the forts, in August, 1914, consisted of the following :—

- 6 disappearing turrets for 155mm. guns for long range fire.
- 14 disappearing turrets for 75mm. guns for close range fire.
- 23 Bourges casemates for covering the intervals between the forts.
- 210 machine guns for use either in the forts or in the intervals.
- 670 guns divided into 130 batteries, placed outside the forts for long range and counter-battery work.
- 68 steel or concrete observation posts.

The ammunition, 800 rounds per gun, was stored in 8 magazines cut out of the rock and linked up with distribution dumps and gun emplacements by a 60 cm. Décauville light railway.

Finally, in the intervals between the forts of the outer ring, were constructed 16 concrete shelters, each to hold one company of infantry and 18, each to hold half a company.

Such, then, at the outbreak of the war was the permanent defensive organisation of Verdun, a fortress to be defended to the last and with the following three-fold rôle to play :—

- (1) To hold the lines of approach along the Meuse and to cover, in part, the concentration of the field forces.
- (2) To assist any offensive movement of the French troops in the Woëvre and to assure their communications.
- (3) To facilitate their retreat in case of defeat, to draw off a portion of the enemy forces, and to harass his communications.

#### THE GREAT TEST.

The early days of the Great War witnessed a complete change of opinion as to the value of permanent fortification.

By an Army order of 9th August, 1915,\* the forts of Verdun were stripped of guns, ammunition and war material, the whole of which was handed over to the field forces, the order stating that the forts were in future only to be used as shelters for reserve troops. An annexure gave the following reasons for this decision :—

- (1) Before the powerful destructive effect of modern artillery permanent defences will inevitably be destroyed. Proof of this has been given by Liège, Namur, Antwerp, Maubeuge, and by the rapid fall of the great entrenched camps in Russia after the retreat of the field armies.
- (2) The violence and length of bombardments essential both in attack and defence entail an enormous expenditure of ammunition, the continuous supply of which to an invested fortress is practically impossible.
- (3) An invested fortress must then eventually surrender to the enemy its garrison and its supplies not expended or destroyed.
- (4) Under these conditions the defence of a country depends solely on the field armies.

It is accordingly only logical to hand over to these armies the resources that would inevitably be lost in the fortresses.

As a result of this order the organisation of fortresses was changed. Whereas, before, they had had their own commanders and had been partially independent of the Commander-in-Chief, they were now placed directly under the latter's control and were to be made use of by him as the military situation demanded. Their permanent works were absorbed into the successive lines of field defences, and the rings of forts were no longer considered circles of defence round one central position. Henceforth in no case was a fortress to be defended to the last solely for its own sake.

In short, it appeared that the gun had at last gained a definite ascendancy over permanent fortification.

When, then, the German attack on 21st February, 1916, was launched, we find all the forts empty save for demolition parties ready to prevent the works falling intact into enemy hands.

This state of affairs lasted exactly five days.

On 26th February the Germans entered Fort Douaumont without opposition.†

The same day General Pétain took over command of the Verdun

\* By Government decree of 5th August 1915, the French fortresses were declassified as such. Their Commandants hitherto responsible direct to the Government were, with the garrisons, assimilated to the field troops and placed under the C. in C. in the field.

† Orders had been given for the re-occupation of Fort Douaumont. But instead of getting them out promptly, the staff concerned waited whilst a draughtsman copied a sketch to be attached to the orders. Meantime an adventurous party of Brandenburg Grenadiers under a Lieutenant, who had been ordered to advance as far as the wire of the fort, seeing it apparently empty, entered it unopposed.

district and he at once gave orders for the complete re-arming of all the forts. His own summing up of the situation is as follows :

" Les forts et ouvrages de l'ancienne place de Verdun, en raison de la valeur de l'obstacle qu'ils présentent, des observatoires et des abris qu'ils fournissent, ont une importance considérable au point de vue de la défense des secteurs. La défense de ces forts et ouvrages doit être organisée par les généraux commandant de groupement, de sorte que, même investis, ils puissent continuer à résister. L'expérience des derniers combats a permis d'apprécier la capacité de résistance des forts. Ceux-ci sont en effet mieux organisés que les points d'appui créés hâtivement sur le champ de bataille (emplacement et tracé étudiés à loisir, flanquements soigneusement organisés, abris très profonds et bétonnés, etc. . . ) et ne constituent, pas plus que les localités, des 'nids à projectiles,' puisque leur superficie est souvent égale à ces dernières. Les forts donc peuvent et doivent être utilisés partout pour la défense des secteurs."

In short, the considerations that led to the framing of the order of 9th August, 1915, were now shewn to be entirely ill-founded, and the re-armed forts re-assumed their original role.

For the purposes of studying the part played by the forts and the effect on them of the enemy fire, it will be sufficient to study the right bank only of the Meuse, as it was on this sector that the main German blow fell.

At the beginning of the enemy offensive in February, 1916, the front line formed a semi-circle to the north of Verdun of radius about 10 miles. Behind this front line on the right bank of the Meuse the French had four main lines of defence :—

- (1) From Samogneux to Bezonvaux by way of the Bois des Fosses and the Bois la Chaume.
- (2) Côte du Talou, Côte du Poivre, Louvemont, Douaumont, Vaux, Damloup.
- (3) Côte de Froideterre, Ouvrage de Thiaumont, Fleury, Souville, Tavannes.
- (4) The ridge held by the forts Belleville and St. Michel.

The following summarises the chief stages in the battle of Verdun in which the forts played a definite role :—

- |                |  |
|----------------|--|
| 21st February. | Beginning of German attack.  |
| 26th February. | Fall of Douaumont.   |
| 22nd May.      | Abortive counter-attack against Douaumont. The French held the superstructure of the fort for two days while the enemy held out underground. |
| 7th June.      | Fall of fort Vaux owing to the garrison running short of water. The enemy had been in possession of the superstructure for 5 days.           |

23rd June. German attack on Froideterre, Fleury, and Souville. The enemy occupied the ruins of Thiaumont but was held up in front of Froideterre by the fire of the 75mm. guns from this latter work. Fall of Fleury.

12th July. German attack on Souville. Unaided, the garrison repulsed the assault several hours before the arrival of reinforcements.

On 1st July the Franco-British offensive on the Somme was launched and from that moment the German attacks became weaker and weaker and finally died away altogether.

24th October. Recapture of Douaumont.

3rd November. Recapture of Vaux.

During the whole of the German offensive the forts, constructed with a view to resisting artillery only up to 270 mm., were subjected, by guns of all calibres up to 420 mm., to a bombardment that surpassed in intensity anything that had been previously imagined.

In reply to the German fire the French fired between February and August, 1916, an average of 100,000 shells per day or a total of approximately 23 million shells in the seven months.

This gives one an indication of the storm of projectiles to which the forts were subjected, and which, nevertheless, they weathered in a remarkable fashion.

#### THE EFFECTS OF SHELL-FIRE ON THE FORTS.

Visiting Douaumont and Vaux, the two forts that suffered the most severely, one expects to find them completely demolished in view of the utter destruction of everything in the vicinity. On entering them, however, it is surprising to find the extent to which the concrete has held.

The effects of the bombardment on the forts on the right bank of the Meuse can be summarised as follows :—

(1) The effect on Casemates and Shelters.

category (a) Those consisting of blocks of masonry 3 to 4 feet thick covered with 6 to 15 feet of earth.

These have collapsed under shells of 210 mm. calibre or over.

category (b) Masonry strengthened with up to 8 feet of concrete with a 3 feet layer of sand in between.

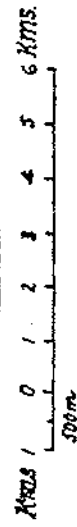
These have held; but in several places where the concrete is less than 6 feet thick they have collapsed under shells of 420 mm. calibre.

category (c) Those protected with reinforced concrete 4 to 5 feet thick.

## VERDUN.

*Plan shewing the permanent works existing at the outbreak of the War.*

### Scale.



*The wooded area on the right bank of the river covers the hilly district known as "Les Hauts-de-Meuse" and is a mass of ravines.*

*The configuration is such that at no period during the attack on Verdun did the German infantry get as much as a glimpse of the town itself.*



Anything less than 380 mm. calibre produced no effect. The 380 mm. shell had more effect on this category than on (b). Under projectiles of 420 mm. calibre they collapsed where the reinforced concrete was less than 5 feet.

It would appear that category (b) owes its superior resisting power in the case of the 380 mm. shell to the layer of sand which acts as a cushion damping down the vibrations set up by the explosions.

The weakness of the reinforced concrete seems to lie in the fact that when a heavy shell explodes the concrete and the reinforcement vibrate with different intensities, thus tending to separate the two.

(2) Effect on Armour Plate.

The machine gun turrets were only constructed to withstand shells up to 150 mm. These they have resisted, but anything bigger destroyed them.

The turrets for the 75 and 155 mm. guns generally resisted well, shells as a rule ricocheting off them.

At Douaumont a shell of 380 mm. calibre fell directly on a 155 mm. turret without causing the gun to cease fire.

The turrets in the forts during the battle of Verdun fired altogether about 8,000 rounds of 155 mm. calibre and 17,000 rounds of 75 mm. calibre. In general they reserved their fire for critical phases in the battle.

(3) Effect on Earthworks and Obstacles.

Under a medium bombardment, including shells up to 380 mm. calibre, earthworks and obstacles were seriously damaged though not rendered absolutely useless.

Under a violent bombardment, including shells up to 420 mm. calibre, they ceased to exist.

The condition of Fort Douaumont as the French found it after its recapture on 24th October, 1916, is very interesting. Out of the 18 casemates in the fort, 13 were still in good order: the 75 mm. and 155 mm. gun turrets were practically undamaged and were rapidly brought into action again: and this although 120,000 shells had fallen on the fort since the beginning of the German offensive, 3,700 of which were of 155 mm. or over and 400 of 370 mm. or 420 mm. calibre.

### CONCLUSION.

Such was the rôle played by Verdun. Whereas in the early days of the war the Belgian fortresses had failed to fulfil their rôle chiefly owing to lack of liaison with the field armies and to faulty construction in their defences, Verdun on the other hand, with more strongly constructed forts and with the intervals between the forts elaborately organised, proved what a valuable asset to the field armies permanent fortification can be.

The chief lesson to be learnt is that a fortress of the type in use before and during the war is doomed once it is cut off from the field forces and completely invested : a permanent work by itself cannot stand.

The pre-war theory that a frontier could be defended by a line of isolated fortresses is no longer tenable, and it must be replaced by a system of fortified areas, inter-connected and stretching the whole length of the frontier, taking advantage of all natural obstacles such as mountains and rivers and the sea.

In short, the permanent fortification of the future will be but the deliberate application of the principles of field defences as established during the Great War.

As it is unlikely, chiefly owing to financial reasons, that a complete defensive system could be prepared along any frontier during peace time, it would appear that the defensive organization of a frontier must be divided into three categories.

- (1) A detailed plan of defence completely worked out on paper.
- (2) The preparation and execution during peace time of elaborate defensive works on essential positions along the frontier.
- (3) The preparation for the execution of the remaining works on the mobilization of the army. This would include—
  - (a) Construction of railways to the points to be defended.
  - (b) Collection of essential materials in dumps ready to hand.
  - (c) A completely worked-out programme for mobilizing the factories and workers needed for carrying out the works as rapidly as possible.

In conclusion, the change in permanent fortification as a result of the Great War only follows the natural evolution of fortification through the different periods of history.

As the organization of the intervals was the logical sequel to the system of detached forts, so the organization of the intervals is the logical sequel to the system of detached fortresses.

## THE LAST DAYS OF THE IRISH COMMAND.

SOME PERSONAL REMINISCENCES DURING 1921-22.

By Major-General G. WALKER, C.B., C.B.E., D.S.O.

In what follows no mention will be found of politics, nor of the many theories propounded by divers experts on the subject of Irish Government. My object in writing is only to record some personal experiences, which will give some idea of what British Army life was like during the rather unpleasant time it put in, in Southern Ireland, immediately prior to the creation of the Irish Free State.

In the autumn of 1920, just after I had witnessed the public funeral in London of the victims of the 21st November murders in Dublin, I received a message from a female relation in Ireland telling me that I was going over there. I was at the time C.E. of the London District, had just been promoted substantive Colonel, and had also been told that I was confirmed in my appointment, which had previously been called "temporary" in the official jargon of the Army List. I was consequently looking forward to getting a settled home in London after wandering about the earth since 1914.

The information came as a very distinct shock, and, do what I could, I could not find out if it was authentic. The people in Ireland said "every one knew it," and yet I had been told nothing officially. I did not want to ask either, as I did not want to do anything likely to put such a move into the heads of the powers that settle such matters.

I did not want to go a bit, as I was what is called an Irishman, and nearly all my relations lived over there. I tell all this to show how secret things get abroad apparently. The rumour was true enough, as in due course I got the letter asking me if it would be agreeable to me to go to Dublin as C.E.? I promptly said it was not in the least agreeable, and gave many, as I thought, good and sufficient reasons why it would be much better to send someone else. However, I said I could not refuse if "They" particularly wanted me, and "They," having satisfied themselves that I was not a politically marked man in Ireland, sent me over.

I immediately received all sorts of complicated orders as to how I was to disguise my errand (not my person). I was not to have a warrant but buy a ticket; I was to carry a "gun," but on no account was it to be in my luggage, etc. My first trouble was how to acquire a gun and get a permit to carry it into Ireland. This



latter was necessary, as, if the British Customs people at Holyhead found it on me, I being in plain clothes, there was trouble in store.

I made many efforts to get this permit. W.O. absolutely declined to give it for some time, and it was only when it was pointed out to them that their orders could not be obeyed without it, that they relented. Their first plea was that Irish Authorities should issue it, and it was only after a rather heated telephone conversation between myself and a youthful Staff Officer, in A.G. something or other, that I won my battle. So much for secrecy—every telephone lady in London knew I was going to Ireland and that I wanted to take a “gun.” I often laughed over this incident later, but it annoyed me at the time.

I started on 18th February, 1921, by the Irish Mail, all my luggage being labelled with my name alone, no rank. Some people said I ought to have had an alias! On my arrival at Kingstown, on the morning of 19th, I found things looking pretty ordinary, except for the sentry on the end of the pier. My luggage was tackled by a frowsy porter much as usual, and poor old Davey was there with his armful of papers. A car had been sent to fetch me, and it was only after we had started in this for Dublin that I began to realise that the rebellion was really a going concern. The chauffeur was in plain clothes, but the appearance of the car (a Sunbeam) left no doubts as to its ownership. My Jehu was a Jehu indeed, and drove like the devil, putting the heart across me, to use a local phrase, properly. I made sure we should kill someone *en route*. All the military drivers I found drove like this, and I can remember telling one of them later on that I preferred taking my chance of being shot by a “Shinner” to making a certainty of death by driving at his pace. He seemed rather crestfallen but after that I had no trouble with the drivers. Our drive of eight miles ended without incident, and we arrived safely at Ross's Hotel, where I was to live.

I got down and rang the bell, and the door was first opened on the chain by an armed soldier, who inspected me before he admitted me. On getting inside I found another soldier in the hall, with his loaded rifle and bayonet at the “charge” waiting for me. A nice welcome truly, but it was the ordinary routine which was gone through whenever any of us either left or entered the house.

Ross's Hotel stood just at the end of Kingsbridge, and was opposite the Railway Station of that name. It has been abused by some people, but I must say that nowhere have I found people so anxious to make one comfortable, and, under the adverse circumstances, we were all very happy there. The hotel was about  $\frac{1}{4}$ -mile from the office, and this distance we had to walk every day, the road being patrolled by an armoured car the while. The hotel was much defended with barbed wire, and we also sported a sentry and, I believe, a machine gun on the roof. Our outlook in front was

open enough, but at the rear we were overlooked and shut in by a host of small squalid houses, and if we had been attacked in that quarter we should have had a warmish time. Why we were not attacked I don't know. I expect the reason was that the rebels knew we were ready for them, and a "Shinner" seldom dared to tackle anyone who was prepared.

We had all sorts of mobilization orders and alarm posts. One of the orders was that, if alarmed at night, everyone was to don a "Coat British Warm." The idea being that this garment was more identifiable than parti-coloured silk pyjamas. I remember being much entertained one night at the appearance, on a false alarm, of a very senior Colonel dressed in this garb, with his hair on end and his eyes half open (he had been rudely awakened), and a large revolver in his hand. He had gone to bed early, and I, with three other irreclaimables, was playing bridge; somebody had started firing out in the street, probably at nothing, and our sentry on the roof was not to be deterred from his share in the sport. Nothing came of it, and so to bed about 1 a.m.

I am not sure that the cause of this adventure was not the gallant press officer at G.H.Q. I know that one night he was returning from the Kingstown Yacht Club in his Ford car and failed to hear the challenge of a sentry near our hotel (the car was not of the silent order). The sentry opened fire at once, such were their habits, and the guard turned out and did likewise. I know the press officer told me that as he fled up the road to his quarters in the "Rat Pit" (Soldiers' Home) he was followed by a cloud of fortunately erratic bullets. The Rat Pit was the abode of the more junior officers on the H.Q. Staff. It was the Soldiers' Home of more peaceful times, and as such was an admirably arranged institution. As officers' quarters it left much to be desired, as the bedrooms were mere cubicles; some of them were made to hold two officers. It may have been uncomfortable, but its denizens were a distinctly cheerful lot, to judge from their general demeanour.

Our life at Ross's was dullish. We worked from 10 a.m. to 5 p.m. with an interval for lunch, and then time hung pretty heavy on our hands. Bridge was my amusement after dinner, and we had a cheerful party enough. The bridge playing was diverted occasionally by scares such as I have alluded to above, and sometimes by comic interludes. I remember two of these in particular. The first was when our roof sentry suddenly fired a shot which was immediately followed by a female scream. This brought us to our feet quick enough. Another shot and a volley of bad language, followed by the expression "I won't be Curfewed," in a shrill female voice. I may here mention that to be "Curfewed" meant to be taken up by a patrol, if you were out without a pass after the "Curfew" hour. It meant a night in "quod" and a fine of 2/6 next morning.

I am told; I had no personal experience. To continue, the sentry shouted "Come here, my dear," and the lady replied "I will *not* be Curfewed"; another shot, and so on until she was brought to the hotel door, when she was taken over by the guard and ultimately put into the Curfew lorry, which called about 11 p.m. This Curfew lorry furnished the other incident. One night we were at bridge, it arrived and we were disturbed by roars of laughter. On going to the window we were just in time to see a rather inebriated lady being shot into the lorry protesting vociferously. As soon as she was safely in, however, she seated herself beside the sentry inside, and him she proceeded to embrace affectionately, much to his annoyance and the merriment of the spectators.

Before I leave "Ross's" I must say a word about some defences I put up. When I arrived we used to play bridge in a bow window facing the street. There were no shutters, and if the blinds were not drawn we played in full view of the street. Even if the blinds were down the lighted window made what, to me, would have been a very tempting target. After some difficulty I got hold of some old boiler plates, which were about 2ft. wide, and we put them up across the windows. After that we sat in comparative safety, as any shot from the street which missed the top of the plates must miss the occupants of the room.

I have said life was dull, but we had some compensations; the first was travelling, of which more anon. The others were the Kildare Street Club with its squash court, and the St. George's Yacht Club at Kingstown. I think the Kildare Street Club saved my life. We used to go down by tram after office and play squash until dinner time, then a bath, then dinner, and sometimes we walked and sometimes taxied home. We went in plain clothes and were all armed. When we were playing squash we usually made up a party of four. Two to play and two to keep guard in the Gallery. The players' "guns" reposed in the corner of the court against the back wall; the spectators' guns were in their pockets. Similarly at the bath, one always had an armed companion in the dressing room and your own gun in the bath room. The trouble was that one never knew who could be trusted. There were, I know, many faithful men in the country, but one could not tell them by head mark, and unfortunate accidents had occurred owing to people being too trustful. I think our taxi drives home were safe enough, but I am not so sure of our walks. However, nothing ever happened. True, we were armed and never walked alone, but still, if they had wanted they could have got us everywhere. A "gun" is no use as a protection to oneself against an assassin; it only helps in case you see a friend being attacked. We were, I dare say, foolish, but we enjoyed it, and I should have gone dotty if I had had no amusement. I am afraid I went anywhere I liked, in trams and cars

by myself, in plain clothes, with a gun in my right pocket, and I never had any ill-luck. I never could make it out, as I am sure I was known, in fact, I had evidence of this. For one thing, when my wife came over after the truce in July, '21, she was greeted by a tram conductor at Kingsbridge with "Welcome home, Ma'am, I hope you're well!" However, there it is; we did escape, and a miss is as good as a mile.

I think the Kildare Street Club was in those days the most comfortable club I have ever been in, and pretty cheerful too. The St. George's Yacht Club was a summer resort, which we began to frequent as the spring progressed. There, too, we were never molested, though we went regularly, and dined there sometimes. I know it was a rush to get dinner and get back before Curfew. Talking of the Yacht Club, I remember going out there to dine one night, after the truce, with Hugh Waller, my Staff Officer. We went by train and at a wayside station a man got in and stumbled over my feet. I did not look up from my paper at first, but I caught sight of Waller's face and noticed that it had turned rather pink! I then looked at the newcomer, who had seated himself beside me, and found that it was de Valera! The other people in the carriage looked as if an archangel had come among them. I am afraid my feelings were not quite the same. Dancing was another of the amusements, and dance festivals used to take place at intervals in St. Patrick's Hall in the Castle, in the afternoon.

I must now turn to the business side of the picture. The C.E.'s office was in the G.H.Q. buildings, and the staff I took over was extraordinarily well organised and efficient. There was any amount of money; in fact, more than could be reasonably spent, and we did not spend it all. The great trouble was the difficulty in getting about the country to see the C.R.E.'s. and works. Dublin was easy enough and so was the Curragh. I used to go about to these places in plain clothes by myself—the fewer the better I always thought. Ulster was easy too, though the train journey to Belfast was a trifle risky. At one time, in order to get to Belfast, I had to go via Holyhead and Liverpool, and thence by the direct sea route, a pretty costly business for the taxpayer! The West of Ireland was impossible without an escort. Cork had to be approached by sea. The usual way was to go by the destroyer that carried the military mail from Dublin to Queenstown, and thence by an armed launch to Cork city.

On arrival there, one was met by two armed motors, one for oneself and one for an escort, and this for a journey of a mile! Bere Haven, in Bantry Bay, was another place where a destroyer trip was necessary, though at first I believe they could go by train to Bantry.

To show the difficulty of getting about the interior of the Divisional

Areas, I may mention a journey I made from Cork to Fermoy in the 6th Division Area, a distance of 22 miles. Something was worrying me at Fermoy and I said I must go. When I got to Cork I was told it was really not necessary for me to go, as Fermoy was quite happy. The trouble was that though Fermoy might be happy about itself, I was not happy about Fermoy. So I had, respectfully, to insist. To make a long story short, I started at 9.30 a.m. inside a Rolls armoured car. Another similar car followed me with the C.R.E. 6th Division, and we were attended by a Crossley lorry containing 14 armed men! This for a joy-ride for two R.E. officers. We got there all right, except for a puncture on one of the Rolls. The outfit had to halt until this was repaired, and then I saw the object of the armed men. They picqueted the hills around. I sat on a bank and smoked.

As all the main road bridges were down we had to make a bit of a detour, and came across one double cut in the road. The cuts were about 3 feet wide and 3 or 4 feet apart. The Rolls negotiated the obstacle by following the track of the country carts down into the ditch beside the road and up again. I was much interested to see the facility with which this big car got over the difficulty. Our return journey was more dramatic. The Brigadier at Fermoy sent a 'plane to watch over us, as he said it was dangerous to return by the same route, and there was no other route open. This drew the audience properly, and I don't think there was a man, woman or child within running distance of the road that did not come out to see the procession. It's all very funny to look back on, but, with such precautions being considered necessary, it became a serious matter to offer an inspectional visit. The troops had quite enough to do without perambulating C.E.'s about the country. In fact, I found it impossible to try to see things in the bad places, and it was a useful lesson to learn that other people could get on without one's personal presence. One could only write and advise and encourage the C.R.E.'s to write their whole mind fully.

The money presented no real difficulty, as we decentralized thoroughly. We allotted the money to Divisional commanders, with authority to sub-allot to Brigade commanders. Each had a limited sum per item. The Divisional limit was £500, the Brigade £250. As long as they did not outrun the constable and stuck to these rules, they could go ahead. I was told by a high official in London that by this method I should bring ruin on the taxpayer, that my predecessor had been expensive, but words would not describe my character as a spendthrift if I pursued this policy. I said nothing, but I know I sent him back a handsome present in the way of a refund at Christmas, and I had a lapse in April. In other words, it worked extremely well when the G.O.C.'s understood it. I was asked by one Divisional commander why he had been allotted

so many thousand pounds. I asked him if he did not take an interest in the housing of his troops? He looked as if he wanted to bite me and said "Yes." I then explained that the money was given in order that he might put his desires into execution. Then he was all over it, though he said he would give his brigadiers no power, as he would rather have control of the money himself! That G.O.C. saved us thousands, and incidentally was quite happy and saved me a lot of what would have been quite futile worry. I can recommend this method of finance to anyone. In fact, it is based upon the principle that, if you want men to do their best for you, you must confide in them.

Talking of finance, I attended a conference in London once just before the Truce in July, 1921. The subject on which we were conferring was ways and means to carry out the engineer services of the campaign. Money was not the difficulty, as there was always plenty of that, but the people in England seemed to feel that we could not be trusted further than the peace regulations allowed. These regulations hampered us and made life very difficult. I was trying to get enhanced powers of making contracts for C.R.E.'s who were very isolated and who found that it was almost impossible to carry on under the rules. I persuaded all the members of the conference that my request was reasonable, with the exception of one civil member. He argued this point, and I got so tired of him that I opened fire in earnest, and told him that I did not understand his attitude of withholding reasonable power from men to whom the Government were willing to pay £1,200 a year. Either the C.R.E.'s were incompetent or he was wrong. I can see the chairman now, sitting with his head in his hands, in apparent despair as to what I was going to say next! My last barrage settled the business. I told my friend that his attitude indicated that he did not consider that British officers were to be trusted, and that I did not think that their conduct during the Great War gave him any justification for that opinion. That settled him and I won my point.

It would be almost impossible to give a detailed account of the work we had to do. It ranged from improving existing barracks, and bringing them up to modern standards, to housing troops in huts where no accommodation existed and providing lighting and drainage. Some of these hutments were for a whole battalion, some for a company. Another class of work was making billets, in breweries, poorhouses, old prisons and country houses, suitable for military occupation. The principal troubles in such places were lack of bathing facilities, warmth and light. It must be remembered that the troops were having a rotten time, and everything that could be done had to be done to make them comfortable. Besides this, certain schemes for building additional officers' quarters for

married officers were in hand at the Curragh and Fermoy. Personally I think we were undertaking too much. It would have been wiser to have concentrated on the war services, and left the existing barracks alone until the war was over. The sequel proved this opinion to be correct, as, when we handed over our barracks on the evacuation in 1922, they were, with few exceptions, burned down during the internecine strife between the Republican and the Free State parties, and all our improvements were lost. Heaven only knows how many millions of pounds' worth of public property was destroyed at this time.

A word must be said as regards the actual evacuation. As a preliminary, we made out lists of all property, machinery, stores, etc., that were to be handed over. The Free State authorities guaranteed to take over and sign for this stuff, and, I believe, to protect it. When the British troops moved, the R.E. had to hand over and I gave particular instructions that on no account was there to be any hurry, and that the Free Staters were to be given every facility. In large places the handing over had to commence before the move, as we could not risk leaving isolated individuals behind to hand over. In most cases I think the taking over was perfunctory and the Free State signed blindly. I think it was in Tralee, however, where the Free State official happened to be an architect and surveyor, that a detailed inspection was attempted; broken window-panes, nail-holes in the wall, etc., were counted. At length, when the day was far spent and the work about 1% over, the architect threw in his hand and remarked, "Here, give me the b---y papers and I will sign the lot." I was not present, so this may be a yarn. This I do know, however, that it was only at the Curragh and in Dublin where any really efficient engineer organisation seemed to exist to take over the properties. There was no talk of values. A valuation would have been most difficult. My impression was that the Free State Government was prepared to do almost anything in order to get rid of us and get hold of the property.

When the evacuation was being arranged in the first instance, the C.E. of the Free State Army was one Roderick O'Connor, familiarly known as "Rory." He was, I believe, brought up as an engineer of sorts, but I imagine that, for a long time, he had lived on his political activities. He came to see me in his capacity of Irish C.E., and I must say the meeting in my office at G.H.Q. had its humorous side. Mr. O'Connor agreed with everything I said or proposed to do. He displayed great lack of any professional attainments whatever. What interested me most was the man, however. I had been connected with Ireland all my life, but I had never met his type before. He was a fanatical mystic if ever there was one. He sat before me and gazed at me out of a pair of deep dark brown eyes, and hardly seemed to realise that he was in

the world. He looked miserably ill—I believe he was dying of consumption. However, he lived to be executed by his own people later on. I was told that he left the Free State army and joined the Republicans on account of some disagreement with Michael Collins over appointments. Be that as it may, the fact remains that he shut himself and a force of Republicans up in the Four Courts, and was directly responsible by his action for their destruction, and with them, for the destruction of most of the historical records of Ireland. As I said before, the Free State Government eventually executed him as a rebel. It is rather curious to contemplate how so many of the leaders of this Irish Rebellion perished at the hands of their own people. In my position I had little to do with these sort of people, and I can only remember seeing Collins and Griffiths once. They were at the time walking together in Duke Street, Dublin.

I have been speaking above of our relaxations during this time, and quite forgot the racing and hunting. Personally I did not hunt, I had not much time; but some used to, and at the Curragh they all did. Apparently anyone could go to a race meeting with impunity. We used to attend the Phoenix Park meetings, and I also went to Punchestown, and spent two nights in a country house in order to do so. Nobody molested me. At the races all the military teams from the Curragh, carrying Sergeants' messes, etc., were there as in old times, and, in fact, one would have thought there was no war. In point of fact, the Irish knew that if anything had happened there would have been no more racing, and they loved racing even more than they loved the other thing.

After the truce I went to Punchestown again in 1922. It was a curious sight to see no police, but yet to find the traffic being marshalled carefully enough. In old days it took a lot of Dublin Metropolitan Police to clear the course. This day there were no police and yet the course seemed to clear itself! The only untoward incident was that some sportsman—I think he really was a sportsman—stole the Lord Lieutenant's motor car. I believe it never was recovered either. It was a foolish jest, but very cleverly executed.

The rebellion went merrily on with its tale of tragedy, until July, 1921, when we were all electrified to hear that a truce had been proclaimed. It was received with rather mixed feelings, I think, but anyhow we were all released from our prison houses, our wives came over and joined us, and we felt a bit safer. My wife and I lived in an hotel opposite the Kildare Street Club, and I started a series of tours round the more isolated parts of the country. The longest was a trip to Athlone, and thence by car via Ballinasloe to Galway, a long, dreadful journey, nothing to see but a squalid derelict country. Starting by car from Athlone we journeyed via Ballinasloe (where the "Royals" were in miserable billets) and Athenry to Galway. Here we stayed two nights and visited the 17th Lancers



(very poorly housed), and a battalion of the Worcesters. Our next day's journey was to Claremorris, where the Argyll and Sutherland Highlanders were quartered. They had a tin hut cantonment and electric light, run by a sapper of 59th Company R.E., I think, all fairly comfortable. Next day we went to Castlebar, where we found the Border Regiment in the barracks and quite comfortable. Thence we fared across a desolate bog country to Swinford, where there was a company of the A. and S. Highlanders, very badly housed, but thoroughly happy! The subaltern in command seemed to be enjoying himself shooting (it was in September). Then on again over the same ghastly country to Boyle, where there was a barracks, but I have forgotten by whom it was occupied. I can remember that the M.O. was much exercised as to the foulness (technical) of the water, but they all seemed pretty bobbish in spite of it. After this we went on to Carrick-on-Shannon. This was a horrid spot, and we met a new regiment just moving in to a perfectly horrible old jail, which had not been occupied previously. It was pouring with rain and the place was a sea of mud. I could only order that everything must be done to make things reasonably habitable, and push on to Longford, where we spent the night in the Longford Arms, quite a fair hotel. The landlady, I think, was not very pleased to see us. We had had a long tiring day. Next day we went on to Mullingar, where there was an infantry battalion in barracks. Here our motor journey ended and we took train for Dublin.

The next tour was by car from Dublin to Dundalk and thence all over the Monaghan salient, visiting such places as Monaghan, Ballybay, Cootehill (workhouse), Cavan (barracks), Virginia, Baillieborough, Kings Court, Carrickmacross. The Monaghan "salient" is the projection of the County Monaghan into Ulster. It was consequently a troublous part of the country. The troops in the area were poorly housed in all sorts of ramshackle places, though from a *war* point of view the billets were good.

A word must be said as to how we ran the works in these out-of-the-way places. The D.O.R.E. had a very wide area to cover, and we usually kept a sapper or two to do what was possible in particular places. The inhabitants did not mind working for us, in fact they would do most things for money, but their work was indifferent and expensive.

The astonishing part of it all was the unfailing cheerfulness that the troops all displayed. The private soldier of the British Army is certainly the most marvellous individual. His placidity and cheerfulness, his discipline and steadfastness under the most adverse conditions being simply astonishing. I have seen the men on duty in the streets of Dublin at the barricades quietly playing with the gutter children who, as often as not, were simply little spies, out to

pick up what information they could get. The men seemed not to realise this and just treated them as children. I came back from the war with an unbounded faith in the virtues of the British soldier, and what I saw in Ireland even more firmly fixed that faith in my mind.

Ulster was a much easier proposition to tackle from my point of view than the Centre and South, as one could go about freely in uniform without an escort, in fact, an officer in a red hat was usually received with cheers and the waving of Union Jacks. The work was troublesome enough, as the troops were crowded and uncomfortable. Our worst job up there was, however, the Ballykinlar Prison, or rather, "Internment" Camp. The Camp was a hutment made during the War to accommodate four Battalions of Infantry. It was lighted by electricity, the huts were good and it was really very comfortable. The internees were, however, a constant source of trouble. They were not pleased to be there, which is not surprising. They were dirty, idle and destructive, and made trouble whenever they could. One of their amusements was to try to tunnel out and escape, but we were able to prevent this, though it was a near thing once or twice. They certainly were a curious looking lot, some peaceful looking traders, some regular "wild men," some priests even. I would not have had the job of commandant for a lot. We had other places of confinement besides Ballykinlar, though that was the largest; notably Dublin, the Curragh (hut camp), Maryborough (old prison) and Bere Island. The latter was hard to escape from on account of its geographical position. It lay in the mouth of Bantry Bay, where they keep about the worst weather in Europe.

On my return from these tours, which gave me some real idea of the country, I settled down in Dublin and was busied with the arrangements for evacuation and redistribution of the garrison, a large proportion of which went to Ulster. Meanwhile the Free State Government and the Republicans had come to loggerheads. The latter began seizing important buildings in Dublin to form "*points d'appui*" for further operations. The Free State troops occupied such buildings as their side valued. The Republicans' first seizure was the Masonic Hall, a substantial building with a narrow street frontage, and of small military importance, except that it was near the entrance to Leinster House, where the Free State Government was functioning. Another theory was that the Masonic Order was hated of the rebels. Heaven only knows the true reason. Anyhow they turned the place into a pigsty, and drank all the liquor before they were persuaded to evacuate.

The next seizure was the Kildare Street Club. This was the stronghold of the Loyal Party, and this, added to the fact that it was a corner site and a solid house, makes the seizure understandable.

I believe protection had been asked for from and refused by the Free State authorities, as some action against the Club was anticipated. At the same time I can't help thinking that the seizure could have been prevented if suitable steps had been taken, even without the assistance of the Free State troops. That, however, is but idle speculation. What actually happened was this. About 9 p.m. one evening I was sitting with some half-dozen others in the hall of the club, when a white-faced waiter appeared and said "They have come." I asked "Who?" and he replied, "The I.R.A." (he pronounced it the "I.R.Ah."). I went towards the door to see what was up, and was met by a gentleman with a revolver who told me not to approach. I should say that as the "Truce" was in being we were all unarmed. Eventually about 10 or 15 young men came in and held us up with "guns" and searched our pockets for arms. Finding none, they allowed those who lived out of the club to go home, and told those who were living in the club to go to bed! I got out as soon as I could and returned to the hotel opposite, where I was living. I, however, sent a subaltern off to telephone from a private house to G.H.Q. to tell the news, as I was afraid my hotel telephone might be watched. I found my wife in bed, and had half undressed myself, when there was a thunderous thumping on the door of our room. I went to see who was there and was confronted by a rather truculent Free State soldier, armed to the teeth, who demanded immediate admission. I asked him "Why?" and he said they were going to man the hotel windows in order to "shoot up" the Republicans in the Club opposite. I explained that he could not come into the room as there was a lady in bed in it, but that, if he would go away I would remove the lady, and he could then come in. He was an unusually modest youth for one of his sort and expressed extreme contrition at his apparent rudeness and vanished! Meanwhile I need hardly say my wife was dressed and ready to go a journey of any length. I got her into a back room and then went down to see what was happening. I found the street full of Free State soldiers, with lorries and machine guns and the Lord knows what else. I interviewed the officer in charge, told him who I was, and asked what his scheme was. He replied that he was going to attack the Club, but that "he could not start the bloodshed." Rather paradoxical I thought, but as he was full of zeal I said no more. I stayed up until 2 a.m. to see what was going to happen, and then they all packed up and departed, saying that the rebels had promised to evacuate the club at 8 a.m. next, or rather, that morning. It was a rotten show. I was perished with cold, as I was clad only in a dressing gown and pyjamas, with my stockingless feet thrust into a pair of slippers. Fortunately the hotel manager kept the bar open all the time. Whether for me or for the Irish Troops I don't know; anyhow, he saved my life. We then all turned in and slept.

The rebels opposite I fancy slept too, as there was no more noise. Next morning, when I came down to breakfast, I saw the club windows barricaded and apparently all arrangements had been made for a prolonged occupation. My wife and I, however, evacuated our quarters in the hotel opposite the club forthwith, and went to live at another hotel near Kingstown.

The strife between the contending Irish parties increased in vigour as time went on. The Republicans next seized the Four Courts and garrisoned it, and it soon became a question as to who was going to rule the country. In the provinces the same troubles were taking place and the papers were full of shootings and burnings. The Free State Government seemed to be afraid to act, some said indeed that there was a good deal of fraternisation going on in a quiet way between the parties, who, though opposed to each other politically, did not really want to kill each other. However, eventually the situation in Dublin became impossible, and the Free State Government decided to evict Rory O'Connor and his men from the Four Courts.

The place had been in a state of siege for some time, but now a definite attack was decided upon. To carry this out the Free State Army borrowed some 18-pr. guns from us. The first news we had of impending action was an order for all officers living out to be ready to return to barracks. This was on a Sunday morning. On Sunday afternoon the order was cancelled. On Monday morning I went in by train to Dublin, and on arriving at Westland Row Station I heard that the battle had begun and that the quays were closed. I got on an outside car and told the man to drive to G.H.Q. He took me a long (and expensive) drive via O'Connell Street and the North Circular Road. On the way we came across the remains of a battle near the Parnell Monument, and a kindly spectator told me that it would recommence after breakfast, so presumably the combatants had broken off the engagement to have a meal. There were no dead men to be seen, and, as far as I remember, there were no casualties, but the street was in a fine mess with broken glass, etc. We arrived at G.H.Q. safely, and there I found an order to say that I was to be safe in barracks by 6 p.m. that night. A nice kettle of fish. The town was in an uproar, the bombardment of the Four Courts having commenced. Hume, my deputy, was similarly situated. His wife and daughter were living in Mount Street. We arranged that we should each take half the day off to arrange for the safety of the ladies. I got on an outside car at once and drove back to Westland Row. I had a lively drive, as my journey took me not far from the guns in action against the Four Courts. We got through all right and I got to Kingstown, collected my kit, told my wife to pack and to be ready to move at short notice, and got back to the office by 2 p.m., thus leaving the afternoon for Hume. He got back late at night, but

safely. I was due to go to Cork that week, so I arranged to see my wife across the Channel on my way. The destroyer service to Cork had ceased, so one had to go via Holyhead and Fishguard, that is by the ordinary mail steamers. We were not allowed to go direct by train. I had to go out to Kingstown by armoured car. The town was deserted, shops shut, etc., in fact it was like a dead city. We were not fired at and got through safely. I met my wife at the boat and got her to England, then I went off via Shrewsbury and Cardiff to Fishguard.

On arrival at Cork I took ship in a destroyer for Berehaven. It was quite an amusing trip. On the way down we called at Castlehaven to put ashore a military officer on leave, who had been stuck up by the railways stopping. Castlehaven is a small but beautiful inlet, and, as we poked our way in, I noticed a lot of men on the hills round. On inspecting them through a glass I noticed they were all armed. I was just in time, as the unarmed boat was leaving for the shore. On hearing my story, however, the skipper armed his men. As the boat approached the shore all the watchers disappeared, and we heard afterwards that they had cleared out of the neighbourhood entirely!

The visit to Berehaven was an uneventful routine visit. I thought it was a desperate spot. I stayed two days and left in a destroyer about 10 p.m. on the second day. It was quite calm when we started, and we had been having quite an amusing evening before we sailed playing some game that sticks in my memory as having been rather like pitch and toss; anyhow I won. On getting outside, however, we encountered one of the worst gales of the year. Never have I had such a tossing. I had the skipper's cabin, but there were four inches of water washing about its floor. Fortunately the sea has no terrors for me and I managed some sleep. We were twelve hours on the journey, and, on arrival at Queenstown about 10 a.m. when I got on deck, I don't think I have ever seen such a dragged crowd as were my companions. A destroyer is something of an acrobat in bad weather, there is no doubt about it. The first news we got that morning was that the Four Courts had fallen. The garrison set it on fire and blew it up, and largely escaped in the smother, including, I believe, my friend Rory O'Connor. I had an uneventful journey back again via Fishguard and Holyhead, and found Dublin beginning to come to life, though it looked a wreck. The Four Courts gone and most of O'Connell Street was in ashes.

Although technically quiet I think the town was more noisy, especially at night, than while the Rebellion was going on. During that period we were able to keep the rebels fairly quiet, but, when the two Irish parties started squabbling and shooting at each other, nothing seemed to keep them quiet. I often thought they must be firing in the air to hearten themselves and depress their opponents;

their acknowledged casualties were, anyhow, insignificant. Once a party of them formed up in the Cattle Market and began to shoot at the R.A. Officers' Mess across the street, but were dispersed by one ill-directed round from the British sentry. My wife was living at this time in a house a few doors away also facing the Cattle Market, in the North Circular Road, and I was away in Ulster. I may say that ladies had been allowed to return by this time and were able to stop on until the evacuation, if they cared to face the risk. There certainly was a risk of being shot by some irresponsible patrol all the time, but the risk was the same for all the people living in the city, no matter who they were.

There were, of course, innumerable incidents. The first one that I actually saw was the funeral of a Brigadier who had been ambushed in Kerry. The procession started at the Military Hospital near G.H.Q. and proceeded via the quays to the Northwall, where the ship was lying. The funeral was attended by the troops, and the C. in C. and all his staff, as well as by an enormous number of Dublin people. The latter were most respectful; those who were not, I fancy, had their hats knocked into the river. We accompanied the procession some way down the quays and there was no sign of a hostile demonstration.

Another case, which shows I think the attitude of the Dublin citizen generally at that time. During the fighting time, before the truce, in fact just after I first arrived, I wanted to lay in a stock of liquid refreshment. My brother-in-law told me he would bring me to a merchant whose stock was unquestionable. I walked down the town and lunched with my brother-in-law, and en route passed a restaurant called the Dolphin Hotel. Everything was quiet and peaceful. After lunch we heard that two policemen had been murdered in front of the Dolphin at about the time I was passing. Later on, at the wine merchant's, we were discussing the incident, and he said he was there when it happened. I asked, "What did you do?" He replied, "I bolted by the back door, as it was no place for me!"

To cite another case. An Infantry patrol under a young subaltern was moving down Brunswick Street one night. They were fired at, and the young officer let off all the rounds in his revolver. He then saw a "Shinner" advancing on him pointing a revolver at him. It was an uncomfortable situation for the subaltern, who had no time to load. However, he did not hesitate. He first hurled the empty revolver and then dashed at the "Shinner," collared him low, bumped him on the ground and sat on his chest before he could fire. The "Shinner" said to him, "You had better shoot me now you have got me," but the boy replied, "No, I am going to have you hanged." I believe he was, too, and that in a very short time.

Another case. There was an *abbatoir* in the North Circular Road, where the Army rations were drawn. An armoured car and a lorry went to draw the rations one day about noon. They were rather careless as regards keeping a look-out while the lorry was being loaded. A man dressed as a British officer came into the yard and shot the lot, and then decamped with the armoured car. It was a daring thing to do, but, as the man was credibly reported to have once been an officer in an Irish regiment and was wearing his old uniform, it was a dastardly one.

We lost one Sapper officer only during my time, and that was near the end. He was kidnapped in Cork and his body was subsequently found, but we could never find out what actually happened. All that was known was that he had gone down to the Cork Club to dine (it was after the Truce) and he was never seen again alive.

A few words must be said as to the R.E. organisation. There were seven C.R.E.'s Districts. They were as follows:—Dublin, Curragh, Cork, Fermoy, Limerick, Athlone, Belfast; later on, after Cork was evacuated and the garrison of Ulster increased, there was one at Omagh. These C.R.E.'s had their D.O.'s. all over the country with assistant D.O.'s. The D.O.'s. really did the work, as the C.R.E.'s had great difficulty in getting about, though they did a wonderful lot of travelling. The labour employed was mostly civilian, either by contract or direct. The Military forces were organised in four Divisions with Headquarters at Dublin (Dublin District), Curragh (5th Division), Cork (6th Division), Belfast (1st Division). Dublin District had a Works company of R.E., 5th and 6th Divisions had each two Field Companies. The 17th and 59th were in the 5th Division. The 17th Company was concentrated as a reserve at the Curragh. The 59th was scattered in detachments all over the West. The 12th and 38th Companies were in the 6th Division, 38th Company concentrated at Fermoy, 12th Company at Limerick, with detachments all over Clare and Kerry. In the 1st Division there were no Field units. We had only a Works company at Belfast.

Besides the above we had Searchlight units, with sections scattered all over the country. These people had a very entertaining time, or at least they said so. They were equipped with motor lorries on which searchlights were mounted, and their job was to accompany and assist raiding parties and patrols at night. The fitting and equipment of the lorries was an unending source of argument, as was also the method of armouring them. The difficulty about the armouring was to make it efficient, and yet at the same time to allow the lights to shine, and further, not to make the lorry too heavy to move. Anyhow, they did very good work, and, as I said above, seemed to enjoy themselves.

The great difficulty about the R.E. Services was that the peace routine as laid down was not suitable to the exigencies of the

case. I found the best way was to try to have a major at the headquarters of each brigade and to call him a Deputy C.R.E., and give him a C.R.E.'s powers without his staff. The real C.R.E. had to do all the accountancy. I could not run to a major everywhere, but I found that the rank did not matter, as long as the individual was a "live" man. In my office in Dublin one was pretty helpless really. All one could do was to try to help by giving power to the people who had to do the work. One method of help which had been very carefully organised by my predecessor, Brig. General Baker Brown, was to have a good drawing office. Here we kept a lot of stock designs as to how to utilise huts for various purposes, and I believe it saved a lot of trouble to some people. On the other hand, there are always folk who will never accept anything but their own ideas. I think we got on pretty well, and the authorities were surprised that I was so cheap! The secret was to get the best man possible into a job and to trust him absolutely. On the other hand, a weak man must be scrapped at once.

At last the end came. In the autumn of 1922, rumours of evacuation were abroad, but we still had to go on with our preparations for the winter housing of the troops evacuated from the Centre, South and West of Ireland. It was a big and by no means a cheap job. However, at last we heard the decision that we were to leave at the end of December. The moves were extraordinarily well and quietly carried out. My principal anxiety was how to deal with the civil subordinates who had served me so loyally. To leave them behind was unthinkable, and yet there were difficulties. However, eventually I think I was able to provide for all those who desired to leave, either by posting to Ulster or England. Some took service under the Free State, and I don't know what was their ultimate fate. I sold the old mahogany bookcases in the C.E.'s office, sent the best of the contents to London, and the old clock, that had been there for 100 years, to the Chatham Mess. The office closed on 16th December, 1922, and we all went to England. A closing down office under my deputy, Colonel A. H. B. Hume, opened immediately at Hounslow to finish off, and they functioned there until April, 1923. Personally, I was put on half-pay; so ended my experience of Ireland. My family have lived there for 250 years, but I don't think I could ever go back. Those two years, 1921-22, were, I think, the worst I ever experienced during my service. It was a horrible experience. It was not so much the possible dangers, as the uncertainty as to who were friends and who were enemies. As you walked the streets, you had to assume that everyone was an enemy, that was the only safe way. To have to do that with people who spoke your own language was horrible.



## PIONEER MOTOR-CYCLING IN INDIA.

By LIEUT.-COLONEL E. W. C. SANDES, D.S.O., M.C., R.E.

When one sees the modern motor-cycle, with its efficient engine, 3 speed gear, chain drive, kick starter, spring forks, footboards and handlebar control, it is difficult to realize that 24 years ago motor-cycles were objects of wonder and often of derision, and that their riders mounted them in a state of pleasing uncertainty as to what would happen, and could never rely on getting anywhere, even if they had the luck to be able to start. Still less could they hope to complete a run of 30 miles in India without at least two or three minor breakdowns. Yet this very uncertainty was half the charm of the ride. The roar of the engine, when it did consent to run, was sweet music to the rider's ears, and the pride and satisfaction which he felt when he had actually got home again—with dirty hands and nicely oiled trousers—more than compensated for the trials of the journey.

It was at Chatham in 1901 that I first saw a motor-bike. It was a 2 H.P. Singer with a steel-disc rear wheel within which reposed the motor—a surprising arrangement which abolished all chance of air cooling and brought about 4/5ths of the combined weight of the rider and machine on to that wheel, so that it skidded alarmingly on grease, while the front wheel bounced gaily in the air. Still the Singer got along quite fast when it overcame its reluctance to start, and it was at least a novelty. The remembrance of this freak induced me to try my luck with a motor-bike in India, so in January, 1903, I placed an order for one with the only Bombay firm which could supply them, and it reached me at Wellington in the Nilgiri Hills in Southern India in February, 1903.

The correspondence with the firm was long and wearisome. The price of my 3 H.P. Quadrant in Bombay was Rs. 1200/- (about £80), so that its cost was not far short of £100 when it reached me at Wellington. The firm wanted to know my height and weight, in order to suggest *a suitable height of frame and a safe horsepower!* They recommended 2 H.P. for riders of medium weight, but could supply a 3 H.P. machine for those who were not afraid of such a monster. As the country around Wellington is mountainous, and the cantonment is 6,100 feet above sea level, I decided to risk the terrors of 3 H.P. and ordered the larger machine.

In due course the case arrived by train and bullock cart, and willing helpers assisted me in unpacking the machine and attaching pedals,

saddle, lamp and other fittings. No one in Wellington knew anything about motor-bikes, so we sat down to discuss the rather vague instructions, and to trace out the electric circuits of the accumulator ignition system. We pumped up the tyres with the small hand pump attached to the top tube, filled up with petrol and lubricating oil, tested the accumulator—which gave a good voltage in spite of loss of acid on the journey—and then gazed in wonder at the machine which shone like a jewel in its new aluminium enamel and nickel plating. Perhaps the photographic illustration will help the reader to follow my description of it.

The frame of the 3 H.P. Quadrant was built almost on the lines of that of a "push-bike," but with rather heavier tubing. There were no spring or girder forks, no carrier, no clutch or gears, and no footboards or even footrests. The tyres were 2" Dunlops. Clipped into the frame were two tanks. The large one, in front of the saddle pillar tube, was divided into two compartments by a vertical partition, the front compartment containing the petrol and the surface carburettor, while the rear compartment held the accumulator and induction coil. The small triangular tank, behind the vertical tube, held lubricating oil, and, attached to the tube itself was a plunger pump to force oil down into the crank case, a drip feed system being unknown in those days. It required some practice to oil the motor while running, as one had to work the plunger, under and behind one's right leg, while leaning over to the right to see if oil was really being sucked into the glass cylinder of the pump with each stroke, and meanwhile to avoid stray Indians, bullock carts and dogs. The plunger had to be worked every 8 to 10 miles. There was, of course, no oil gauge on the crank case, and the rider pumped till smoke issued from the little apology for a silencer considerably placed between his knees and below the petrol tank. By experience I soon learnt that the silencer got almost red hot after a few miles running in India, and needed frequent observation—but of that more anon. Also its connections with the exhaust pipe and the tank were elementary, and more than once the nuts loosened under vibration and it fell off. For the same reason other fittings dropped off from time to time, and many were lost, so I kept a large assortment of spares.

Spray carburettors were almost unknown on motor-cycles at the end of 1902, and the few that had appeared were unreliable in the extreme. The Quadrant had what was called a "surface carburettor," i.e., a tray or compartment inside the petrol tank from which, I believe, wicks led into the petrol below, and in which petrol vapour was allowed to mix with air to form an explosive gas. A simple, though primitive, arrangement, which had the advantage of reliability, and was not affected by water or dust in the petrol. The petrol tank was well made of sheet brass and did not leak. In 1903

most tanks leaked after a time, so the rider carried a piece of soap which served the double purpose of temporary repairs to the tank and frequent washing of dirty hands. The filler cap was only  $\frac{3}{4}$ " in diameter, so replenishing the tank was a long job.

On top of the tank was a transverse tube in which was a gauze-covered orifice to admit air to the surface carburettor, the orifice being uncovered as much as desired by working a small lever on the tube. Another lever on the tank was the combined ignition and throttle control, and, when pushed forward, it also connected up the low tension circuit. In addition there was a small break in this circuit, as a safety device, which was filled by a flat piece of metal before starting. Of course, this slip of brass always got lost, and a supply of 4 anna pieces was advisable for replacements. Thus it will be seen that all control of the ignition and mixture had to be done by operating the two levers on top of the tank, and consequently with only one hand on the handlebar. The results of the action of the surface carburettor were most exciting. The rougher the road, the more the petrol was shaken up, and the stronger the mixture. Consequently the machine often increased its speed without warning and the throttle had to be closed hurriedly. If one was turning a corner and struck a rut in the road, the acrobatic feat of making the turn with only one hand on the handlebar, while throttling down with the other, was often worthy of a circus. Many a time I only missed the ditch by inches.

In the rear compartment of the tank the upper part held the induction coil—of non-trembler variety—and the lower part the accumulator, the compartment having a door so that both coil and accumulator could be exposed. The accumulator was an endless source of trouble. As the machine weighed less than 150 lbs., and had only 2" tyres and no spring forks, the vibration on Indian roads was terrible. The rider's wrists were often quite numb after a 20 mile spin. The acid spilled from the accumulator, and, after a time, ate through the floor of the tank, while the accumulator itself split and leaked and the plates buckled and sulphated. Early in 1903 at Wellington, and later in that year at Secunderabad in the plains, I found that there was no electric installation of any sort from which to charge an accumulator. I thought of getting a set of primary batteries for charging, but the Bombay motor firm advised me to send accumulators to them for charging (400 miles away) and undertook to return them, when charged, filled with distilled water instead of acid so that I could refill with acid when they arrived. The result was a complete failure. I then designed a special box for sending an acid-filled accumulator by rail. It was on the lines of a binnacle compass with concentric rings transversely pivotted within it, so that the accumulator, slung in a receptacle inside the innermost ring, remained upright whatever happened to

the box. Incidentally my design was patented or protected by someone in England a year later, and he described his design as "novel." The box prevented any acid from being spilled, but I found that the heat of the journey ruined the accumulators. In despair I resorted to dry batteries, trying Hellesen batteries at first, and later a battery of 3 "Transport" cells, which were filled with a solution of sal-ammoniac. These cells lasted for several months. To avoid vibration I hung them at the back of the saddle in place of the tool bag and put the latter on the handlebar.

The Quadrant engine was a single cylinder with side-by-side poppet valves. It was fairly well balanced, and at most speeds up to 25 miles an hour there was little vibration from the engine. The steel of the cylinder was soft compared with modern steel. After about 5,000 miles running the cylinder wore slightly oval, and two or three sets of piston rings had been used by then, but this was probably due partly to defective lubrication. Some play developed in time in the connecting rod bearing within the piston, so that vibration became considerable after about a year. The valves, especially the exhaust valve, pitted continually, and had to be ground in every month or so. When it became necessary to dismantle the timing gear the re-timing was a problem to a novice, as there were no marks on the pinions. Nevertheless, considering the limited experience available at that time in the design of motors, the engine was a creditable production, but the frame of the motor-bike was not stiff enough to carry it and gradually developed a lateral twist, so that the front wheel was never quite vertical.

As far as I can remember, the machine could be jacked up on two separate legs which pivotted on the rear axle. The rider sat on an ordinary bicycle saddle, and kept his feet (if he could) on the pedals, by means of which he helped the motor on steep hills. Pedalling was hard work as the gear was low, but the pedal gear was useful when one broke down hopelessly 5 miles or so from home. Many a time did I remove the belt and pedal home. On the level it was possible to get along at 10 miles an hour, though the smallest hill meant dismounting and pushing.

The leather driving belt was of triangular cross section, which was a novelty in 1903. This shape was considered to be a great advance on the flat belt of previous years, though some riders still preferred the flat belt. The worst feature of the triangular belt was its fastener, which was merely a piece of steel wire shaped like a C. As no belt punch had been invented, the rider had to bore holes with a gimlet through the ends of the belt and force the curved ends of the fastener through them. Late in 1903, hinged fasteners, with screws to pierce the belt, appeared on the market. Lubricating oil always leaked from the big end bearing on the belt pulley side, and the pulley picked up this oil and transferred it to the driving belt, which

sprayed any excess of oil on to the rider's left trouser. The oil which the belt thought fit to retain caused it to slip, and gave it a hard and polished surface of incredible filthiness in spite of frequent scraping. Because of this slipping the belt pulley lost its V section through friction, and the belt slipped still more. It was necessary, therefore, to keep the belt very tight, and this tension was too much for the fastener, which tore through its holes. One got quite used to the occasional roar of the racing engine when the belt had been left behind in the dust. Collan oil, or castor oil, was recommended by the makers to keep the belt pliable, but, in practice, the lubricating oil from the engine made the belt as pliable as anyone could want—and also destroyed it. I always carried a couple of very short lengths of spare belt to insert as the original belt was gradually cut down shorter and shorter. The grimy operations on the black and oily belt spoiled many a ride, but the clean and efficient rubber belt had not then made its appearance in India.

A novel feature in the 1903 Quadrant was the forward extension of the front mudguard over the front wheel. Both mudguards were very narrow, and on muddy roads the rider's legs were soon well coated with dirt, but the extension of the front mudguard saved his face from a similar coating, and the makers were proud of the luxury thus given. A leather flap at the bottom of the front mudguard was also a novelty designed to protect the engine and the rider's feet.

I covered about 5,500 miles on the 3 H.P. Quadrant between February, 1903 and August, 1904. In April, 1903, when it was in good condition, it carried me from Wellington up to Ootacamund, 7,300 feet above sea level, which included a climb of about 1,500 feet. It did this without much pedal assistance, and was almost the first, if not the first, motor-bike to reach Ootacamund. The return journey, with very inadequate brakes, was exciting. The machine had ordinary cycle brakes on both wheels, one operated by hand from the handlebar, and the other, I believe, a back-peddalling brake. The engine, however made a good enough brake, except in emergencies. The Indians in Ootacamund lined the roads to see the Quadrant rattle past, and shouted "Chota Shaitan Gharri" (little Devil carriage) and "Chota Ag Gharri" (little Fire carriage), the former seeming to be the favourite name, though not too flattering to the rider. The machine was swallowed up at once in a crowd if I stopped and left it for a minute, and eager hands tried the fittings to see if any were loose enough to be removed unseen. As nothing faster than a dogcart or a bicycle had appeared on the roads, the traffic made no attempt to move quickly to one side, however loudly I sounded my cycle bell, which was the predecessor of the horn, and, of course, no driver or foot passenger knew the rules of the road. In Secunderabad, when I arrived in July 1903, I believe that there was one motor



**3 HP QUADRANT Of 1903**

car, though I never saw it, but soon afterwards a major in the Lincolnshire Regiment produced a motor-bike with a flat belt drive. When I left the place in August, 1904, there were three other motor-bikes besides my own, and two other cars. Up till then no motor vehicles were registered or numbered, and there were no taxes. I think that number plates appeared in 1905, but taxation of privately owned motors was not introduced anywhere in India till some years later, and even now it is not universal. Speed was limited in 1903 by the small power and the unreliability of the engine, and I never heard of a complaint of dangerous driving. The motor-cyclist himself was in continual danger from dogs and cattle. Native dogs would charge out in a pack from every village and surround the machine, so, after two or three nasty falls, I carried a canvas bag full of stones on my handlebar and opened fire as the pack neared me. A cutting whip, clipped to the front forks when not in use, was then brought into play to beat off the brutes on either side. Cattle seemed to have an intense aversion to the noise of the "Pulputtia," as the motor-bike is now called in some parts of India. If a herd was passed near the road, one or two of the younger beasts were almost certain to snort and charge. When the road ahead was clear it was usually possible to accelerate enough to outpace the cattle galloping behind, but I was sometimes held up for ten minutes or more by a brute who blocked the way and, when I had dismounted, circled round me looking for a favourable opening.

The old Quadrant was very noisy, so I naturally wanted to silence the engine more effectively. Knowing nothing of back pressure, and not realising the heat transmitted to the silencer itself, I made a thick canvas bag and tied it over the silencer, which, as I have said, was immediately below the petrol tank. A sorry confession to make, but there it is! The result, from the point of view of silencing, was all that could be desired, and a muffled purr replaced the rattling bark of the explosions. After running five miles, however, I thought I smelt something burning, and concluded that my trousers must have touched the cylinder—a not uncommon occurrence. But, on looking down, I saw to my horror that the bag containing the silencer was rapidly blackening on one side, so I applied both brakes and jumped off. As I stopped the bag burst into flame, and the flames ran up each side of the petrol tank. There was nothing for it but to try to beat them out with my cap before the tank exploded, and luckily I managed to do this. The lesson was not wasted. I abandoned my amateur attempts at more efficient silencing.

Motors were very expensive to run in 1903 in either Wellington or Secunderabad, because no petrol could be bought locally. It had to be ordered from Bombay in 4-gallon drums, which rarely held more than three gallons on arrival, and it was classed by the railway companies as a mild form of "explosive," and charged for

accordingly. As far as I can remember the cost on arrival worked out at about Rs. 5/- (6s. 8d.) a gallon. Lubricating oil also had to be sent from Bombay.

An adventurous friend once suggested that he would like to be towed behind my motor-bike on his bicycle, so we got a length of 20 yards of rope and introduced a yard of stout rubber into the middle of it. He took a turn with one end round his handlebar and I tied the other end to my saddle pillar. For some miles we buzzed along merrily on the level till I got tired of looking round to see if he was still there. Then came a small descent down which I coasted with the exhaust valve lifted. When I switched on again at the bottom I was surprised to hear a tinkling sound mixed with the banging of the exhaust so I took a peep at the engine, but all seemed right so I opened the throttle. The tinkling increased and I looked behind me. In the distance on the road sat my gallant follower rubbing his head, while behind me on its side bounced the wreck of his bicycle with the towing rope firmly wound round its front wheel and hub. Coasting down the hill he had naturally gained on the motor-bike, whose engine could not be freed, and had run over the trailing rope which had jammed his front wheel. That was the end of *his* experiments in being towed by a rope! We afterwards tried the method of towing with the cyclist's hand on the motorist's shoulder and got along very well, though it was tiring to both riders after a few miles.

Since those early days I have had motor-bikes of many different types—a 3 H.P. Triumph in 1905, a 5 H.P. twin-cylinder Rex heavyweight in 1909, a 2½ H.P. twin-cylinder Moto-Reve lightweight in 1910, and lastly a 5 H.P. twin-cylinder Clyno heavyweight in 1913—but the memory of the old 1903 Quadrant is still fresh. I ran a trailer with the Triumph, a cane sidecar with the Rex, and a coachbuilt sidecar with the Clyno; yet, though these later machines were more powerful, reliable and speedy than the Quadrant, they did not give the excitement which made pioneer motoring what it was. The 1905 Triumph was an immense improvement, for it had girder spring forks, large tyres and saddle, rubber belt, handlebar control, footrests, and a spray carburettor, but even then accumulator ignition was recommended in India in preference to the magneto, which was still in the experimental stage, and was expected to deteriorate through loss of magnetism from road vibration. I risked magneto ignition on the Triumph and did not regret it. The old Quadrant was sold to a young Parsee doctor in Secunderabad in August, 1904, for Rs. 550/-. It was an extraordinary machine, but it could be guaranteed to teach its rider more about the inside of a motor in two months than a modern machine would in as many years. The experience was useful, though, like most experience, hardly bought.



## OUR LATER SELVES.

By "ARTHUR VINCENT."

To a 'Wild East' reader visiting Home after an unusually long absence abroad the successive articles by Captain Kerrich and 'Praefectus Fabrum' and Sir Reginald Buckland's letter have at least this in common, that they are of extreme interest. It is certainly not surprising that somewhat different conceptions of our own ideals should exist within the Corps, when such widely divergent ideas of us are to be found in individuals of other arms and services. The not unfounded fable of the commander who used his Sappers as escort to his guns still lives; a distinguished commander quite lately told us that in his first command, during 1914-18, he did not know what on earth his Sappers were for, until battle brought revelation, after which he would go nowhere without them. On a wider basis, the writer has equally been told, and by high officers at that, that we are a fine Corps best given a pretty free hand, and that we should exist as departmental and entirely subordinate ancillaries to the 'Q' staff.

The original idea of this article was to repair an omission, and not necessarily to discriminate between the rival views of the two previous ones; although we confess straightway to an intuitive leaning towards 'Praefectus Fabrum' and his support of General Macdonogh. In its development, however, facts and reason diverted it steadily towards the latter. Nevertheless, both previous articles have made at any rate one reader think hard upon facets of our task which ought to have, but alas did not, occupy his attention earlier.

Returning to the charge, both articles reveal a notable omission which it is desired to try to fill constructively. Neither of them brings out the very marked task of the R.E. officer of more senior rank, constant alike in peace and war, which is the business of directing efficiently, and getting the very best out of, his subordinate specialists of various kinds. Speaking of India, even the C. R. E. of a second class District has at least one specialist, to wit his E. & M. officer; and amongst the others he may well find officers who have themselves acquired some specialist knowledge of any of the other branches of the daily work, such as building construction, water supply, sanitation or architecture. In war C.R.E's., and much more so those Sappers who hold still higher posts, will find around

them, whether on their staff or within their command, a much larger number of specialists of whom many may be late civilians with little or no military knowledge. The harmonious and efficient co-ordination of the efforts of all these towards the common end calls strongly for particular qualities. Before these are examined, however, it is desirable both to show and to insist that the higher direction of military engineering in the field must remain in the hands of the regular personnel. Without that, the training of the Corps towards its higher duties might well become unnecessary.

In respect of the higher R.E. appointments, there seems no doubt that the first essential qualification is sound and instinctive military knowledge. From C.R.E.'s upwards, the engineers to-day are very close in the councils of Commanders and Staffs—if the latter are doing their job properly, that is! Tomorrow, on the analogy of 1914-8, the relationship will certainly not decrease. Senior Sappers must, therefore, without wasting time over a single unnecessary question, be able in conference to follow clearly and continually what is in the Commander's mind, what is in his Staff's mind, and how the Staff are working and will work to put his decisions into effect. That ability can only be achieved by lifelong professional knowledge of the military machine, supplemented by the study of military history in general and by that of military engineering in particular. Such knowledge is perforce denied to the best of civilian engineers, who naturally have put their own trade first and foremost all their lives. It is only by the habitual and automatic understanding of every relevant military detail, with nothing left in fog or strange terminology, that a military engineer can be fairly certain that his advice, given too in even consonance with the military means available and the military end aimed at, will be as sound as it needs to be. It thus seems unquestionable that the senior military engineers, particularly in the highly technicalized campaigns of nowadays, must be taken from the regular ranks alone. The same, in a lesser but still important degree, applies to their personal engineer staff officers; for a personal staff officer who has to learn a lot of his profession whilst he is the responsible first assistant to a responsible senior officer, is never going to come within thirty per cent. of true efficiency.

It is therefore the regular Sapper who has got to train and be trained for the higher duties of his Corps in war. How can he best aim at it? Passing now from the purely soldiering side of his training, which is the affair of the General Staff, his seniors and himself, it is necessary to look broadly at his engineering duties. Those given on page 470 of the *Journal* by 'Praefectus Fabrum' can be taken en bloc. Yet almost as a first duty, in the case of the higher ranks, there is for the senior Sapper the efficient co-ordination of the work of the experts under his orders. His no more than general

knowledge of engineering in all its war branches is here taken for granted, as being the duty of every officer of the Corps; but his handling of the specialists can work greatly for good or evil. Take for instance the Chief Engineer of a good sized Army Corps on any front in the world, let alone the C.E.'s. of Armies and the E's-in-C. of other fronts. He is practically certain to enjoy the services of regular or non-regular specialists in E. and M. work, in light railways, in water supply, which east of Suez is practically always a vital matter, in building construction, in roads and bridges, and so on. If not actually posted to him as such, they will be found in the flesh in various R.E. appointments. How is he to get the best out of them.

We were once asked: "How much ought you to know about a specialist's trade in order to utilize him efficiently?" For want of an established reply, we answered: "Enough to know when he is talking sense." For the purposes of war, where needs and deeds are sharpest and where anything less than sense is apt, in front of the particular problem being faced, to be nonsense, the definition may perhaps be allowed to stand. Broadly, it crystallises down to a sound knowledge of general principles in all the main branches of engineering which a Sapper is likely to have to direct towards the ends of war, backed up with the practical knowledge that comes with all R.E. experience. To a 'Wild East' reader, that sound knowledge of general principles does seem to be precisely what is afforded by the present training of the R.E. subaltern.

Proceeding, that knowledge gives the full degree of 'intelligent understanding of the other man's job' which is the first basis of efficient co-operation. Next, it enables one to discern quickly whether or not the specialist's particular knowledge is, or is not, the required asset for the business in hand; and it also allows one to judge fairly how far the specialist may have a free hand as against the other considerations affecting the problem. It also guards against a common danger, that of the specialist's natural inclination to view things with an unduly specialist eye. As an illustration of this it is only necessary to recall the noble lord, largely interested in the automobile world, who was chaffed in the Upper House for looking at statesmen's problems through his motor goggles. Further, with a knowledge of general principles, it is difficult to fall into the error of not seeing the wood for the trees.

It is not the 'specialist in nothing' who is to be advocated, he represents the extreme case, and extremes are usually unsatisfactory. To be too much of a 'Jack of All Trades' in the Corps leads to indefiniteness of purpose, and thence to that type of 'drifting' which is all too likely to end early and irredeemably in a lieutenant-colonel's pension. Moreover it leads to temporary specialization and subsequent forgetfulness. It is quite possible to specialize quite satisfactorily in one or two forms of engineering without

wearing the motor goggles quoted, and without failing in any way to keep up-to-date that wide knowledge of general principles which is essential to the control of varied experts.

No Sapper can hope to keep up-to-date in the technical progress of all the branches of engineering required in war, he must always be prepared to find the individual experts far ahead of him. Nevertheless he can, even in his spare time if his official work does not afford opportunity, keep very well up-to-date in general principles. It is just this latter knowledge, combined with the wealth of commonsense which is reaching out to be grasped in the everyday work and experience of every Sapper, which will give him the mental equipment necessary to get the very best out of the collective specialists.

From thence we pass to ask, "What is a first class engineer?" General Macdonogh used the term in respect of military engineers. In civil life the expression can fairly be said to embrace two types, firstly, the specialist at the head of his profession or near it, such as Senator Marconi; and secondly, the experienced engineer who controls and directs a large engineering firm containing numbers of varied specialists, such as may be met with in all the big commercial centres of the world. For military purposes, it seems very clear from the ground gone over that it is the second of these men who fulfils the definition. In his past he will almost always have practised specially some one branch of engineering, be it an ordinary Garrison Engineer's construction work or anything else; and the practical detail to which he has gone in this will enable him not to fall foul of detail in the other specialist trades he controls. Taking General Macdonogh's definition to apply to this second type, we ourselves would prefer to regard it as permanent, indeed as something nearer to an axiom than to a definition. It is to this end, we venture to say, that the bulk of the Corps should direct its efforts, in consonance with its early training; after due provision has been made for the number of definite specialists which it is likely to require in the regular cadre in war.

To exemplarize the test of this particular pudding by eating, we need only go back as far as 1914-8, when the standing of the Corps was greatly enhanced by the successes of its senior engineers. They were just of the type advocated, men fitted by long and often very general experience, by commonsense and by up-to-date general knowledge, to direct and control their numerous specialists towards the results which are known to all of us.

Before closing, we would dare to join issue with General Buckland upon one point. He quotes in his letter the Sapper who gets his *p.s.c.* as thereafter aspiring "to command something other than the R.E. of a Division, in fact, a Brigade of Infantry. . . ." As nothing but a personal opinion, we ourselves have held long and strong quite another point of view, namely, that a certain proportion of the R.E.

*p.s.c.*'s. should stay in the Corps, not by chance or mischance, but by design.

In older days, force of circumstances made this view barely tenable, very few vacancies fell to the Corps at Camberley and Quetta; and at that College which we knew intimately before the War, they fell frequently to men of outstanding personality who moved swiftly to high Army office almost as if by right. Since 1919 a much greater number of Sappers have passed through the Colleges; and even if by now their total has been much reduced, as notably at Quetta, there are still no less than eight at Camberley at the time of writing. Surely some, at any rate, could be made available for the Corps itself? The Infantry has a host of *p.s.c.* Battalion Commanders, for instance: it is commonly said in Indian messes that, in years to come, the *p.s.c.* will even become a necessary qualification for a battalion command.

Take the Army point of view. It seems an old-established principle that service on the Staff is a duty returnable after having the advantages of the Staff College course. On the other hand, at long long last the Colleges are becoming able to provide a little more than the immediately required graduates, so that there is room for a few elsewhere: for years of course we had no reserve of trained staff worth speaking about. At another angle, we had asked more than one senior commander: "Other things equal, would you rather your C.R.E. or C.E. was a *p.s.c.* man, or not?" In each case the reply was unequivocally affirmative.

Well, circumstances have made it temporarily much more possible than before for the *p.s.c.* Sapper to aim at the career of a *p.s.c.* Sapper; and it may be advocated as intrinsically good, so long as the opportunity exists. One of the first bases of the Staff College training is co-operation, and in this case it is built upon a far more than superficial knowledge of the other men's jobs. It has been pointed out that to-day the higher engineer officers are, as they must needs be, very close in the councils of Commanders and Staffs. The advantages which the Army would gain from the former's Staff College training are thus too obvious to need elaboration. The main question seems to be whether or not, in these days of recovery from war casualties and of cheeseparing finance, the Army can afford to pass through the Colleges officers not necessarily destined for the Staff. That is not for us to answer, but from a careful and not at all disinterested scrutiny of the necessary statistics, we do believe that one Sapper a year, or perhaps two in three years, could be advantageously so spared. In India, indeed, the C.R.E.'s. of Districts are officially shown in the Army List as "Attached to the General Staff," which is an additional and authoritative plea.

From the Corps point of view the advantages are plain. The closer co-operation possible would benefit alike the Army and the

Corps, the military training of the Corps would be sure of a measure of gain, and graduates with their higher military training would not be lost to the engineering cadre of the corps as they so often have been in the past.

There remains to consider the outlook of the individual. His engineering experience must naturally suffer; but two years away from it is, after all, no more than the period which his grandfathers used to take from India on actual leave, and some of his contemporaries in civil employ and under civil leave rules take almost the same nowadays. Even if he takes one four-year staff appointment after graduating, as seems usually to be required of him, a gap of six years is not an irreparable one, if it is neither prolonged by leave nor added to by later intervals. Better still, the six years can be split up by a return to Corps duty after the College, for a year or two. It is believed that one year's return is now compulsory.

As an individual opinion, therefore, but one formed long ago and strengthened since, it seems that the career of a "*p.s.c.* Sapper" is one which needs more attention drawn to it as a very desirable asset for both Army and Corps. Better if we could kill, once for all, the old idea that the Colleges are necessarily but gates out of the Corps into a better land. Besides, there is no better land.

## MODERN PRACTICE IN E. AND M. ENGINEERING.

### III.

#### NOTES ON PROTECTIVE GEAR.

By MAJOR A. C. FINNIMORE, M.C., R.E.

##### 1. *The Necessity for Protection.*

Protective gear of some sort is well known to be necessary in every system of distribution of electrical power. The larger the system, and the higher the pressures employed, the greater is the need for adequate protection. In a study of the matter, the first question to consider is, what are the risks from which protection is to be sought? Then arise further questions, such as, how can such risks be avoided, what degree of security can be attained, what additional expense and complication must be involved in supplying the desired degree of safety, and to what extent are such additions likely to be warranted?

##### 2. *The Object of Protective Gear.*

(a) In the simplest circuit, consisting of one generator, two conductors, and a motor, the generator requires to be protected from the effects of any one of the following possibilities:—

- (i) Excessive overload upon the motor.
- (ii) Short circuit in the windings of the motor, or loss of field.
- (iii) Short circuit between the conductors.
- (iv) Earthing of both conductors simultaneously.
- (v) If a point in the generator windings is earthed, an earth leak anywhere else in the system.
- (vi) A short circuit in the windings of the generator.

(b) The conductors require protection from the same possibilities, except for the last.

(c) The motor requires protection from (i), (ii) and (v).

(d) If there are several motors, every consumer should be protected, not only from these risks, but also from the inconvenience of a shut down, resulting from an accident to the gear of any other consumer.

(e) In a network system, every consumer should be protected from the risk of failure of supply resulting from an accident to any portion of the system.

(f) In any case, the General Public should be protected from the risks to life and property, that may arise in consequence of any defect in any portion of the system.

(g) Where the pressure or type of current varies in different parts of the system, the transformers, converters, frequency changers, etc., require protection, both as motors, or consumers of power, and also as generators as regards their own distribution systems.

### 3. *The Insufficiency of Fuses.*

Fuses provide protection against overload, whether due to excessive demand for power, or developed through leakage, in any part of the system supplied through those fuses. They cannot be fitted in a suitable position to protect a generator from the effects of a fault in its own windings.

Fuses are somewhat unreliable; their replacement after they have blown is not always easy, and their power of discrimination is limited. For instance, a large and sudden leak, in the gear of one consumer, may "blow" a fuse which also carries the supplies of other consumers. Two-pole or triple-pole fuses seldom blow simultaneously; and after one has melted and broken the circuit, the conductors may be left alive.

### 4. *Overload Automatic Switches.*

The shortcomings of fuses are mostly absent from automatic switches, fitted with overload relays. However, in order to equal the virtue of fuses, in carrying brief overloads, such switches require to be provided with some delaying action. It is normal to fit every important overload switch with a delay action relay, generally in the form of a rotating disk ammeter, loaded so that it cannot develop sufficient torque to begin to turn, unless the current should exceed full load value by some predetermined amount. When the disc revolves under such overload conditions, which may normally be 125% to 200% of full load, it is made to raise a weight, and also to drag slowly through the field of a permanent magnet, designed to delay the trip action for some definite period, such as half a minute. At the end of this period, if the overload still continues, the weight reaches a trigger or contact, by means of which the switch is made to open, generally through the action of a second relay, such as a solenoid and plunger.

Such switches are very reliable. They open all poles simultaneously, so that no conductors can be left alive. Discrimination can be provided to a considerable extent, by setting switches nearer the source of supply to open only under greater overloads, and with more delay, than those further away. Thus, for instance, a defective distributor should be isolated before the feeder switch can open.

There is one state of affairs in which overload devices are unsatisfactory, namely, where several units or feeders supply the same bus-bars. An overload on one will mean that all are to some extent



overloaded ; and the opening of one switch will cause all the others to trip out in rapid succession, thus completely disorganising the supply of power. Overload trips are naturally in disfavour in such cases, and, if they are provided, operators are tempted to disconnect them and risk consequences.

Yet some form of protection is necessary ; otherwise, if the insulation of one generator or feeder should break down, or if the field of one generator should fail, the others would pour back energy into the defective one, and great damage might result.

#### 5. *Reverse Power Relays.*

For positions such as the last considered, Reverse Power Relays are of value for protecting plant. In alternating current circuits, these relays must be of the two magnet type, in order to be able to discriminate between the directions of the flow of power. One of these magnets is energised by a series coil, the current in which must be in phase with the supply. The other is energised by a shunt coil, across two conductors, and is designed with sufficient inductance to provide a flux in quadrature with the supply current in the series coil.

The relay disc, set between these magnets, develops a torque, like the rotor of a squirrel cage induction motor. Reversal of power in the cable causes the series field to change  $180^\circ$ , thus reversing the direction of rotation of the combined field, and therefore reversing the direction of the torque. Shunts may be used to divert most of the line current from the series coils ; and in extra high tension lines it is usual to provide power to the relays through current and potential transformers.

The disc may be fitted with a projection, which normally engages a stop ; so that no movement may occur unless the torque is reversed. When the disc revolves, under the influence of such a reversed torque, it trips out the switch by some means ; for instance, by closing the circuit of a solenoid. It is usual to load such relays, and also to give them a time lag ; so that they may not trip the switch on the occurrence of occasional reverse power, of an order and duration which is unlikely to cause trouble. Too sensitive a relay may increase the difficulty of paralleling in a set on to the busbars. Overload and Reverse Power sensitivity may be combined in the same relay. In this case, the disc is left free to revolve in either direction, subject to suitable loading and drag, and is arranged to trip the switch after a predetermined amount of movement either way ; but the reverse movement may be more lightly loaded, and provided with less lag than the overload movement.

#### 6. *Discrimination in Protective Devices.*

Protective gear is said to be discriminating when it is only sensi-

tive to faults in the conductors to which it is applied, and is arranged to be unaffected by faults which may develop in other parts of the system. For instance, in a network system, one sub-station may be supplied by several feeders. It is advisable, since continuity of supply is the main object of providing the network, that any protective gear, that may be fitted in this case, should be fully discriminating. In other words, a fault in one feeder should cause the switches of that feeder to open, leaving all the others closed; so that the supply may not be cut off from the sub-station.

It will be sufficient to consider gear designed for three-phase E.H.T. systems; since gear for lower tension, and for single and two-phase systems, may be designed upon the same principles. Many different systems of protection have been evolved, varying widely in the matter of expense and complication, the degree of protection afforded, and in discriminating power. One system may be suitable for protecting the cables of a network, and another may be better for taking care of transformers. The matter of cost will be normally the ruling factor in the choice. Discriminating protective gear generally depends for its action on one of two main rules, which are self-obvious, namely:—

(i) In any insulated conductor, the flow of current must be equal throughout its length, except for a small charging current. The ampères leaving at the far end must be very nearly equal to the ampères entering at the generator end.

(ii) In a polyphase cable, the total current flowing in the cores should have an algebraic sum of zero, unless some power returns via the earth, *i.e.*, through a fault.

#### *7. Ferranti-Field Protection.*

In Fig. 1 is illustrated a simple and cheap form of protective gear, known by the name of Ferranti-Field. The cable, including the fourth wire if present, is surrounded by the laminations of a Ferranti-Field current transformer, which are split to facilitate assembly. Leads are taken from the secondary winding to a suitable relay, capable of tripping the switch controlling the cable, if any appreciable amount of current is induced in the secondary.

So long as the sum of the currents in the cores is zero, none will be so induced; but if a fault to earth occurs anywhere in the portion of the system fed through the cable, the power which returns via the earth must pass through the current transformer to the seat of the fault, and must therefore induce some current in the secondary. Thus any fault to earth, if of sufficient magnitude, will cause the relay to operate.

Such gear affords no protection against faults between phases; nor is it discriminating, for a fault in any portion of the distribution system may bring out the feeder switches.

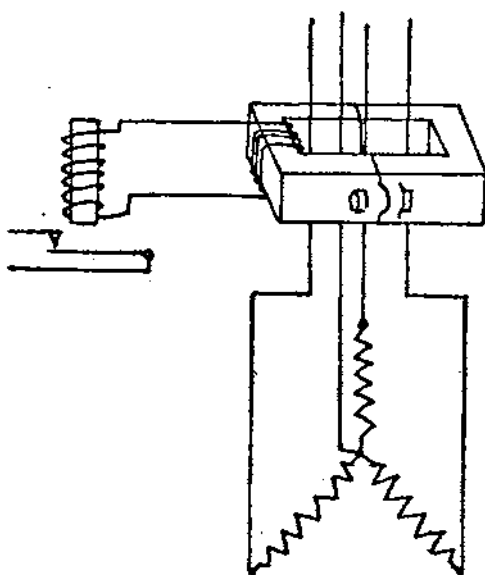


Fig. 1. Ferranti-Field.

It is valuable for protecting generators from the effects of faults to the frame; for, if the neutral point in the windings is earthed through a wire, and the current transformer embraces both this earthing wire and the supply cable, then any leakage to the frame must return through the current transformer.

#### 8. *Self-Balancing Protection.*

A slightly less simple, but much more effective method of protecting generators and transformers, is the self-balancing system illustrated in Fig. 2.

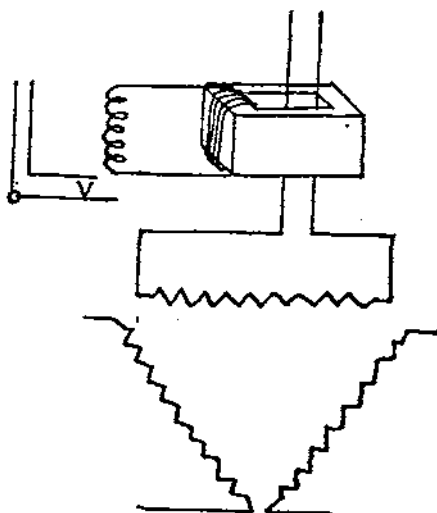


Fig. 2. Self-Balancing.

Both ends of every winding are brought out of the machine, and the two ends of a winding pass through a current transformer, connected to a switch tripping relay.

Any leakage in the machine, whether to earth or between phases, will cause the currents in the two ends of a winding to be unequal; and, if the difference is sufficiently great, enough current will be induced in the secondary to actuate the relay, and open the switch. This gear is fully discriminating, for nothing but a fault in the winding concerned can cause the relay to act. No protection is afforded against loss of field; nor against the effects of a short circuit between turns of the same winding.

#### 9. *Ferranti-Hawkins Protection.*

Two Ferranti-Field transformers, placed one at either end of a cable, as in Fig. 3, and connected in opposition through a pilot wire and relays, constitute the Ferranti-Hawkins system of cable protection.

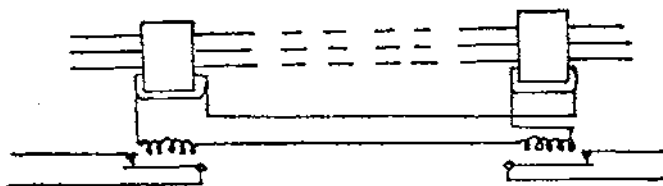


Fig. 3. Ferranti-Hawkins.

A fault to earth in the cable causes one transformer to develop a secondary current; since the fault current must pass through the cable to the seat of the trouble, either through the transformer at one end only, or in different directions through both ends.

Any fault *elsewhere* in the system is fed through both transformers in the same direction, and so can produce no currents in the two opposed secondaries. Thus this system is completely discriminating. It affords no protection against faults between phases.

#### 10. *Merz-Price Protection.*

The Merz-Price system of protection may be regarded as a development of the Ferranti-Hawkins, giving protection from leakage between phases, at the cost of increasing the amount of gear. Every phase is separately protected; and this requires six transformers instead of two, and at least three pilot wires.

There is a difference between the methods of wiring systems for the protection of cables and machines, due to the very different lengths of pilot wire required.

In the case of cables, whose pilot wires must be long, it is usual to oppose the *potentials* of the two transformers on a phase, so that no current may pass until a fault develops in that phase. This is known

as *Potential balancing*, and is effective with carefully balanced transformers and delicate relays. In the case of machines, whose pilot wires may be short, it is normal to use the *current balancing* method illustrated in Fig. 4.

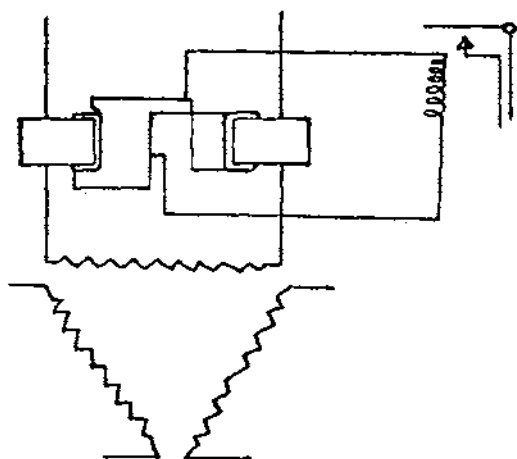


Fig. 4. Merz-Price, Current Balancing.

The transformers are connected in series, so that a current circulates in them whenever there is any demand for power. The relay is connected across the mid-points of the pilot-wires; and therefore receives no current if the induced currents in the transformer secondaries are equal. If one should pass more current than the other, the *difference* must flow through the relay.

The reason for the adoption of this principle of current balancing is, that current transformers can be made to give a more nearly straight line ratio-load curve, if a current is permitted to flow through the secondaries, opposing the excitation of the core. Thus the flux in the iron remains more nearly constant, and also on the straight line portion of the B.H. curve for the iron. If no current is permitted to circulate in the secondaries, such a low intensity of flux can seldom be ensured, except by the inclusion in the magnetic circuit of complications in the form of air gaps, to raise the reluctance of the path.

In the case of cables, potential balancing permits the use of lighter pilot wires, and saves losses in power, which outbalance the extra cost of potentially balanced transformers. The relays must be very sensitive; and here arises a difficulty, in the danger that they may respond to chance currents, induced in the pilot wires by external causes. In order to avoid such trouble, it is usual to enclose the three pilot wires in one cable, in which earthed screening tubes are introduced, one surrounding each wire. These are known as "compensated pilot-wire" cables.

### 11. *Split Conductor Protection.*

In this system the expense of providing pilot wires is saved, and the risk of operation of relays by induced currents is avoided, at the price of supplying a six core cable. Thus no extra copper is required, but some extra expense in insulation is necessary.

The current in any phase is equally divided between two cores ; and these are led in opposite directions through a current transformer, in whose secondary no current can be induced so long as the balance is maintained. Any leakage from one of a pair, whether to earth, or to another phase, destroys the balance of current in the " splits," and causes the transformer to operate a relay. Discrimination is complete ; and protection is provided against faults to earth and between phases, unless both cores of a phase should be simultaneously earthed through faults of identically equal resistance, a most unlikely event. For overhead lines this system presents the interesting feature, that the breakage of any one of the six conductors may be made to isolate the line instantly, before the broken wire can touch anything, or endanger life or property.

### 12. *Callender-Hunter Protection.*

All the advantages of the split conductor system of protection can be obtained by splitting only one of the conductors, if all the conductors are woven through a laminated iron ring, as shewn diagrammatically in Fig. 5. Any fault in one of the undivided conductors will

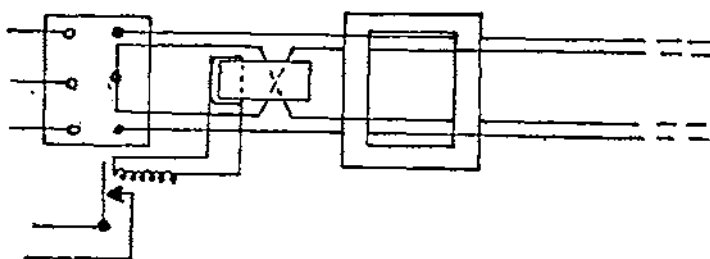


Fig. 5. Callender Hunter.

then induce a circulating current in the halves of the split core, destroying the balance, and so causing the relays to operate. This system incidentally affords protection against a fault between the halves of the split core ; for the inductances at the ends of the cable always produce opposing E.M.F's. in the split core, which normally balance, so that no current circulates. A fault between the halves permits both currents to circulate through the fault, and so operates the relays at both ends.

### 13. *Ferranti-Waters Protection.*

When the conductors of a cable are split, but all contained in the same sheath, damage to any one necessitates isolation of the whole

cable. Therefore two or more entirely separate cables are sometimes provided, working in parallel.

They may be balanced as complete cables, and protected separately by relays on the Ferranti-Field or the Merz-Price system. The Ferranti-Waters system protects without the use of long pilot wires, by balancing one cable against the other.

The two or more "generator ends" may be balanced by current transformers connected in opposition through a simple relay, set to open the switches if the power taken through the cables should become unequal. It is preferable to fit one relay per cable, or even one per core, of the reverse power discriminating type, so that only the defective cable may be isolated, leaving the other or others to carry the load, and so maintain continuity of supply.

At the receiving ends, reverse power relays are essential when only two cables are provided; for, if there happened to be no demand for power when a fault developed in one cable, the power flowing outward through the sound cable, and back through part of the damaged one to the seat of trouble, would balance. In that case the relays might not operate for some considerable time, if they were unable to discriminate between directions of flow of power. Separate reverse power relays would meet the case; but, since it is necessary that any *difference* in power transmitted by two cables should cut out that carrying the smaller amount, the relays should be coupled in opposition. Fig. 6 illustrates the principle, applied

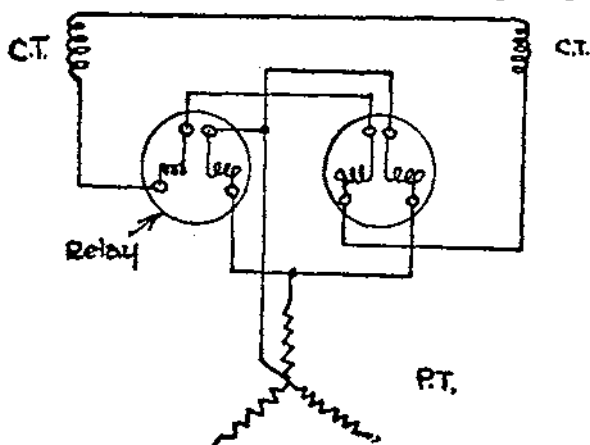


Fig. 6. Ferranti-Waters.

to protect against earth faults only. Separate protection for every phase can be similarly applied, but the gear then becomes somewhat complicated.

#### 14. Callender-Waters Protection.

The Callender-Waters system of protection is dependent upon an entirely different principle from those already described.

Surrounding the insulation of the cable, and lightly insulated from the sheath or armouring, are placed six tapes of copper. Of these, three are connected to earth at one end, through a relay, and the other three at the other end. It is almost impossible for a core to develop a fault to earth without touching one of the tapes. Even if the tape should be well earthed at the fault, the surge of current through the faulty core would induce a considerable current in the tape, whose two earths would make it a closed circuit, including the relay. Contact, with one tape only, might bring out the switch at one end only, leaving the cable live. To guard against this it is common to provide an auxiliary contact in the switch, set to connect one of the other tapes with a battery whose other pole is earthed when the switch opens. Thus the opening of one switch causes the other, at the far end of the cable, to follow, completing the isolation of the cable.

#### 15. Ferranti Surge Absorber.

Protection against the effects of lightning and sudden breaks in the circuit, which may cause high frequency surges and steep fronted waves, are discussed to some extent in *Military Engineering (Technical Training)*, Vol. II, *Electrical Engineering*. Horn arrestors, and other spark gap types of protective device, suffer from the disadvantage that they can only permit disturbances to dissipate their energy, by allowing an arc to form to earth. This arc tends to persist; and, if it is broken at an inopportune instant, it may cause further disturbances of even greater destructive power.

Choking coils and condenser devices, while they protect plant, are apt to reflect waves back into the line. Moreover, they are often troublesome to keep in working order. The Ferranti Surge Absorber is a device intended to absorb the energy in such disturbances without the formation of an arc, and without reflecting waves back into the line. Fig. 7 illustrates in simple diagram the principle on which such an absorber is designed.

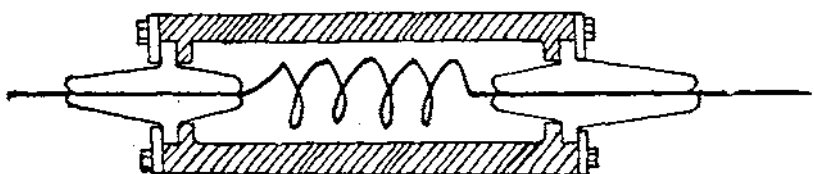


Fig. 7. Ferranti Surge Absorber.

One absorber is necessary for every core or conductor, and is generally fitted near the point where the latter is led in to the station or sub-station. An absorber consists mainly of a few turns, normally about sixty, of copper conductor, well insulated, and carried in a shell, built of a special iron, which is nearly non-magnetic and of a high specific resistance. The absorber operates as a transformer,



of which the primary (the sixty turns of copper), is interposed in the power line circuit. The shell constitutes a secondary, of one short circuited turn, of low resistance. Since any change of flow in the primary must cause a flow of the order of sixty times its value in the shortcircuited secondary, the normal power current causes an alternating flow of large magnitude in the shell. The heating effect of this induced flow depends upon the resistance of the shell; and it is normally designed to be of the order of one watt at full load.

Surges of oscillatory frequency, or other steep crested waves, in sweeping along the line, cause the steep gradients of potential which are apt to produce flashing over or rupture of insulators, puncturing of the insulation of transformers, and other damage, against which the surge absorbers are intended to be a protection. Such surges consist of large local charges, travelling at very high velocity. This is equivalent to a local momentary flow of current of very large magnitude. Surges induced by lightning flashes probably attain a current value of a hundred thousand ampères.

When such a surge enters an absorber, momentary currents of the order of six million ampères are induced in the shell. Since the heating effect of the current is proportional to  $I^2R$ , the loss in the shell is very large, in spite of the low ohmic resistance offered. Thus the energy represented in the surge is mostly converted to heat; and since this is a non-reversible change, no reflection into the line can take place.

Briefly summarised, the effect of the absorber is that of a transformer, producing, in a secondary circuit of small resistance, currents of a much higher order than those flowing in the power line. Since heating losses are as the square of current values, the losses in this secondary circuit may be arranged to be negligible as regards normal power load, but powerfully damping to violent surges.

Moreover, the heat generated in this secondary circuit is produced in a resistance whose thermal capacity is ample, and its radiating surface large. Thus all danger of fusing or starting a conflagration is eliminated; for surges are generally of short duration, and seldom follow without sufficient interval to allow the shell to cool down in between disturbances.

#### 16. *McColl Alternator Protection.*

In the case of a generator, the mere provision of relays, set to open the switches if a fault should develop in the windings of the machine, is insufficient protection; for, after the switch has opened, the generator may still continue to damage itself, unless it is definitely rendered incapable of generating electrical energy.

In the McColl system of Alternator protection any fault in the generator is made to operate several relays. One opens the main

switch, while another stops the excitation of the field, and short-circuits the field coils.

A third relay may be provided, in the case of generators cooled by forced air circulation, to start up a motor, and thereby to close the air ducts, and isolate any conflagration that may have started in the machine.

The relays may be of a simple beam type, sensitive only to leakage faults; but a greater degree of protection may be provided by fitting induction relays, which are also sensitive to reversal of power, whether due to weak or lost field, or to failure of the prime-mover.

### 17. *Special Considerations.*

Limitation of space prohibits more than a cursory review of the circumstances in which protection may be desirable, and of the means available to meet the needs.

One of the systems that have been considered in these notes will generally be applicable to any case; but sometimes a little thought may be necessary, to avoid obvious pitfalls.

For instance, a system, such as Merz-Price, which is normally applicable to a cable, may be used equally well to protect a transformer; but it must be remembered that the currents entering and leaving the transformer will have very different values as expressed in amperes.

The question of ratio is easily dealt with in the design of the current transformers, on the H.T. and L.T. leads respectively; but the matter of losses is not quite so simple. They may be met by a definite loading of the relays; for it follows that, if the losses greatly exceed those calculated for full load working, then either the transformer is grossly overloaded, or there must be some internal fault. Copper losses are fairly well proportional to the load, and can be compensated in the design of the current transformers. Therefore it is usual to leave only the iron losses to be met by loading the relays.

Switchboards may be protected by insulating the framework lightly from the ground, and earthing it through a relay. Detail gear, such as the current transformers on feeders, should be earthed by separate wires, each with its own relay; so that the failure of one may only bring out the switch of its own cable, and not cut off the supply of sound feeders. It is very important to realise that protection, if applied without due regard for power of discrimination, soon becomes an intolerable nuisance.

## BATTLE HONOURS OF ROYAL ENGINEER UNITS

(continued).

N.B. "SOMME 1918" COUNTS AS AN EXTRA HONOUR FOR PARTICIPATION IN ANY OF THE BATTLES FROM ST. QUENTIN TO VILLERS BRETONNEUX.

ST. QUENTIN. 21ST-23RD MARCH, 1918.

| Unit.                               | Formation.      | Remarks.  |
|-------------------------------------|-----------------|-----------|
| THIRD ARMY.                         |                 |           |
| ARMY TROOPS.                        |                 |           |
| G Special (Projector) Co.           | Special Bde.    | E.        |
| J " "                               | " "             | "         |
| Q " "                               | " "             | "         |
| No. 3 Special (Mortar) Co.          | " "             | N.E.      |
| 132nd Army Troops Co.               | VI Corps        | "         |
| 142nd " "                           | IV " "          | "         |
| 147th " "                           | V " "           | E.        |
| 149th " "                           | IV " "          | D.        |
| 232nd " "                           | VI " "          | N.E.      |
| 280th " "                           | V " "           | E.        |
| 559th " "                           | V " "           | "         |
| 565th " "                           | VI " "          | "         |
| 577th " "                           | V " "           | "         |
| 7th R. Monmouth Army Troops Co.     | IV " "          | N.E.      |
| No. 1 Siege Co. R. Monmouth         | VI " "          | "         |
| 174th Tunnelling Co.                | VI " "          | E.        |
| 175th " "                           | V " "           | "         |
| 181st " "                           | VI " "          | N.E.      |
| 252nd " "                           | IV " "          | E.        |
| 257th " "                           | VI " "          | N.E.      |
| 2nd Australian Tun. Co. New Zealand | V " "           | E.        |
| No. 352 E. & M. Co.                 | XVII & VI Corps | N.E.      |
| No. 3 Field Survey Co.              | " "             | D.        |
| No. 3 Pontoon Park                  | " "             | No diary. |
| No. 1 Foreway Co.                   | V Corps         | E.        |
| No. 2 " "                           | IV " "          | D.        |
| No. 3 " "                           | XVII & VI Corps | N.E.      |
|                                     | V Corps         | E.        |
| IV CORPS.                           |                 |           |
| 12th Field Co.                      | 6th Div.        | E.        |
| 459th " "                           | " "             | "         |
| 509th " "                           | " "             | "         |
| 81st " "                            | 19th Div.       | "         |
| 81st " "                            | " "             | "         |

## BATTLE HONOURS OF ROYAL ENGINEER UNITS.

## ERRATA.

Page 438.

PILCKEM. 31ST JULY-2ND AUGUST, 1917.

| Unit.                       | Formation. | E. | Remarks. |
|-----------------------------|------------|----|----------|
| XIV CORPS.                  |            |    |          |
| Add—                        |            |    |          |
| 455th (W. Riding) Field Co. | 29th Divn. | E. |          |
| 510th (London)              | " "        | "  |          |
| 497th (Kent)                | " "        | "  | N.E.     |

## ST. QUENTIN, 21ST-23RD MARCH, 1918.

| Unit.                       | Formation.   | Remarks.         |
|-----------------------------|--------------|------------------|
| <b>V CORPS.</b>             |              |                  |
| 517th Field Co.             | 47th Div.    | E.               |
| 518th " "                   | " "          | "                |
| 520th " "                   | " "          | "                |
| 247th " "                   | 63rd " Div.  | "                |
| 248th " "                   | " "          | "                |
| 249th " "                   | " "          | "                |
| <b>VI CORPS.</b>            |              |                  |
| 45th Field Co.              | Guards Div.  | N.E.             |
| 75th " "                    | " "          | "                |
| 76th " "                    | " "          | "                |
| 56th " "                    | 3rd " Div.   | "                |
| 438th " "                   | " "          | D.               |
| 529th " "                   | " "          | N.E.             |
| 210th " "                   | 31st " Div.  | "                |
| 211th " "                   | " "          | "                |
| 223rd " "                   | " "          | "                |
| 207th " "                   | 34th " Div.  | E.               |
| 208th " "                   | " "          | "                |
| 209th " "                   | " "          | "                |
| 224th " "                   | 40th " Div.  | "                |
| 229th " "                   | " "          | "                |
| 231st " "                   | " "          | "                |
| 467th " "                   | 50th " Div.  | "                |
| 469th " "                   | " "          | "                |
| 470th " "                   | " "          | "                |
| <b>FIFTH ARMY.</b>          |              |                  |
| <b>ARMY TROOPS.</b>         |              |                  |
| 5th Field Squadron.         | 5th Army     | E.               |
| A Special (Projector) Co.   | Special Bde. | "                |
| E " "                       | " "          | "                |
| H " "                       | " "          | "                |
| No. 1 Special (Mortar) Co.  | " "          | "                |
| 135th Army Troops Co.       | III Corps    | "                |
| 144th " "                   | " "          | N.E.             |
| 146th " "                   | VII Corps    | D. No diary.     |
| 213th " "                   | 5th Army     | N.E.             |
| 216th " "                   | XVIII Corps  | D.               |
| 217th " "                   | 5th Army     | N.E.             |
| 221st " "                   | VII Corps    | E.               |
| 238th " "                   | VII " "      | "                |
| 239th " "                   | XIX " "      | "                |
| 281st " "                   | XIX " "      | "                |
| 283rd " "                   | XI " "       | D.               |
| 284th " "                   | III " "      | E.               |
| 288th " "                   | XIX " "      | "                |
| 567th " "                   | III " "      | "                |
| 568th " "                   | III " "      | "                |
| 574th " "                   | VII " "      | D. No diary.     |
| No. 1 Siege Co. R. Anglesey | XVIII " "    | E.               |
| No. 4 Siege Co. R. Anglesey | III " "      | " No diary.      |
| 172nd Tunnelling Co.        | XVIII " "    | "                |
| 173rd " "                   | XIX " "      | D.               |
| 177th " "                   | VII " "      | E.               |
| 178th " "                   | VII " "      | " Diary missing. |
| 180th " "                   | VII " "      | "                |
| 182nd " "                   | III " "      | "                |
| 253rd " "                   | XIX " "      | D.               |
| 258th " "                   | XIX " "      | E.               |
| No. 353 E. & M. Co.         | " "          | D.               |
| No. 5 Field Survey Co.      | " "          | "                |
| No. 6 Foreway Co.           | XVIII Corps  | E.               |

## ST. QUENTIN, 21ST-23RD MARCH, 1918.

| Unit.              | Formation.      | Remarks. |
|--------------------|-----------------|----------|
| III CORPS.         |                 |          |
| 2nd Field Squadron | 2nd Cavy. Divn. | E.       |
| 3rd                | 3rd             | "        |
| 61st Field Co.     | 14th Div.       | "        |
| 62nd "             | "               | "        |
| 89th "             | "               | "        |
| 79th "             | 18th Div.       | "        |
| 80th "             | "               | "        |
| 92nd "             | "               | "        |
| 503rd "            | 58th Div.       | "        |
| 504th "            | "               | "        |
| 511th "            | "               | "        |
| VII CORPS.         |                 |          |
| 63rd Field Co.     | 9th Div.        | E.       |
| 64th "             | "               | "        |
| 90th "             | "               | "        |
| 155th "            | 16th Div.       | "        |
| 156th "            | "               | "        |
| 157th "            | "               | "        |
| 97th "             | 21st Div.       | "        |
| 98th "             | "               | "        |
| 126th "            | "               | "        |
| 225th "            | 39th Div.       | "        |
| 227th "            | "               | "        |
| 234th "            | "               | "        |
| XVIII CORPS.       |                 |          |
| 83rd Field Co.     | 20th Div.       | E.       |
| 84th "             | "               | "        |
| 96th "             | "               | "        |
| 200th "            | 30th Div.       | "        |
| 201st "            | "               | "        |
| 202nd "            | "               | "        |
| 121st "            | 36th Div.       | "        |
| 122nd "            | "               | "        |
| 150th "            | "               | "        |
| 476th "            | 61st Div.       | "        |
| 478th "            | "               | "        |
| 479th "            | "               | "        |
| XIX CORPS.         |                 |          |
| 1st Field Squadron | 1st Cav. Div.   | E.       |
| 2nd Field Co.      | 8th Div.        | N.E.     |
| 15th "             | "               | "        |
| 495th "            | "               | "        |
| 103rd "            | 24th Div.       | E.       |
| 104th "            | "               | "        |
| 129th "            | "               | "        |
| 7th "              | 50th Div.       | "        |
| 446th "            | "               | "        |
| 447th "            | "               | "        |
| 430th "            | 66th Div.       | "        |
| 431st "            | "               | "        |
| 132nd "            | "               | "        |

## SIGNALS.

## ST. QUENTIN. 21ST-23RD MARCH, 1918.

| Unit.                 | Formation. | Remarks. |
|-----------------------|------------|----------|
| Third Army Signal Co. | 3rd Army   | D.       |
| D Corps Signal Co.    | IV Corps   | E.       |
| 6th Divl. Sig. Co.    | "          | "        |
| 19th "                | "          | "        |
| 25th "                | "          | "        |
| 41st "                | "          | "        |
| 51st "                | "          | "        |

## SIGNALS.

ST. QUENTIN. 21ST-23RD MARCH, 1918.

| Unit.                    | Formation.    | Remarks. |
|--------------------------|---------------|----------|
| O Corps Signal Co.       | V Corps       | E.       |
| 2nd Divl. Sig. Co.       | "             | "        |
| 17th "                   | "             | "        |
| 47th "                   | "             | "        |
| 63rd "                   | "             | "        |
| F Corps Signal Co.       | VI Corps      | D.       |
| Guards Divl. Sig. Co.    | "             | "        |
| 3rd "                    | "             | "        |
| 31st "                   | "             | "        |
| 34th "                   | "             | E.       |
| 40th "                   | "             | "        |
| 59th "                   | "             | "        |
| Fifth Army Signal Co.    | 5th Army      | D.       |
| Cavalry Corps Signal Co. | Cav. Corps.   | "        |
| 1st Signal Squadron      | 1st Cav. Div. | E.       |
| 2nd "                    | 2nd "         | D.       |
| 3rd "                    | 3rd "         | E.       |
| C Corps Signal Co.       | III Corps     | "        |
| 14th Divl. Sig. Co.      | "             | "        |
| 18th "                   | "             | "        |
| 58th "                   | "             | "        |
| G Corps Signal Co.       | VII Corps     | "        |
| 9th Divl. Sig. Co.       | "             | "        |
| 16th "                   | "             | "        |
| 21st "                   | "             | "        |
| 29th "                   | "             | "        |
| S Corps Signal Co.       | XVIII Corps   | "        |
| 20th Divl. Sig. Co.      | "             | "        |
| 30th "                   | "             | "        |
| 36th "                   | "             | "        |
| 61st "                   | "             | "        |
| T Corps Signal Co.       | XIX Corps     | "        |
| 8th Divl. Sig. Co.       | "             | D.       |
| 24th "                   | "             | E.       |
| 50th "                   | "             | "        |
| 66th "                   | "             | "        |

BAPAUME, 1918 (FIRST BATTLE). 24TH-25TH MARCH, 1918.

| Unit.                           | Formation.      | Remarks.     |
|---------------------------------|-----------------|--------------|
| THIRD ARMY.                     |                 |              |
| ARMY TROOPS.                    |                 |              |
| G Special (Projector) Co.       | IV Corps        | N.E.         |
| J "                             | VI "            | "            |
| Q "                             | V "             | "            |
| No. 3 Special (Mortar) Co.      | VI "            | E.           |
| 132nd Army Troops Co.           | VI "            | N.E.         |
| 142nd "                         | IV "            | E.           |
| 147th "                         | V "             | "            |
| 149th "                         | IV "            | D.           |
| 232nd "                         | VI "            | "            |
| 280th "                         | V "             | E.           |
| 282nd "                         | XVII "          | D.           |
| 559th "                         | V "             | E.           |
| 565th "                         | VI "            | "            |
| 577th "                         | V "             | D. No diary. |
| 7th R. Monmouth Army Troops Co. | IV "            | E.           |
| No. 1 Siege Co. R. Monmouth     | VI & XVII Corps | N.E.         |
| 174th Tunnelling Co.            | VI Corps        | E.           |
| 175th "                         | V "             | D. No diary. |
| 179th "                         | XVII "          | E.           |
| 181st "                         | VI "            | "            |
| 252nd "                         | IV "            | "            |

## BAPAUME, 1918 (FIRST BATTLE), 24TH-25TH MARCH, 1918.

| Unit.                | Formation.      | Remarks.       |
|----------------------|-----------------|----------------|
| <b>ARMY TROOPS.</b>  |                 |                |
| 257th Tunnelling Co. | VI & XVII Corps | E.             |
| 2nd Aust. " "        | V Corps         | "              |
| N.Z. " "             | XVII & VI Corps | N.E.           |
| No. 352 E. & M. Co.  |                 | D. No diary.   |
| 3rd Field Survey Co. |                 | " No diary.    |
| No. 364 Forestry Co. | V Corps         | " No diary.    |
| No. 3 Pontoon Park   | V " "           | E.             |
| No. 1 Foreway Co.    | IV " "          | D. No records. |
| No. 2 " "            | VI " "          | E.             |
| No. 3 " "            | V Corps         | "              |
| <b>IV CORPS.</b>     |                 |                |
| 81st Field Co.       | 19th Div.       | E.             |
| 82nd " "             | " "             | "              |
| 94th " "             | " "             | "              |
| 105th " "            | 25th Div.       | "              |
| 106th " "            | " "             | "              |
| 130th " "            | " "             | "              |
| 228th " "            | 41st Div.       | "              |
| 233rd " "            | " "             | "              |
| 237th " "            | " "             | "              |
| 400th " "            | 51st Div.       | "              |
| 401st " "            | " "             | "              |
| 404th " "            | " "             | "              |
| 457th " "            | 62nd Div.       | "              |
| 460th " "            | " "             | "              |
| 461st " "            | " "             | "              |
| <b>V CORPS.</b>      |                 |                |
| 5th Field Co.        | 2nd Div.        | E.             |
| 226th " "            | " "             | "              |
| 483rd " "            | " "             | "              |
| 69th " "             | 12th Div.       | N.E.           |
| 70th " "             | " "             | "              |
| 87th " "             | " "             | "              |
| 77th " "             | 17th Div.       | E.             |
| 78th " "             | " "             | "              |
| 93rd " "             | " "             | "              |
| 517th " "            | 47th Div.       | "              |
| 518th " "            | " "             | "              |
| 520th " "            | " "             | "              |
| 247th " "            | 63rd Div.       | "              |
| 248th " "            | " "             | "              |
| 249th " "            | " "             | "              |
| <b>VI CORPS.</b>     |                 |                |
| 55th Field Co.       | Guards Div.     | E.             |
| 75th " "             | " "             | "              |
| 76th " "             | " "             | "              |
| 56th " "             | 3rd Div.        | "              |
| 438th " "            | " "             | "              |
| 529th " "            | " "             | "              |
| 210th " "            | 31st Div.       | "              |
| 211th " "            | " "             | "              |
| 223rd " "            | " "             | "              |
| 207th " "            | 34th Div.       | "              |
| 208th " "            | " "             | "              |
| 209th " "            | " "             | "              |
| 224th " "            | 40th Div.       | "              |
| 229th " "            | " "             | "              |
| 231st " "            | " "             | "              |
| 427th " "            | 42nd Div.       | "              |
| 428th " "            | " "             | "              |
| 429th " "            | " "             | "              |
| 467th " "            | 59th Div.       | D.             |
| 469th " "            | " "             | "              |
| 470th " "            | " "             | N.E.           |

## BAPAUME, 1918 (FIRST BATTLE), 24TH-25TH MARCH, 1918.

| Unit.                       | Formation.    | Remarks.     |
|-----------------------------|---------------|--------------|
| <b>XVIII CORPS.</b>         |               |              |
| 73rd Field Co.              | 15th Div.     | E.           |
| 74th "                      | "             | "            |
| 91st "                      | "             | "            |
| 9th "                       | 4th Div.      | N.E.         |
| 406th "                     | "             | "            |
| 526th "                     | "             | "            |
| <b>FIFTH ARMY.</b>          |               |              |
| <b>ARMY TROOPS.</b>         |               |              |
| No. 1. Special (Mortar) Co. | VII Corps     | E.           |
| 146th Army Troops Co.       | "             | D. No diary. |
| 221st "                     | "             | N.E.         |
| 238th "                     | "             | "            |
| 574th "                     | "             | D. No diary. |
| 177th Tunnelling Co.        | "             | E.           |
| 178th "                     | "             | "            |
| 180th "                     | "             | "            |
| <b>VII CORPS.</b>           |               |              |
| 1st Field Squadron          | 1st Cav. Div. | N.E.         |
| 63rd Field Co.              | 9th Div.      | E.           |
| 64th "                      | "             | "            |
| 90th "                      | "             | "            |
| 97th "                      | 21st Div.     | "            |
| 98th "                      | "             | "            |
| 126th "                     | "             | "            |
| 203rd "                     | 35th Div.     | "            |
| 204th "                     | "             | "            |
| 205th "                     | "             | "            |

## SIGNALS.

## BAPAUME, 1918 (FIRST BATTLE). 24TH-25TH MARCH, 1918.

| Unit.                    | Formation. | Remarks. |
|--------------------------|------------|----------|
| Third Army Signal Co.    |            | N.E.     |
| D Corps Signal Co.       | IV Corps   | E.       |
| 19th Divl. Signal Co.    | "          | "        |
| 25th "                   | "          | "        |
| 41st "                   | "          | "        |
| 51st "                   | "          | "        |
| 62nd "                   | "          | "        |
| O Corps Signal Co.       | V Corps    | "        |
| 2nd Divl. Signal Co.     | "          | "        |
| 12th "                   | "          | N.E.     |
| 17th "                   | "          | E.       |
| 47th "                   | "          | "        |
| 63rd "                   | "          | "        |
| F Corps Signal Co.       | VI Corps   | D.       |
| Guards Divl. Signal Co.  | "          | E.       |
| 3rd "                    | "          | "        |
| 31st "                   | "          | "        |
| 40th "                   | "          | "        |
| 42nd "                   | "          | "        |
| 59th "                   | "          | N.E.     |
| R Corps Signal Co.       | XVII Corps | D.       |
| 15th Divl. Signal Co.    | "          | E.       |
| Fifth Army Signal Co.    | "          | N.E.     |
| G Corps Signal Co.       | VII Corps  | D.       |
| 1st Cav. Div. Signal Co. | "          | "        |
| 9th Divl. Signal Co.     | "          | E.       |
| 21st "                   | "          | "        |
| 35th "                   | "          | "        |



## ROSIERES. 26TH-27TH MARCH, 1918.

| Unit.                       | Formation.  |      | Remarks.              |
|-----------------------------|-------------|------|-----------------------|
| <b>FIFTH ARMY.</b>          |             |      |                       |
| <b>ARMY TROOPS.</b>         |             |      |                       |
| 5th Field Squadron          | XIX Corps   | E.   | 1st R.E. Batn.        |
| A Special (Projector) Co.   | XVIII "     | "    |                       |
| E "                         | XVIII "     | "    |                       |
| H "                         | XVIII "     | "    |                       |
| No. 1 Special (Mortar) Co.  | VII "       | N.E. |                       |
| 144th Army Troops Co.       | Fifth Army  | E.   |                       |
| 146th "                     | VII Corps   | D.   | No diary.             |
| 213th "                     | Fifth Army  | E.   |                       |
| 216th "                     | XVIII Corps | "    |                       |
| 217th "                     | Fifth Army  | "    | Carey's Force.        |
| 221st "                     | VII Corps   | N.E. |                       |
| 238th "                     | VII "       | "    |                       |
| 239th "                     | XIX "       | E.   | C. Co. 1st R.E. Batn. |
| 281st "                     | XIX "       | "    | C. Co. 1st R.E. Batn. |
| 283rd "                     | XIX "       | "    | D. Co. 1st R.E. Batn. |
| 288th "                     | XIX "       | "    | D. Co. 1st R.E. Batn. |
| 574th "                     | VII "       | D.   | No diary.             |
| No. 1 Siege Co. R. Anglesey | XVIII "     | E.   |                       |
| 172nd Tunnelling Co.        | XVIII "     | "    |                       |
| 173rd "                     | XIX "       | "    | A. Co. 1st R.E. Bat.  |
| 253rd "                     | XIX "       | "    |                       |
| 258th "                     | XIX "       | "    | B. Co. 1st R.E. Bat.  |
| No. 353 E. & M. Co.         |             | D.   | No diary.             |
| 5th Field Survey Co.        |             | E.   | Carey's Force.        |
| No. 6 Foreway Co.           | XVIII Corps | "    |                       |
| <b>XVIII CORPS.</b>         |             |      |                       |
| 83rd Field Co.              | 20th Div.   | E.   |                       |
| 84th "                      | "           | "    |                       |
| 96th "                      | "           | "    |                       |
| 200th "                     | 30th Div.   | "    |                       |
| 201st "                     | "           | "    |                       |
| 202nd "                     | "           | "    |                       |
| 121st Field Co.             | 36th Div.   | "    |                       |
| 122nd "                     | "           | "    |                       |
| 150th "                     | "           | "    |                       |
| 476th "                     | 61st Div.   | "    |                       |
| 478th "                     | "           | "    |                       |
| 479th "                     | "           | "    |                       |
| <b>XIX CORPS.</b>           |             |      |                       |
| 2nd Field Co.               | 8th Div.    | E.   |                       |
| 15th "                      | "           | "    |                       |
| 490th "                     | "           | "    |                       |
| 155th "                     | 16th Div.   | "    |                       |
| 156th "                     | "           | "    |                       |
| 157th "                     | "           | "    |                       |
| 103rd "                     | 24th Div.   | "    |                       |
| 104th "                     | "           | "    |                       |
| 129th "                     | "           | "    |                       |
| 225th "                     | 39th Div.   | "    |                       |
| 227th "                     | "           | "    |                       |
| 234th "                     | "           | "    |                       |
| 7th "                       | 50th Div.   | "    |                       |
| 446th "                     | "           | "    |                       |
| 447th "                     | "           | "    |                       |
| 430th "                     | 66th Div.   | "    |                       |
| 431st "                     | "           | "    |                       |
| 432nd "                     | "           | "    |                       |

## SIGNALS.

ROSIERES. 26TH-27TH MARCH, 1918.

| Unit.                 | Formation.  | Remarks. |
|-----------------------|-------------|----------|
| Fifth Army Signal Co. | Fifth Army  | N.E.     |
| S. Corps Signal Co.   | XVIII Corps | D.       |
| 20th Divl. Signal Co. | "           | E.       |
| 30th "                | "           | "        |
| 36th "                | "           | "        |
| 61st "                | "           | "        |
| T. Corps Signal Co.   | XIX Corps   | D.       |
| 8th Divl. Signal Co.  | "           | E.       |
| 16th "                | "           | "        |
| 24th "                | "           | "        |
| 39th "                | "           | "        |
| 50th "                | "           | "        |
| 66th "                | "           | "        |

ARRAS, 1918 (FIRST BATTLE). 28TH MARCH, 1918.

| Unit.                       | Formation  | Remarks.                                 |
|-----------------------------|------------|--|
| <b>FIRST ARMY.</b>          |            |  |
| <b>ARMY TROOPS.</b>         |            |  |
| 176th Tunnelling Co.        | XIII Corps | E. R.E. Batn. "B" Reserve Bde. 56th Div. |
| No. 4 Siege Co. R. Anglesey | "          | D. No diary.                             |
| <b>XIII CORPS.</b>          |            |  |
| 416th Field Co.             | 56th Div.  | E. } R.E. Batn.                          |
| 512th "                     | "          | " } "B" Reserve Bde.                     |
| 513th "                     | "          | " }                                      |
| <b>THIRD ARMY.</b>          |            |  |
| <b>ARMY TROOPS.</b>         |            |  |
| G (Special) Projector Co.   | IV Corps   | N.E.                                     |
| J "                         | VI "       | "  |
| Q "                         | V "        | "  |
| No. 3 (Special) Mortar Co.  | VI "       | "  |
| 132nd Army Troops Co.       | VI "       | "  |
| 142nd "                     | IV "       | "  |
| 147th "                     | V "        | "  |
| 149th "                     | IV "       | "  |
| 232nd "                     | VI "       | E.                                       |
| 280th "                     | V "        | N.E.                                     |
| 282nd "                     | XVII "     | D. Diary useless.                        |
| 559th "                     | V "        | N.E.                                     |
| 565th "                     | VI "       | E.                                       |
| 577th "                     | V "        | N.E.                                     |
| 7th R. Monmouth "           | IV "       | E.                                       |
| No. I Siege Co. R. Monmouth | XVII "     | "  |
| 174th Tunnelling Co.        | VI "       | "  |
| 175th "                     | V "        | N.E.                                     |
| 179th "                     | XVII "     | E.                                       |
| 181st "                     | VI "       | "  |
| 252nd "                     | IV "       | N.E.                                     |
| 257th "                     | XVII "     | E.                                       |
| 2nd Aust. "                 | V "        | N.E.                                     |
| N.Z. Tunnelling Co.         | XVII "     | E.                                       |
| No. 352 E. & M. Co.         | "          | D. No diary.                             |
| 3rd Field Survey Co.        | "          | " No diary.                              |

## ARRAS, 1918 (FIRST BATTLE), 28TH MARCH, 1918.

| Unit.              | Formation.     | Remarks.                            |
|--------------------|----------------|-------------------------------------|
| THIRD ARMY.        |                |                                     |
| ARMY TROOPS.       |                |                                     |
| No. 3 Pontoon Park | V & VI Corps   | N.E.                                |
| No. 8 "            | XVII Corps     | "                                   |
| No. 1 Foreway Co.  | IV "           | D. No records.                      |
| No. 2 "            | VI "           | N.E.                                |
| No. 3 "            | V "            | "                                   |
| IV CORPS.          |                |                                     |
| 228th Field Co.    | 41st Div.      | E.                                  |
| 233rd "            | "              | "                                   |
| 237th "            | "              | "                                   |
| 427th "            | 42nd Div.      | "                                   |
| 428th "            | "              | "                                   |
| 429th "            | "              | "                                   |
| 457th "            | 62nd Div.      | "                                   |
| 460th "            | "              | "                                   |
| 461st "            | "              | "                                   |
| 1st N.Z. Field Co. | N.Z. Div.      | "                                   |
| 2nd "              | "              | "                                   |
| 3rd "              | "              | "                                   |
| 4th Aust. "        | 4th Aust. Div. | N.E.                                |
| 12th "             | "              | "                                   |
| 13th "             | "              | "                                   |
| 81st Field Co.     | 19th Div.      | D.                                  |
| 82nd "             | "              | } Within the area but not employed. |
| 94th "             | "              |                                     |
| V CORPS.           |                |                                     |
| 5th Field Co.      | 2nd Div.       | E.                                  |
| 226th "            | "              | "                                   |
| 483rd "            | "              | "                                   |
| 69th "             | 12th Div.      | N.E.                                |
| 70th "             | "              | "                                   |
| 87th "             | "              | "                                   |
| VI CORPS.          |                |                                     |
| 55th Field Co.     | Guards Div.    | E.                                  |
| 75th "             | "              | "                                   |
| 76th "             | "              | "                                   |
| 56th "             | 3rd Div.       | "                                   |
| 438th "            | "              | "                                   |
| 529th "            | "              | "                                   |
| 210th "            | 31st Div.      | "                                   |
| 211th "            | "              | "                                   |
| 223rd "            | "              | "                                   |
| 206th "            | 32nd Div.      | N.E.                                |
| 218th "            | "              | "                                   |
| 219th "            | "              | "                                   |
| 207th "            | 34th Div.      | E.                                  |
| 208th "            | "              | "                                   |
| 209th "            | "              | "                                   |
| 4th Can. "         | 2nd Can. Div.  | "                                   |
| 5th "              | "              | "                                   |
| 6th "              | "              | "                                   |
| XVII CORPS.        |                |                                     |
| 9th Field Co.      | 4th Div.       | E.                                  |
| 406th "            | "              | "                                   |
| 526th "            | "              | "                                   |
| 73rd "             | 15th Div.      | "                                   |
| 74th "             | "              | "                                   |
| 91st "             | "              | "                                   |

## SIGNALS.

ARRAS, 1918 (FIRST BATTLE). 28TH MARCH, 1918.

| Unit.                   | Formation. | Remarks. |
|-------------------------|------------|----------|
| First Army Signal Co.   |            | N.E.     |
| N. Corps Signal Co.     | XIII Corps | D.       |
| 56th Divl. Sig. Co.     | "          | E.       |
| Third Army Signal Co.   |            | N.E.     |
| D. Corps Signal Co.     | IV Corps   | D.       |
| 41st Divl. Sig. Co.     | "          | E.       |
| 42nd "                  | "          | "        |
| 62nd "                  | "          | "        |
| N.Z. "                  | "          | "        |
| 4th Aust. Signal Co.    | "          | N.E.     |
| O. Corps Signal Co.     | V Corps    | D.       |
| 2nd Divl. Signal Co.    | "          | "        |
| 12th "                  | "          | "        |
| F. Corps Signal Co.     | VI Corps   | "        |
| Guards Divl. Signal Co. | "          | E.       |
| 3rd "                   | "          | "        |
| 31st "                  | "          | "        |
| 32nd "                  | "          | N.E.     |
| 2nd Can. "              | "          | E.       |
| R. Corps Signal Co.     | XVII Corps | D.       |
| 4th Divl. Signal Co.    | "          | E.       |
| 15th "                  | "          | "        |

AVRE. 4TH APRIL, 1918.

| Unit.                 | Formation.     | Remarks. |
|-----------------------|----------------|----------|
| FOURTH ARMY.          |                |          |
| ARMY TROOPS.          |                |          |
| 135th Army Troops Co. | XIX Corps      | E.       |
| 239th "               | "              | "        |
| 281st "               | "              | "        |
| 283rd "               | "              | "        |
| 288th "               | "              | D.       |
| 173rd Tunnelling Co.  | "              | E.       |
| 258th "               | "              | "        |
| XIX CORPS.            |                |          |
| 3rd Field Squadron    | 3rd Cav. Div.  | E.       |
| 5th "                 | Cav. Corps     | D.       |
| 61st Field Co.        | 14th Div.      | E.       |
| 62nd "                | "              | "        |
| 89th "                | "              | "        |
| 79th "                | 18th Div.      | "        |
| 80th "                | "              | "        |
| 92nd "                | "              | "        |
| 103rd "               | 24th Div.      | D.       |
| 104th "               | "              | N.E.     |
| 129th "               | "              | "        |
| 503rd "               | 58th Div.      | "        |
| 504th "               | "              | "        |
| 511th "               | "              | "        |
| 5th Aust. "           | 2nd Aust. Div. | "        |
| 6th "                 | "              | "        |
| 7th "                 | "              | E.       |
| 9th "                 | 3rd Aust. Div. | D.       |
| 10th "                | "              | N.E.     |
| 11th "                | "              | "        |
| 8th "                 | 5th Aust. Div. | "        |
| 14th "                | "              | "        |
| 15th "                | "              | "        |

## SIGNALS.

AVRE. 4TH APRIL, 1918.

| Unit.                  | Formation.    | Remarks. |
|------------------------|---------------|----------|
| Fourth Army Signal Co. |               | N.E.     |
| T. Corps Signal Co.    | XIX Corps     | D.       |
| 3rd Signal Sqn.        | 3rd Cav. Div. | E.       |
| 14th Divl. Sig. Co.    | XIX Corps     | "        |
| 18th "                 | "             | "        |
| 24th "                 | "             | D.       |
| 58th "                 | "             | N.E.     |
| 2nd Aust. "            | "             | "        |
| 3rd Aust. "            | "             | "        |
| 5th Aust. "            | "             | "        |

ANCRE, 1918. 5TH APRIL, 1918.

| Unit.                           | Formation.     | Remarks.     |
|---------------------------------|----------------|--------------|
| THIRD ARMY.                     |                |              |
| ARMY TROOPS.                    |                |              |
| G Special (Projector) Co.       | Special Bde.   | E.           |
| J. "                            | "              | "            |
| N. "                            | "              | "            |
| Q. "                            | "              | "            |
| 132nd Army Troops Co.           | VI Corps       | D.           |
| 142nd "                         | IV "           | N.E.         |
| 146th "                         | VII "          | D. No diary. |
| 147th "                         | IV "           | "            |
| 149th "                         | IV "           | "            |
| 221st "                         | VII "          | N.E.         |
| 232nd "                         | VI "           | "            |
| 238th "                         | VII "          | "            |
| 280th "                         | V "            | "            |
| 559th "                         | V "            | "            |
| 565th "                         | VI "           | "            |
| 574th "                         | VII "          | D. No diary. |
| 577th "                         | V "            | No diary.    |
| 7th R. Monmouth Army Troops Co. | IV "           | "            |
| No. 1 Siege Co. R. Monmouth     | VI "           | N.E.         |
| 174th Tunnelling Co.            | VI "           | D.           |
| 175th "                         | V "            | No diary.    |
| 177th "                         | VII & VI Corps | N.E.         |
| 178th "                         | VII Corps      | D. No diary. |
| 180th "                         | VII "          | N.E.         |
| 181st "                         | VI "           | "            |
| 252nd "                         | IV "           | D.           |
| 257th "                         | VI "           | N.E.         |
| 2nd Aust. "                     | VII "          | D.           |
| N.Z. "                          | VI "           | N.E.         |
| No. 3 Pontoon Park              | V "            | "            |
| No. 1 Foreway Co.               | IV "           | E.           |
| No. 2 "                         | VI "           | N.E.         |
| No. 3 "                         | V "            | "            |
| IV CORPS.                       |                |              |
| 152nd Field Co.                 | 37th Div.      | E.           |
| 153rd "                         | "              | "            |
| 154th "                         | "              | "            |
| 427th "                         | 42nd Div.      | "            |
| 428th "                         | "              | "            |
| 429th "                         | "              | "            |

ANCRE, 1918. 5TH APRIL, 1918.

| Unit.               | Formation.     | Remarks. |
|---------------------|----------------|----------|
| IV CORPS.           |                |          |
| 457th Field Co.     | 62nd Div.      | E.       |
| 460th "             | "              | "        |
| 461st "             | "              | "        |
| 1st N.Z. "          | N.Z. Div.      | "        |
| 2nd "               | "              | "        |
| 3rd "               | "              | "        |
| V CORPS.            |                |          |
| 69th Field Co.      | 12th Div.      | E.       |
| 70th "              | "              | "        |
| 87th "              | "              | "        |
| 77th "              | 17th Div.      | "        |
| 78th "              | "              | "        |
| 93rd "              | "              | N.E.     |
| 123rd "             | 38th Div.      | E.       |
| 124th "             | "              | N.E.     |
| 151st "             | "              | E.       |
| 517th "             | 47th Div.      | "        |
| 518th "             | "              | "        |
| 520th "             | "              | "        |
| 247th "             | 63rd Div.      | "        |
| 248th "             | "              | "        |
| 249th "             | "              | "        |
| VI CORPS.           |                |          |
| 55th Field Co.      | Guards Div.    | N.E.     |
| 75th "              | "              | "        |
| 76th "              | "              | "        |
| 206th "             | 32nd Div.      | E.       |
| 218th "             | "              | "        |
| 219th "             | "              | "        |
| VII CORPS.          |                |          |
| 4th Aust. Field Co. | 4th Aust. Div. | D.       |
| 12th "              | "              | E.       |
| 13th "              | "              | "        |

## SIGNALS.

ANCRE, 1918. 5TH APRIL, 1918.

| Unit.                    | Formation. | Remarks. |
|--------------------------|------------|----------|
| Third Army Signal Co.    |            | N.E.     |
| D. Corps Signal Co.      | IV Corps   | D.       |
| 37th Divl. Sig. Co.      | "          | E.       |
| 42nd "                   | "          | "        |
| N.Z. "                   | "          | "        |
| O. Corps Signal Co.      | V Corps    | D.       |
| 12th Div. Sig. Co.       | "          | E.       |
| 47th "                   | "          | "        |
| 63rd "                   | "          | "        |
| F. Corps Signal Co.      | VI Corps   | N.E.     |
| 32nd Divl. Sig. Co.      | "          | E.       |
| G. Corps Signal Co.      | VII Corps  | N.E.     |
| 4th Aust. Divl. Sig. Co. | "          | E.       |

## VILLERS-BRETONNEUX. 24TH-25TH APRIL, 1918.

| Unit.               | Formation.     | Remarks. |
|---------------------|----------------|----------|
| FOURTH ARMY.        |                |          |
| III CORPS.          |                |          |
| 2nd Field Co.       | 8th Div.       | E.       |
| 15th "              | "              | "        |
| 490th "             | "              | "        |
| 79th "              | 18th Div.      | N.E.     |
| 80th "              | "              | "        |
| 92nd "              | "              | "        |
| 503rd "             | 58th Div.      | E.       |
| 504th "             | "              | N.E.     |
| 511th "             | "              | D.       |
| AUSTRALIAN CORPS.   |                |          |
| 4th Aust. Field Co. | 4th Aust. Div. | N.E.     |
| 12th "              | "              | "        |
| 13th "              | "              | "        |
| 8th "               | 5th Aust. Div. | "        |
| 14th "              | "              | "        |
| 15th "              | "              | "        |

## SIGNALS.

## VILLERS-BRETONNEUX. 24TH-25TH APRIL, 1918.

| Unit.                    | Formation.  | Remarks. |
|--------------------------|-------------|----------|
| Fourth Army Signal Co.   |             | N.E.     |
| C Corps Signal Co.       | III Corps   | "        |
| 8th Div. Signal Co.      | "           | E.       |
| 18th "                   | "           | N.E.     |
| 58th "                   | "           | D.       |
| K Corps Signal Co.       | Aust. Corps | N.E.     |
| 4th Aust. Divl. Sig. Co. | "           | "        |
| 5th "                    | "           | D.       |

## *DESCRIPTION OF WATER POWER PLANT FOR COUNTRY HOUSE LIGHTING.*

*By* CAPTAIN A. R. HILDEBRAND, R.E.

The success which has attended the installation of a small water power plant for power and lighting purposes on a farm at Higham, Suffolk, has induced the author to write a description of it, with a view to showing that, where water power is available, a plant of this kind is quite practicable and useful.

The stream which has been harnessed is some 15 feet wide, and its normal depth is from 3 to 4 feet in the middle. Calculations made before any work was begun showed that during the summer months about 5 h.p. was available if all the water coming down were used. The maximum possible head which could be obtained without flooding above the site was 3ft. 6ins. The level of the stream is somewhat variable, depending on the operations of mills further up stream; and down stream, owing to weeds, there is a tendency to flood at certain times of the year. When this occurs there is no corresponding rise in the level of the head water, and the head available is sometimes reduced to 9 inches. During the four years in which the plant has been in use, the floods have never lasted for more than a week, and the head never remains at its minimum for more than 48 hours. These varying conditions are of importance as they have considerable bearing on the choice of design and of the capacity of the battery, as will be seen later.

The actual site available was that of an old linseed mill which had been destroyed by fire. The old mill-race was still intact, but the wheel itself and sluice-gates were gone. A sketch plan of the site is given, and it will be seen that the arrangement of the old mill was unusual. The original bed of the stream was used as a bye-pass, while the mill stream itself, after passing under the site of the old mill in a bricked tunnel, ran along an artificial channel and joined the bye-pass some 200 yards down stream. The sluice-gates were originally at the point of division of the bye-pass and the mill stream. From there the bye-pass ran down a narrow passage 15 feet long and 7 feet wide, with vertical brick sides and concrete bottom, and fell into a mill pond. This pond is some 20 yards in diameter, and in the centre, and where the stream falls into it, is nearly 14 feet deep. There were two possible positions for the turbine, (i) point A on sketch 1 where the old mill had been, with the sluice-gates in their original position, and (ii) point B, at the end of the passage mentioned above, with the outlet submerged in the deepest part of the pool.

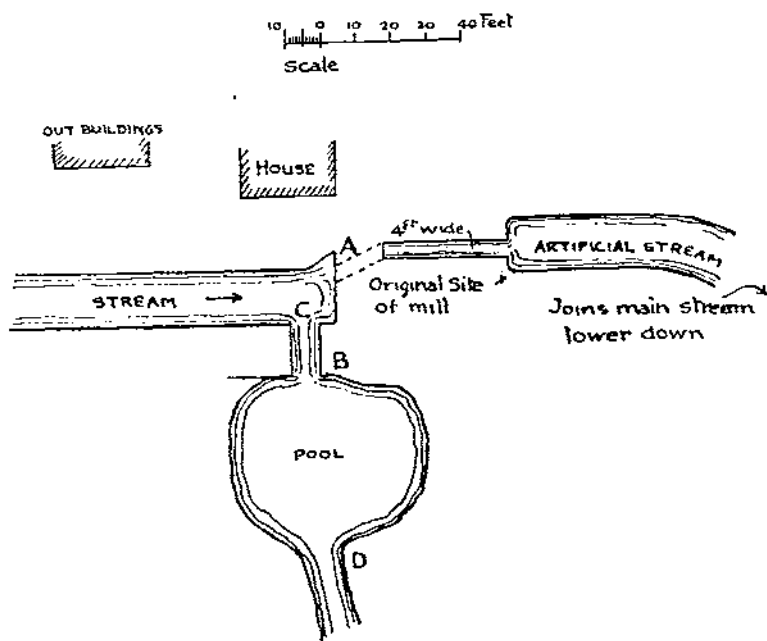


The disadvantage of the first position was that the narrow tunnel did not form a quick get-away for the tail water and that the bottle neck formed by this and the somewhat narrow artificial channel would have the effect of raising the level of the tail water, thereby reducing the available head. The only advantage in this position was that the water could be diverted into the pool, and that all construction work could be done in the dry.

The second position was therefore chosen as the large surface of the pool would reduce any tendency for the water to back up. The sluice gates were placed at the mouth of the tunnel where the old mill had been.

In order to be able to make the foundations for the turbine and to get the outlet pipe fixed in its proper position, it was necessary to drain the mill pond as far as possible. This was done by damming the stream at points C and D on sketch 1, and pumping the water

Sketch I



out of the pond over the dam at D. The main stream was meanwhile diverted through the tunnel. Great difficulty was experienced in sufficiently reducing the level to allow the construction of the foundations to begin. Owing to leaky dams and the presence of either springs at the bottom of the pool, or leaks through the ground from the stream above, it was necessary to instal a power pump and keep it running continuously. Eventually after considerable delay, due to strikes and bad weather, the work was completed, and the position of the various parts of the plant are shown on sketch II.

The grille, made of  $1\frac{1}{4}$ " flat iron with 1" waterway between each bar is to prevent weeds, which would soon do damage, from getting into the turbine. The drop gate above the weir, rests along the top of the concrete wall, and is used to head up the water an extra 6" if desired. The boom is so placed to prevent surface scum from going through the turbine.

Now as to the plant itself. Enquiries had been addressed to three firms who specialised in pump and turbine manufacture, asking them to give an approximate estimate for the manufacture of a 5 h.p. turbine to work at a head of 3 feet. The results were somewhat surprising. The first firm refused to give any estimate and said the cost of manufacture would be prohibitive. The second quoted between £400 and £450, and the third the surprisingly low figure, in view of the replies of the other firms, of £180. This offer was accepted, and they sent an expert down to look at the site, and in consultation with him the arrangement outlined above was decided on. The turbine is an in-flow-radial type, i.e., the inlet is round the circumference and the outlet at the bottom of the machine, and is designed to give 5 h.p. with a head of 3 feet. The driving shaft is vertical and its normal speed is 90 R.P.M. The only other working part of the turbine is the gate regulator which increases or decreases the apertures on the circumference, thereby regulating the amount of water flowing through the turbine. This is worked by another vertical shaft turned by means of a worm and wheel gearing.

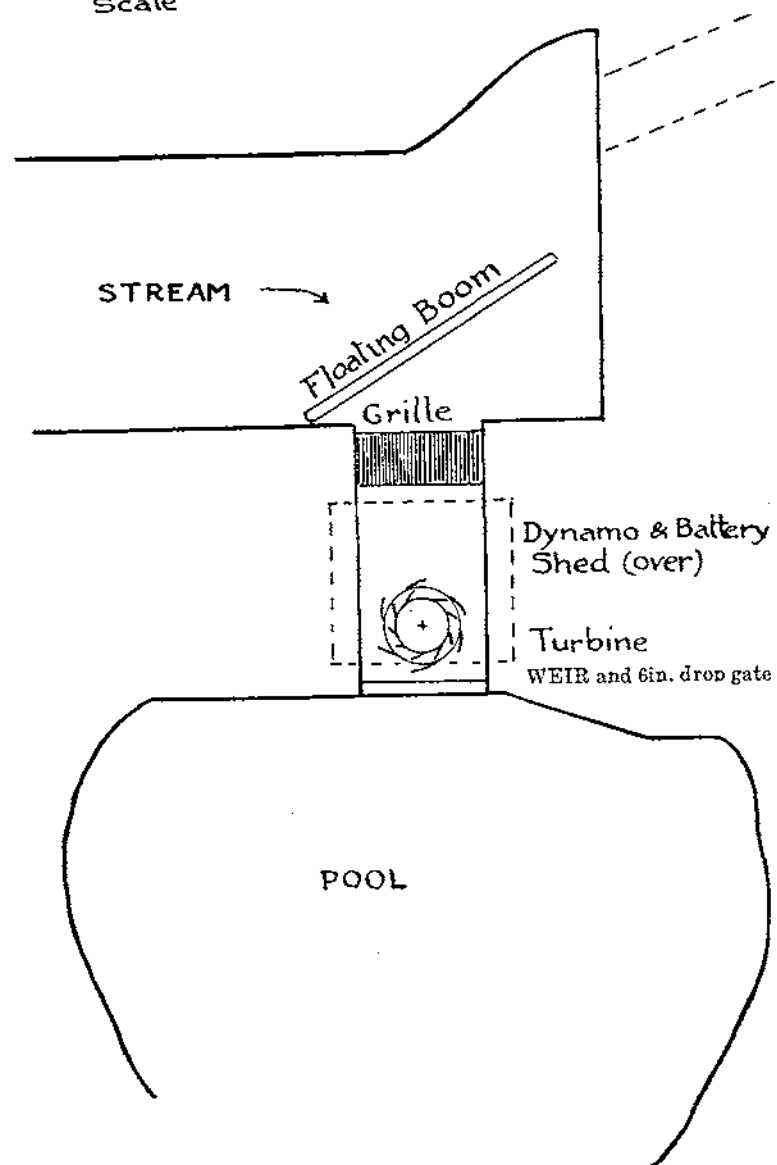
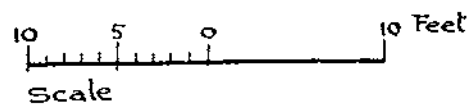
On top of the driving shaft is a crown wheel and from this by means of a bevel drive, geared at 8 to 1, is driven a horizontal shaft. This shaft is coupled to the dynamo by means of a flexible coupling, and it is supported by two ringed oiled bearings. The small bevel wheel is made of compressed raw hide to reduce noise and vibration.

The controls, dynamo and battery, are placed in a wooden hut built on R.S.J's. across the passage, the vertical shaft of the turbine coming up through the floor. The bevel gearing is protected by a wooden box.

At first the turbine was run without any automatic speed control, but owing to the constantly varying head of water and varying loads which came on it, it was found necessary to fit a governor to control the inlet gates. Briefly the action of the governor is this. There are two drives from the horizontal shaft to the governor, one works the governor head, the other a small oil pump. The regulator is opened or closed by a double acting cylinder on the governor. If the speed falls below normal, the governor head opens a valve which admits oil under pressure to one side of the cylinder. The cylinder moves and in doing so opens the inlet gates of the turbine and allows more water to flow through, until the correct speed is attained. If the speed rises above normal, the oil is admitted to the other side of the cylinder, and so closes the gates. This form of governor has been

PLANT FOR COUNTRY HOUSE LIGHTING.

Sketch II



found to work quite satisfactorily, and the machine very quickly adjusts itself to any condition of load. There is a tendency to hunt when the turbine is first started up, but once it has settled down the machine can be left to run itself. The governor is not used when charging accumulators, as the turbine speed for this purpose has to be reduced below the minimum speed at which the governor is sensitive.

The dynamo is a compound-wound 220 v. 3 KW. Crompton machine, normal speed 700/800 revs. The compound winding is necessary to keep the voltage constant at varying conditions of load, since the speed is already kept constant, as described above. The chance of a simultaneous failure of the turbine and automatic cut-out, while charging, is very remote, and there is nothing to be feared in using a compound motor for this purpose.

The accumulators are 100 A.H. capacity and the house lighting voltage is 50, i.e., 27 cells in all, including end cells. The capacity was arranged so that in case of flood the lighting service can be maintained for one week without recharging.

At first an attempt was made to light the house direct off the dynamo at 220 volts, but owing to an irregularity in the crown wheel gearing, the voltage was not sufficiently steady to give direct light, and a battery had to be introduced. In any case it would have been necessary to carry over times of flood, when it is impossible to obtain sufficient speed to give the full voltage. Charging is done by removing the belts to the governor and running the dynamo slow. The normal charging rate is 10-12 amps., and even with the head as low as 9" it has been found possible to give the batteries a charge at 5 amps. By taking every available opportunity of a slight fall of water, it has always been possible to keep the batteries fully charged during floods.

The switchboard is of the usual type with field regulator, dynamo and battery voltmeter, an ammeter in the dynamo circuit, automatic cut-in and out with mercury contacts, charge and discharge switches for the end cells, a double throw switch for connecting the generator to the power circuit or to the battery, and finally, a single throw switch for disconnecting the house lighting circuit.

The house wiring is in two separate circuits, one for power at 220 v., the other for lights at 50 v.

The former is intended for the standard fitments such as kettles, irons, etc., and also for the various machines connected with the farm. On this circuit is run a circular saw, corn grinder, chaff cutting machines and root cutter, and a small electric laundry. Some control is necessary in the use of these machines to ensure that the plant is not overloaded, but this is a comparatively simple matter.

The lighting circuit consists of about 30 points and this includes lights in some of the farm buildings where required.

The whole of the wiring is done with lead covered twin or 3-core wire in the house itself and the ordinary braided wire on cleats in the out buildings. Wires between buildings are overhead.

The total cost of the complete installation as described was £800. The running costs, apart from interest charges, are practically nil, and only amount to the cost of a few gallons of lubricating oil per annum. As there are no running costs to speak of, it is no extravagance to run the machine for the smallest load for 24 hours out of 24 if required.

If at any time it is found necessary to increase the amount of power available, it can very easily be done by either increasing the voltage or the capacity of the batteries, and charging during the night.

This plant has now been in use for over 4 years, and since the battery and governor were installed has given no trouble whatsoever. It is extremely simple to work, and anyone can be taught to start it up and stop it in a very few minutes. The battery has been given regular work and kept well charged and is in perfect condition. It is most important to keep weeds and solid matter from the inside of the turbine, but apart from that there is very little to go wrong. The only breakdown which has occurred since the plant was put in, was due to a nut dropping through the floor of the hut and becoming wedged in the turbine gate. When the gates, which are cast iron, were closed, one of them cracked and had to be replaced. A recurrence of this has been avoided by covering in the whole of the floor, so that nothing can drop through.

On the whole this plant has very decided advantages over a paraffin plant of the same H.P. and up to the present has proved itself quite as reliable and useful, and the possibilities of installing a similar set where water with even very low heads is available, should be carefully explored.

NOTES BY A CHIEF ENGINEER DURING THE GREAT  
WAR OF 1914-18 (*concluded*).

By BRIGADIER GENERAL W. BAKER BROWN, C.B.

CAMPS.

During the summer of 1915 there was a great demand for tent camps for the rapidly increasing number of troops who could not be accommodated in hutments. For these camps there is no regular schedule of buildings to be provided by the R.E., but in peace time each command issues its own "instructions for the formation of summer camps." These, however, are only occupied for a few weeks, while it was evident that any camps we made were likely to be occupied for the whole summer. We therefore issued in the first place only a list of buildings which should be provided, but this list was supplemented later as the need became evident. I deliberately avoided sending out type drawings, as I did not want to check the initiative of local officers, and I had full confidence in my C.R.E's. The camp accommodation provided in 1915 reached a total of 250,000 all ranks.

In the summer of 1916 we had hoped that the improved accommodation we had been able to give in hired buildings would render many tent camps unnecessary, but partly, as explained above, that a redistribution of the troops for strategical reasons was ordered by Sir J. French, and partly in order to get the troops out of the towns in the hot weather, a very large programme of camps was called for, up to a total exceeding 200,000 men, and many of these were on new sites.

A few details of our experience during these two years may be of value in future. The first and most important point was that of site, and on this point I would only confirm what I have written above in the case of hutments, that the three main points to consider are roads, drainage, and water supply.

In selecting a site, the existence of good roads is the dominant feature. In the case of a camp in a private park the camp should be put *astride* the main drive, or along the edge when the park is bounded by a road. If the road contains a main drain, and also water mains, much trouble will be saved, and it is worth going to the trouble of consulting the local authorities to secure these details.

The various establishments should be arranged along the roads and sleeping tents put just behind them. Paths should be marked

out early and gradually improved. Short cuts across the grass should be forbidden, and all transport should be *strictly* confined to the roads or to selected parking grounds. It is particularly necessary to watch this in the early stages, or the transport bringing the tents, &c., to the site may spoil the surface irretrievably.

In an ordinary camp it is usual to cook in the open, but in a standing camp cover should be provided over the cooking stoves, and also over some place for preparing and issuing food. A store is also required for meat and bread, which must be made fly-proof. The floors of these shelters should be of concrete, graded to a foul drain. As concrete floors take time to set and troops are always impatient to occupy their camps, we started a slab factory on the site of each camp, where we made up concrete slabs about 2ft. x 2ft. x 2½in. thick. These were given plenty of time to harden, and can then be laid in a few hours and are easily replaced if broken or worn. They can also be used for floors of ablution and bath rooms, and possibly for latrines.

Wherever possible we arranged a bathing establishment on the same lines as described for hired buildings, using for this purpose some neighbouring building or barn.

#### ACCOMMODATION FOR PRISONERS OF WAR.

If the work we did on hired buildings was that which gave us the most satisfaction, the work on prisoners' camps was the most troublesome. In March, 1915, the only prisoners' camp in the command was at Stratford (atte Bowe) in the east of London. It was an old building, such as can be met with in hundreds in London, used for general manufacture. It was large enough to provide sleeping space for 900 prisoners, but the only open ground near it was a small yard enclosed by a wire fence. The whole building was surrounded by small workmen's houses, and this was perhaps its greatest safety, as the occupants of these houses who had relatives and friends at the front, used to express their opinion of the Germans in very plain language. After the first gas attack outside Ypres the prisoners asked for permission to do without their usual exercise, as they were afraid of violence from their neighbours! Over £6,000 was spent on structural alterations to make this building habitable.

My next experience was with the Alexandra Palace. This pleasure house of iron and glass had been occupied by parties of refugees from Belgium, and, when better accommodation was found for these, was taken over for prisoners. Our first instructions, received through the General Staff of the Command, were that the Palace would hold 5,000 prisoners and would be required in a week. I at once visited the building and discussed details with the Commandant and with the D.O.R.E. The nature of the buildings made the problem

somewhat unusual, as the glass sides allowed of a forced exit at almost any point, while the floors were open battens and the whole building was a nest of rooms and passages. Also in the building itself there were practically no facilities for cooking, and almost all the latrines provided for the public were outside the building. However, there was a roof and water, and drains were within reach.

For the walls of the building my D.O. made an excellent suggestion, which was to line the whole building to a height of about 9 feet with expanded metal as used for reinforced concrete. This did not interfere with light or air, but is a good obstacle, as it is very difficult to cut and very uncomfortable to climb.

For cooking we had to provide an entire new outfit, as the Belgian refugees had only been supplied with very meagre apparatus. For ablution and latrines we had to form enclosures inside the building, and lay drains and water, the floor being formed of patent flooring material laid straight on to the boards. Baths were also provided.

The layout of the building presented some difficulty, and it was evident that the number who could be accommodated had been overstated, but later, by making some structural alterations, we accommodated the full 5,000. In order to fit beds into a large area like this, with no walls on which clothes could be hung, we made dwarf walls of wood about 3 feet high and about 15 feet apart, running the length of the building. Beds were then arranged head to wall on each side, and the clothes were arranged on a shelf on the top of the wall. At the same time the sentry had an uninterrupted view of the whole space. Each group of a thousand men was formed into a unit under its own leader, and each group had its own dining-room and accessory buildings. As the occupants were Germans domiciled in this country they were presumably friendly, and were allowed some privileges, such as access to the Concert Hall, where they gave excellent performances. For the purpose of exercise we formed areas in the grounds, one for each group of 1,000. The staff of the camp was accommodated in a wing of the building. The military guard was in huts in the grounds. It took us three weeks of hard work before the prison could be occupied, even in part.

The third big prisoners' camp we had to do with was near Weedon. The first we heard of it was a letter from the War Office stating that a camp to take 5,000 prisoners had been constructed by the Office of Works, and that they required assistance in arranging the wire enclosure surrounding the camp. Here again I found the original camp had been formed for refugees, who had been allowed to construct their own shelters. There was originally a small house and a few buildings on the site, but no facilities for water or drainage. The place was some way from the nearest railway station.

The shelters erected by the refugees were supposed to accommodate 1,000 in all; they mostly consisted of small shanties about



8 feet wide, with a double tier of bunks down each side. The floor space was less than 10 feet per head and the lighting and ventilation were defective. There was one good hall, with a wooden truss roof, which was used for dining. On to this very inadequate nucleus the Office of Works had added a new camp for 4,000 men. I gathered that the Office of Works, who in times of peace are responsible for the "works" connected with all Government establishments, and who have a very efficient staff of engineers and surveyors, had represented to the Government that they might be able to help in the execution of some of the heavy programme of engineering work. They were thereupon put in charge of this prisoners' camp for 4,000 men, and proceeded to lay it out and erect huts and accessories, without any reference to the Command, and apparently without reference to the W.O. scale of accommodation in hutments. The latter is important, as prisoners of war are supposed to receive the same facilities as regards floor space, light, air and water as are given to our own men under war conditions. The results of the work were very much what was to be expected under the circumstances. All the engineering work was excellent; the huts were well constructed, an elaborate system of water supply, with a specially sunk well, was provided, a new sewage plant was constructed on the sprinkler system, and an electric power station for light. On the other hand, the accommodation in the sleeping huts was on a scale of 30 feet floor space only; the whole lay-out was very cramped, the huts were too close together and too near the boundary of the site, and there was no hospital accommodation, except a small house which had been used for the refugees, which contained beds for seven men only. The latter was about enough for the sick of the guard detachment, but much too small for the prisoners.

On reference to the War Office it was decided that as the huts were of a large size with high roofs, the 30-feet floor space could stand, but the original nucleus of refugee shanties was abolished altogether. A hospital for about 50 beds was provided in huts inside an enclosure. Additional accommodation was provided for the guard and a barbed wire enclosure added round the main camp, with sentry posts. The camp was then taken into use, but was rather troublesome to work, as everything and everybody had to be carried by road transport from the nearest town, which was some miles away.

In addition to these three camps, we had to prepare a large house near Uxbridge as a prison for officers, which gave a lot of trouble, and also had to enclose a large hospital near Dartford for sick prisoners. When home-grown timber began to be cut systematically, several small camps for small parties of German prisoners were formed in different localities. These gave no trouble. We also prepared Feltham Detention Institution to accommodate prisoners from friendly countries who had been compelled to fight against us.

The form of the obstruction round these camps requires a short notice. The obstacle surrounding such a camp has got to be capable of keeping out communication from outside, as well as of keeping prisoners in, and if the prisoners try to force a way out the obstacle must detain them sufficiently long to give the sentries time to use their rifles. The best form of obstacle is, therefore, two lines of vertical fence, each about 5 feet high and set 6 feet apart. This centre gangway should be kept perfectly clear and must be commanded by sentry posts at intervals, which should if possible be raised above the ground. Inside and outside these fences there should be an apron of loose coils of wire about 5 to 8 feet wide. The fence must be illuminated at night throughout its whole length, and the neighbourhood of the prisoners' huts and the ground inside the enclosure must also be sufficiently illuminated to enable any movement to be detected.

#### MISCELLANEOUS.

In addition to the accommodation for men, there were a large mass of miscellaneous services which can only be indicated.

*Churches.* At first no provision was made for religious services in any of the hutments, but later, in the middle of 1915, the War Office approved of the allotment of one 60-feet hut in each Brigade camp as a chapel and office for the Church of England padre, and of one hut each in a divisional camp for the Roman Catholics and Presbyterians. These huts were fitted up by voluntary effort and were much appreciated.

*Barrack Stores.* Two huts in each brigade lines were allotted to the Barrack officer, and the space between enclosed as a yard for heavy stores and cases. These answered fairly well, but it would have been better to provide a special establishment in the first place, situated near a main road and with proper unloading space for lorries.

*Horse Lines and Veterinary Hospitals.* Horse lines were provided in the original hutments for the 1st line transport of the units, but were practically hardly ever used. When the hutments were used for Reserve brigades, the horse lines were converted into drill sheds, by knocking out the insides as far as possible. We had also in the command a number of horse depots, of which the most important were at Northampton, Kettering, and Puckley, in Kent. In most cases we had to improve the accommodation for attendants. The question of flooring gave some trouble, as the supply of bedding gave out, so that horses had to stand on a hard floor. As a rule, concrete makes a bad stable floor, unless it has plenty of time to harden, and bricks on edge are a better substitute. Watering places

must be surrounded by a hard, well-drained surface, or there will be trouble with mud. Drainage wants a good deal of attention.

*Pay and Record Offices.* These offices grew enormously during the war, and special arrangements were made for their accommodation. They not only kept the accounts of the troops themselves, but had to deal with a mass of correspondence with wives and other dependants; they were staffed very largely by women. At first these offices started in barracks and military buildings, but as they increased in size, extra buildings were required. I found the R.E. Record Office was occupying nearly a quarter of Brompton Barracks, while the Pay office was using about 70 different dwelling houses in Rochester.

The first change we made was at Hounslow, the Headquarters of the Home Counties group of units, where my D.O., Major Chapman, S.R.E.S., suggested that an office of large huts should be constructed at one side of the parade in the barracks. We obtained War Office approval to the erection of two large huts, each 150 ft. by 30 ft., to accommodate 100 clerks in each, and these proved so successful that the number was increased up to 10 huts, accommodating about 1,000 clerks in all. The 28-ft. sectional hut was used for the extension. These huts were arranged parallel to one another with a central corridor down the middle. Cloak rooms were arranged off this corridor and latrines for women clerks were put at one end. In the centre of each hut was put the supervisor's room, which was screened by a glazed partition. Each end of the hut accommodated 50 clerks. Emergency doors were arranged at each end for exit in case of fire. I designed a special form of desk on the knee-hole principle, but these were not liked, as the officers preferred to use the ordinary trestle table, and to keep all papers above the table. This scheme was so successful that we applied the same principle to other offices. A large office was constructed on the Black Lion field on Chatham Lines for the R.E., also one at Warley for the East Anglian units, at Dover for R.G.A., and at Woolwich we had three offices for R.F.A. and A.S.C. Two of these were in existing buildings expanded by huts. One was in a new hut office on Woolwich Common. I believe the War Office adopted our arrangement for other commands.

*Ordnance Buildings.* The ordnance stores in the Command all required some additional accommodation, notably at Dover. At the Weedon depot we were told to provide accommodation for 1½ million rifles which were being supplied. The W.O. scheme was to stack the rifles on their sides in stacks which could not exceed 6 feet in height. The building selected was a high one, and in order to get more floor space it was proposed to erect a wide gallery all round the walls. On going into details as to space round stacks, we found it

advisable to construct a complete upper storey of steel and concrete, and this was really easier to construct than a gallery. A large lift capable of carrying considerable weight was constructed between the two floors. In addition we had to carry out a scheme for the extension of existing buildings and sidings.

*Schools, &c.* Among miscellaneous jobs which may be mentioned was the conversion of houses into schools, both for our own Command and the London District, and the conversion of hutted camps into convalescent depots, the latter requiring the provision of massage accommodation and an extension of recreation and lecture rooms. A very successful convalescent camp was formed at Eastbourne, and both Seaford and Shoreham hutments were similarly used.

*Rest Camps at Folkestone.* This was the principal port of embarkation and disembarkation for the Army in France. As the train movements did not always fit the boats, there were always a number of men in Folkestone at a loose end. When bad weather prevented the boats from starting, the number grew very large. During the winter of 1914-15, accommodation was found for such men in the local drill halls and at Shorncliffe barracks. But with the occupation of these barracks by Canadians, and with the increased numbers travelling, the accommodation proved inadequate, and at the beginning of the winter of 1915-16, the War Office decided to form a Rest Camp near the harbour. House valuers were sent down from the War Office, who selected two streets, totalling 30 houses, and warned the occupants to turn out, bag and baggage, at 7 days' notice. The scheme was then turned over to us, and we were told to provide a minimum of cooking and ablution accommodation and to enclose the area. As these houses had no gardens, we took over the road in front of the houses and erected a temporary cook-house and ablution rooms on the road. Drains and water were available, and we had some sort of an establishment ready in three or four days. At first we fenced the area with barbed wire, but later erected a close galvanised iron fence about 7 feet high, entirely cutting off the view from outside. The establishment of this camp undoubtedly caused much inconvenience to some individuals, but under the circumstances, it was the only solution of the difficulty. I never understood, however, why the construction of a rest camp was deferred to the second winter of the war, as it seemed such an obvious necessity at a port of embarkation.

Later on, a second rest camp was formed at Folkestone, from another group of houses a little further away from the pier.

*Richborough.* The now well-known port of Richborough, though situated in our Command, did not give much work to our staff. When it was first suggested in 1916, I accompanied Major General

Scott-Moncrieff on a visit to the site with Captain Collard, who was one of the originators of the scheme. The question of accommodation was discussed, and it was suggested that as the staff of the Port would be mainly Engineers, and as they would be doing a good deal of engineering work in constructing the wharf, they might be allowed to build their own huts. As we had at the time plenty of work on hand in that part of the country, I was glad to accept the offer of help. At the same time General Scott-Moncrieff asked me if he could take away Mr. Allen Williams, then acting as my Division Officer at Shoreham, to take charge at Richborough. At the end of 1917, when I was D.D. Works in France, I visited Richborough in connection with the large transport of engineer stores to France, and found Brig. General Allen Williams commanding an establishment which had grown to a total of 14,000 all ranks!

*Mechanical Transport Depot.* The last job which calls for comment in this part of these notes is the Mechanical Transport depot at Kempton Park, which was started in 1916. This was a scheme prepared at the War Office, and the site was taken over and work commenced before the Command was told anything about it. I visited the site as soon as I heard of it, with my C.R.E. from Hounslow, Colonel G. Savage (late R.E.), and found it was proposed to form a large depot for the assembly and completion of new mechanical transport vehicles. The chassis for these were being made by contract in the United States, and were being landed at Avonmouth, whence they were to come to the depot by road; the bodies and other parts were made in England and came by train and road. When the bodies were put on, the vehicles had to be completed with tools, spare parts, water and petrol, tried on the road, and despatched overseas, generally through the port of Avonmouth.

The site selected for these operations was the racecourse at Kempton Park, which had a large expanse of grass, the usual grand stand and a few buildings, such as refreshment rooms and latrines for the use of the public. It was on clay soil near the Thames, with a nearly flat site.

We had establishments on racecourses at Epsom, Kempton, Brighton, Newmarket and Headcorn, and in each case when we took over a racecourse, it was coupled with the condition that the course itself was to be protected as far as possible. This condition makes the centre of the course a sort of island, and though we made boarded tracks across the racecourse itself, it was never possible to put buildings in the centre or to extend water and drainage to this area. The available ground for development was then restricted to the comparatively narrow strip containing the stands and enclosures. Also the stand itself is usually rather lightly built, and its construction, in a series of large steps, made it inconvenient

for any purpose, unless the whole of the staging is removed and the building reduced to a roof with supports.

Knowing these disadvantages, as soon as I had ascertained the purpose for which the establishment was to be used, I departed from our usual practice and suggested to the M.G. i/c A. that before going further a report should be made to the War Office. This was done, but we got a reply that the selection of the site was settled and could not be altered. So we had to make the best of a bad job.

The principal requirement of a depot of this sort is covered workshop accommodation, with a hard floor on which the vehicles can stand, with inspection pits at intervals and arrangements for storing spare parts, &c., conveniently situated for the workshops. The grand stand was enclosed and made into a store. For the workshops Col. Cleeve, A.D.F.W., was able to produce from another Command a quantity of curved roofing sheets and iron supports, and by putting the latter on concrete legs about 3 feet high, we were able to obtain sufficient head room. With this we roofed the whole of the public enclosure next the grand stand. For flooring, we obtained the assistance of Mr. Maybury, who himself visited the site and arranged to supply tarred macadam for the floor, though this took nearly three months to finish. As it was obvious that any attempt to cover more grass surface would require a long time, we took over a length of new road close to the entrance of the park. This road was nearly a mile in length, and of a width to allow two lines of traffic in the centre and two lines of cars in sheds down each side. The surface was in good order and made a fairly good floor, and we constructed a line of shedding on each side. Even with this covered accommodation a very large number of cars in all stages of completion had to be parked in the open on the grass, and as winter approached these sank into the ground up to their axles. I believe that after I had left the Command it was necessary to keep two heavy lorries constantly at work dragging these new cars out of the mud.

Many of the workmen lived in the neighbouring houses, but we had to provide huts for a number of A.S.C., about 300 in all, on the site. The refreshment buildings were of some use as dining rooms and kitchens, and also the latrines, but we had to lay a complete drainage scheme to the nearest main drain, about 200 yards away, and also to lay a new water main of increased size. In short, we had as much work and expense as if we had started an entirely new establishment on a new site.

#### WORK FOR AND IN CONJUNCTION WITH THE MEDICAL AUTHORITIES. HOSPITALS.

Although left to the last, the provision of hospital accommodation for our own sick and for the sick and wounded from overseas was not the least of our duties. It was certainly one to which I personally

attached great importance, and to which I gave a good deal of my time. The first problem of the kind was brought to my notice a few days after I arrived in the Command by a visit to my office by the D.D.M.S., who said he had been sent by the M.G.A. to discuss a very important letter just received from the War Office. This was to the effect that the hospital accommodation for wounded men was insufficient for the numbers coming from France, and that immediate steps should be taken to increase the number of beds in the Command. The question was to be treated as very urgent. At first the D.D.M.S. seemed to think that the R.E. might raise difficulties, but I soon disabused him of this idea, and we settled down to a real discussion of the problem. It was evident that no individual building we could get hold of would meet the case, while the work involved in starting an entirely new hospital would take some time. All the military hospitals in the Command were full and were being expanded as fast as possible. None of the new hutments were sufficiently advanced to accommodate wounded. Tents were ruled out by the time of year—March, 1915. The only remaining alternative was the use of an existing barrack, which was pressed for by the D.D.M.S. On considering the available barracks in the command, it was evident that the nearer we could get to Folkestone the less distance would have to be covered by the wounded on arrival. There was already at Shorncliffe a good military hospital, and it happened that the nearest barrack to the hospital was built of one storey huts—brick with felt roof—probably erected in one of our little wars. It was therefore readily convertible. We put the proposal to the M.G.A., who approved of work going on at once and reported to the War Office the action we were taking. I communicated at once with my C.R.E. at Dover—Col. Littledale, R.E.—who I knew had had much experience of hospitals, told him what we wanted to do, and gave him instructions to go ahead and send us in a scheme, but meanwhile to start work on preliminaries. A few days later we got a reply from the War Office saying that General Scott-Moncrieff would visit Shorncliffe and inspect our scheme. I gathered later that the War Office had not expected we would use a barracks, but when I explained the circumstances to General Scott-Moncrieff, he not only agreed with our conclusion, but on visiting the site found very little to criticise in the details. He asked me, however, to keep him personally posted in any large scheme of this sort we might start, and this we did in future.

The next hospital scheme I had to deal with was at Brighton, where a large group of hospitals had been formed for the use of Indian troops, after the first hospital for native troops, formed in the New Forest, had proved too small for their requirements. The buildings used were the workhouse, re-named the Kitchener Hospital, and the historic buildings known as the Pavilion and Dome, near

the front. These buildings were taken over at first by one of the leading Civil Surgeons and the work of adapting them was carried out by the town Surveyor. After the work was completed and the hospitals in use, we got instructions from the War Office that the Chief Engineer was to certify that the work was satisfactory and the expenditure reasonable. As the total sum involved was over £40,000, this was rather a large order. Fortunately it proved less difficult than appeared at first sight, as the work had been very well done. The accommodation provided was for about 2,000 beds, so that the expenditure was only £20 a bed, against £80 for a new hutment. We found, however, we had to add to the arrangements in several directions. The female nursing staff was badly housed, extra lifts and a second operating theatre were required in the work-house building, and later, when the Pavilion was made a special hospital for the final treatment of men who had lost a limb, we erected workshops and other buildings in the grounds.

Another hospital which may be mentioned was at Cambridge, on a College cricket ground, where a hut hospital had been constructed under the supervision of a local doctor, who made a speciality of open air treatment. All the huts were built with one side open to the air both summer and winter. The results, as far as the treatment of sick and wounded was concerned, were quite satisfactory, but the treatment involved some hardship on the nursing staff in cold winter weather. The hospital lasted into the winter of 1915-16, when questions were asked in Parliament, and we were ordered to enclose the open sides of the huts with glass panels.

These three are only samples of the hospital work which came to hand at once, and as soon as I had got the main hutting work organised we began considering the question of more hospitals. As far as I could ascertain, on the outbreak of war the War Office policy was limited to the increased use of all military hospitals and to the taking over of certain buildings in defended ports, in accordance with the provisions of the defence scheme. In addition, the Central Force took over a number of buildings all over the Command as hospitals for their own troops, and when hutments were erected, a hospital was included in the scheme. At first all these hospitals were intended mainly for the sick of the Home troops, and it seems to have been thought that the wounded of the Expeditionary Force could be adequately dealt with in the existing military hospitals such as Netley, Millbank, or the Herbert Hospital, Woolwich, and in the Civil hospitals of the country. As soon as the probable scope of the war began to be understood, a special effort was made to increase the accommodation for wounded. In many places, like Cambridge, local hospitals were constructed under some special surgeon, in other cases individuals turned their own houses into hospitals and organised a staff of voluntary workers. Most of these were useful,



some excellent, but there was evident some want of co-ordination, as all the hospitals were not readily accessible, and many of them were obviously too small to be worked economically.

After full discussion with the D.D.M.S. and M.G.A. we evolved a scheme for future hospital development in our Command on the following lines :—

1. The construction of a number of large hospitals within easy train journey of the ports of disembarkation.
2. The adoption of a large unit, 2,000 beds, as the minimum which could be economically administered.
3. The erection of such hospitals in the vicinity of towns of some size which would provide facilities for supplies, transport and accommodation for voluntary workers, and also systems of water, gas and electric light which could be of use for the hospitals.

As regards the last point, all the towns on the east coast of the Command were already occupied by defence troops and were within range of attack from the air, but along our south coast west of Folkestone there were very few troops except at Brighton, and this stretch of coast includes some of the best seaside resorts in England, which are well known for their healthy air and amount of sunshine.

A proposal was therefore put to the War Office that future extensions of hospital accommodation in our Command should be concentrated on the construction of hut hospitals for 2,000 to 4,000 beds each, to a total of 30,000 or 40,000 in all, in the towns on the south coast of Sussex. This proposal was accepted in principle, and we were told to put forward definite schemes. I then arranged with the D.D.M.S. to send one of his officers with Lt. Etherington to visit all the coast towns from Hastings westwards, to interview the local authorities and select sites. In the course of three days this deputation visited Hastings, St. Leonards, Bexhill, Eastbourne, Worthing, Littlehampton and Bognor, and in each place found one or two good sites which fulfilled our requirements. We were therefore able to put definite schemes to the War Office for the accommodation of 36,000 men. The cost of hut hospitals at this time was about £80 a bed, so the total scheme would have cost three million pounds.

After sending in the scheme we heard nothing for some time, and on making enquiry at the War Office we gathered that difficulties had arisen, and finally all the schemes were dropped, much to my disappointment.

Meanwhile, the War Office had been in communication with the Metropolitan Asylums Board and with the Education authorities with a view to the occupation of some of their buildings as hospitals. The M.A.B. control a number of excellent establishments for the accommodation of pauper lunatics. By boarding out the quiet cases and concentrating the remainder, they were able to vacate

several establishments, of which four were in our command. The two with which I had most to do were the Graylingwell Asylum at Chichester and the Horton Asylum at Epsom. The arrangements were very similar in both cases, the main building consisting of a series of two-storeyed pavilions, with large rooms connected by large wide corridors. There were also good administrative offices and cooking and dining accommodation, while in each case the buildings were surrounded by well-kept grounds. The superintendent of each Asylum, who was of course a medical officer, was retained in charge of the hospital, and also most of the staffs. By putting beds in the corridors, each building provided accommodation for about 2,500 beds, instead of the usual occupation of 800 to 1,000 patients. The engineer services required were mainly in connection with the accommodation for the female nursing staff, the provision of operating rooms (usually two) and some additions to the cooking apparatus. These involved an expenditure of £4,000 or £5,000 at each hospital. The proximity of the hospitals to small towns was of advantage in facilitating the service of the hospital, and the towns also provided a number of voluntary workers, who were of great service in many capacities. Altogether these buildings were an undoubted success.

The educational authorities were also able to give up a number of school buildings. These, if large enough, make good groups of wards, but a good deal of work is required to provide sanitary annexes, an operating room, and cooking and dining accommodation. Another difficulty was that, as only a proportion of the schools could be surrendered in any locality, this scheme involved the opening of a number of rather small hospitals scattered all over the Command.

In addition to hospitals run by the Command, we were often asked to advise on questions of drainage and fencing and similar details for hospitals erected by the Colonial Governments for their own men.

Before concluding this section a few words may be added on the adaptation of country houses for hospitals. Such houses generally have the advantage of being situated in private parks, which give excellent recreation space for convalescent patients, but there the advantage ends. The water supply and lighting are usually limited, the drainage out of date, while even in the largest houses, the rooms are comparatively small, and only a very small number of patients can be put into each room. Added to this there are a good many stairs, and no lifts capable of dealing with stretcher cases.

We had an example of this at Addington Park, near Croydon, formerly the residence of the Archbishop of Canterbury. This was an old house with beautifully panelled walls, and fitted with marble fireplaces and several large old-fashioned glass chandeliers.

When I first saw it, it had been occupied for some months, and it had been found necessary to close the front staircase altogether,

to board up all the marble fire-places, and to enclose the chandeliers in large cages of wire netting. Finally we decided to use the house itself for administrative offices and for officers' cases, and to erect wooden huts for ordinary cases, and later a convalescent hut camp was erected in the grounds. This involved the laying of a new water main from the Croydon system and the construction of a new drainage system.

By the end of 1915, we found we had in our area over 65,000 hospital beds administered directly by the Command, besides many voluntary hospitals.

During 1916, although we did not open many new hospitals, there was a continuous growth in the number of beds, due to urgent demands from the War Office following each phase of the operations overseas.

The nett result of our experience, as it was impressed on my mind at the time, is that the best hospitals, with the possible exceptions of the M.A.B. buildings, were the newly-constructed hut hospitals, built on a large scale on carefully-selected sites. Such hospitals being all on one floor, the movement of the occupants is easy, not only as stretcher cases, but also when convalescent. Two-storey buildings require lifts, and lifts to take stretcher cases are not often available.

For constructing hut hospitals the allowance of floor space was usually 60 feet per bed, with 6 feet of wall space. At first hospital huts were built to a width of 24 feet, but later Col. Armstrong got out a design for an 18-feet hut, which is about the minimum width which should be used. Later he got out a 100 bed ward with four rows of beds, but this seemed to me rather cramped, though much more comfortable than a tent hospital.

The arrangements of the hospitals followed the normal design of permanent military hospitals, except that a much larger proportion of the space was allotted to surgical cases, involving additional operating rooms and careful grading of corridors.

The increase in the female staffs, not only for nursing but for cleaning and cooking, required special arrangements, such as a special cloakroom and latrine accommodation, for the staff which came to work daily, while the nursing staff, who had to sleep in, were given accommodation similar to that provided for officers in hutted camps.

## DEMOLITION OF TREE STUMPS.

By LIEUT. T. I. LLOYD, R.E.

In the training of troops in the use of explosives it is as well if the work done can be of use to someone. A good opportunity for this was afforded in Belfast recently, and since a similar opportunity is liable to occur at many another station, a short account of the work done and a certain amount of data collected, follows.

A new golf course was in course of construction some six miles from the city, and with the consent of the club we were allowed to do our training there.

There were trees of all sizes which had to be felled, and it was these that we attacked.

On a golf course a tree stump is a nuisance less only than the whole tree, and so we decided to remove stumps and all if possible.

The blowing of a small mined charge under the centre of the tree was satisfactory. The larger roots on the side of the tree in the required direction of fall were first cut by axe, and, when the charge was fired, the tree fell into the crater, overbalanced, and crashed to the ground pulling out the roots on the far side.

This method was employed with complete success for several trees, but was given up for two reasons :—

- (a) The direction of fall could not be guaranteed and the tree was liable to get entangled with others near by.
- (b) The trunk was generally split.

The merchant who bought the timber objected to (b), so we let him fell the trees and ourselves tackled the stumps, for which the small mined charge was completely successful.

To place the charge, the turf was removed from around the tree and the most suitable spot for burrowing selected. To make the burrow, a crowbar was found the most useful tool, and since the burrow never had to be longer than a man's arm, no difficulties were met. In the case of a large tree with tangled roots, a primary charge was sometimes fired to help the burrowing.

The explosives used were ammonal and guncotton. The ammonal charges were made up in small bags, and were easier to place and more satisfactory than the slabs of guncotton. Tamping of wet clay, well rammed, completely filling the burrow, and heaped to a height of about two feet, was satisfactory.

The effect of firing the charge was to split the stump into three or four fragments, which were hurled a few feet, leaving a neat shallow crater.

This method of dealing with stumps shows a great saving in time and labour on the normal method of digging and jacking them out. The foreman in charge of the construction of the golf course was most enthusiastic about it. He had had experience of splitting stumps with charges in auger holes—our method was more satisfactory.

The supply of primers gave out, but we had plenty of No. 8 detonators. Two detonators tied together never failed to detonate an ammonal charge. To detonate a two-slab charge of guncotton after the primers had all been used, it was necessary to employ a half-pound charge of ammonal tied to the slabs and detonated as above. A smaller amount of ammonal only smashed the guncotton. When this happened we were able to collect the fragments and with them make up a charge which was successfully detonated with a half-pound charge of ammonal.

Both the electrical and the safety fuse methods of firing were used. Every man was given his turn at making up and placing a charge. The training was considered satisfactory, and although only a small proportion of the total number of stumps on the course were dealt with, the committee of the club were very grateful.

Taking the average, three men demolished a stump in two hours.

As a stump is weak against vertical shear, it is important that the charge should be under the very centre of the bole. A charge not so placed will hurl the portion of the stump immediately above it a considerable distance, leaving the remainder of the stump in the ground.

Too heavy a charge throws a lot of debris into the air. The following table gives charges which will do the work satisfactorily with a minimum throw of debris :—

| Diam. of tree or stump<br>at height of 2ft. | Weight of charge.<br>Pounds. |
|---|------------------------------|
| 0"—17"                                      | 1                            |
| 18"—23"                                     | 1½                           |
| 24"—27"                                     | 2                            |
| 28"—31"                                     | 2½                           |
| 32"—35"                                     | 3                            |
| 36"—42"                                     | 3½                           |

The table is for all the common species of trees in clay soil. The charge should be no deeper than necessary.

*AN UNOFFICIAL HISTORY OF THE SIGNAL SERVICE  
WITH THE BRITISH SALONIKA FORCE, 1915-18.*

*By* CAPTAIN C. C. S. WHITE, M.B.E., R.E.

A campaign that has had very little written about it, is that of the British Army in Salonika, 1915-18. The reasons why this campaign did not become "spectacular" until September, 1918, are many and beyond the scope of this article to propound. It is sufficient to say that the British and French troops arrived in Salonika about three months too late to rescue the Serbs from a combined attack of the Austro-German and Bulgarian Armies, due to the delays of diplomatic and military "pour-parlers." Bulgaria, after nine months' vacillation, mobilised on September 23rd, 1915. The following day Greece followed suit. Serbia, who had so far resisted the Austrian attack on her northern frontier with success, saw that her only hope lay in attacking Bulgaria immediately, before the latter had completed her mobilization, and so appealed to the Powers of the Entente to sanction an immediate assault on Bulgaria. This appeal was supported by the Greek Government, who were pledged by the Treaty of Bucharest to assist Serbia in the event of her being attacked by Bulgaria.

At first this was not permitted, but it soon became evident that Bulgaria, in conjunction with Austro-German forces then being made ready, evidently intended to attack Serbia. So the question of sending troops to the aid of Serbia was once again considered. Greece alone was in a position to help. A condition of her intervention was that she should be reinforced by 150,000 Entente troops, and as an encouragement to her to take action, one British and one French Division were ordered to Salonika from Gallipoli. While they were on their way the position at Athens was revolutionized. On October 5th, 1915, King Constantine had driven M. Venizelos from office by a flagrant violation of the constitution, and had definitely repudiated his treaty obligation to assist Serbia. Not only did he decline to intervene but he did everything in his power to hamper our movements. On arrival at Salonika, the first Entente troops were allotted 15 metres of quayside for their disembarkation. This situation, of being confronted with a pro-German Greece instead of an ally, proved a very serious menace to our base and lines of communication. It had its effect on all our subsequent operations in Macedonia until May, 1917, when King Constantine was forced to abdicate and the Greek Army came to our assistance with a final total of 200,000 men in 1918.

## SERBIA, 1915.

At the very moment when our first troops, the 29th Brigade of the 10th (Irish) Division, were landing in Salonika, October 5th, 1915, the Bulgars, who had completed their mobilization, crossed the Serbian frontier. By the time the remainder of the Division had arrived and we were ready to move up north from Salonika, they had already invaded southern Serbia and had effectually blocked the way between the retreating Serbian Army and any possible assistance from us.

The French Division, nevertheless, moved up the Vardar and endeavoured to effect a junction with the Serbs. They got through the Demir Kapu (Iron Gates of the Vardar) as far as Krivolak, and the 10th Division held the Bulgars on their right flank along the frontier from Strumitza to Doiran till we withdrew on December 6th, 1915.

From the beginning it was evident that the Signal Service in Salonika was not going to obtain any assistance from the local authorities. For over a month they would not permit the laying of any cable lines whatsoever in the town of Salonika, or along any of their telegraph routes, so immediately on arrival, October 5th, 1915, visual signalling was established from the "Splendid Palace Hotel," Base Headquarters, to the 29th Infantry Brigade at Lembet Camp, and to H.M.S. *Albion*, whence messages were transmitted by wireless to Mudros and London.

When the 10th Division moved up to Doiran, early in November, the sole means of communication was by despatch riders, who travelled on the daily train to Doiran Station, which, incidentally, still continued to run right through Bulgaria to Constantinople.

On the arrival of the 12th Corps Signal Company (Captain G. G. Rawson, M.C., R.E.), a D5 cable line was laid along the Greek Railway route from Salonika to Doiran station. It is interesting to note that this line, 45 miles long, was laid from both ends, and buzzer communication was established through a gap of 20 miles by induction on to the Greek telegraph wires. The line, however, was soon completed, and Morse communication established on November 20th, 1915. By this time the 10th Signal Company (Captain L. S. M. Smithers, Indian Army), had Morse communication from Doiran Station to Divisional Headquarters at Dedeli, and vibrators working to their three brigades at Hasanli, Calkali and Ormanli. It was found that a D Mark III telephone was capable of working through 11 miles of D1 cable, if care was taken in the laying of the line to keep it off the ground wherever possible, by means of bushes, existing poles, etc.,

The country in which the Salonika Army was operating was somewhat similar to the N.W. Frontier of India, that is to say, suitable for pack transport only, except along the main roads, which

were few and far between. It consisted mainly of steep hills covered with rocks, and rising to 5,000 feet, interspersed by deep ravines often devoid of even a foot track.

In addition to the natural difficulties of terrain, the climatic conditions were most trying to British troops. Extremely cold and wet in winter, frost and snow prevailing for several months in the wind-swept uplands, varying to tropical heat (113° F. in the shade) for the greater part of the summer. From April to September military operations or other work were impracticable for three or four hours in the middle of the day. The so called "Vardar" winds blew for four or five days with unrelenting fury, causing a fine Balkan dust to penetrate and settle everywhere, even on the food. Added to this, the low lying valleys were alive with the *anopheles* mosquito, and both mild and malignant malaria were prevalent throughout the country.

At the end of November, 1915, snow began to fall and during the first week in December it was three feet deep everywhere north of Doiran. This was the same blizzard that visited the Gallipoli peninsula shortly before the evacuation. During the night the temperature dropped to seven degrees below zero, and consequently the infantry of the Division, who were on top of the hills, suffered very severely from frostbite, and in some instances the men were actually frozen to the rocks and their machine-guns.

On December 6th, the 10th Division was heavily attacked on a two Brigade front by the Bulgars in mass formation. Visual signalling was used on several occasions during these operations, and proved extremely useful as a stand-by when the cables were cut. This division fought a stubborn rear-guard action, they eventually withdrew from their position in Serbia on December 12th, and were within the Salonika defences by the 18th. The Bulgars only pursued as far as the Greco-Serbian frontier.

Meanwhile the 22nd, 26th, 27th, and 28th Divisions had now arrived from France, and established a defensive line round Salonika known as the 'Bird-Cage.'

#### SALONIKA DEFENCES.

By the end of the year an elaborate system of poled cable lines had sprung up. The longest of these was from Hortiach, via Ajvasil and Langavuk, to Stavros. This line was nearly fifty miles long; it was laid through unknown country in three days, as communication was urgently required with the 29th Brigade, who had gone round to Stavros by sea. About 15 miles along the southern side of Lake Besik the cable followed the old Via Ignatia, through a marsh. It was *just* possible to work a vibrator through this 50 odd miles of D5 cable on the ground, from Hortiach to Stavros. It was decided to pole the line throughout, but only 200 airline poles were available



for this job, and so 2,000  $2\frac{1}{2}$ " x  $2\frac{1}{2}$ " 15ft. scantlings were obtained from R.E. Base Park and mainly used—the airline poles being used wherever the cable ran near our own trenches.

When the poling was completed, this line gave loud telephone speech throughout its entire length. No insulators were available; the cable was attached to each pole by a clove hitch. Notwithstanding this it proved quite satisfactory, and was in use for nearly 18 months, before it was finally replaced by a permanent air line.

On January 9th, 1916, the Fourth Army Signal Company, (Major A. H. W. Grubb, D.S.O., R.E.), together with Nos. 1 and 3 Airline and A.H. and A.J. Cable Sections, arrived and immediately took over all signal work in the town of Salonika from XII Corps Signals, and established a Signal Office (SAR.) at Army Headquarters in the Rue Reine Olga, near the British Consulate. An extensive programme of 'comic line' construction was undertaken forthwith. Telephone pairs were first built, of 40lb. bronze wire and bobbins, on such poles as could be obtained locally, from A.H.Q. at Salonika to XVI Corps Headquarters at Kirechkoj and 10th Division at Hortiach. After this a semi-permanent route was constructed to replace the two-wire airline routes erected by XII Corps to Ordnance and Main Supply Depots, some few miles outside the town on the Monastir Road. Similarly, all other signal lines were gradually strengthened or replaced by semi-permanent lines. Later, these lines were again replaced as opportunity offered, by absolute permanent lines, in accordance with strict G.P.O. practice, until finally it was possible to hold a telephone conversation from G.H.Q. to any of the British Headquarters.

In March, 1916, a consignment of 12-pair V.I.R. multicore cable arrived and was used to replace the vast number of D5 cables that had been erected on the Electric Power standards in the town of Salonika. A wooden arm was wedged into the lattice work of the posts, and projected about 6 inches toward the road; a steel suspension wire was run along these arms, and the multi-core cable was hung from this wire by means of raw hide suspenders. That there was practically no inductive hum, or interference due to leakage from either the power or tramway wires, speaks well for the quality of this cable.

#### SPECIAL PACK EQUIPMENT.

During this time the Divisional and Corps Signal Companies had been experimenting with devices for carrying and laying cable from pack mules. The most satisfactory type of equipment was a special saddle, with a vertical spindle mounted centrally, designed to take a *one mile drum* of D5 cable. Needless to say that as the load was entirely on the centre of the animal's back, care had to be taken, firstly, to select a strong mule, and secondly, not to overload him

with too heavy a centre load—hence the *one mile drum*. The chief advantage of this system was that cable could be paid off at any angle irrespective of the direction of travel of the mule, which was a great asset in negotiating tortuous mountain paths and re-entrant nullahs. Incidentally, having the cable on *one mile drums*, enabled two of them to be slung on either side of a mule for transport purposes.

A revised War Establishment was prepared and issued for Divisional Signal Companies on a pack transport basis.

#### ADVANCE TO STRUMA-DOIRAN LINE.

Early in April, 1916, British cavalry moved forward and took up positions north of Kukus, and along the Struma River in front of Orljak; they were supported by the 22nd and 10th Divisions respectively. A twenty-three mile route of four wires was built along the railway from Salonika to Kukus, by 3 Airline and 1 Cable Sections, in 14 days.

XII Corps Signals maintained communication with the cavalry on the Struma, by establishing their Report Centre at Orljak; this involved a great deal of maintenance work on the old Turkish telegraph route which existed between Salonika and Seres. This route was built of two 800 lb. iron wires (used for Constantinople-Monastir-Valona-Italy telegraph lines), and two 400 lb. iron wires (used for Constantinople-Salonika-Uskub-Serbia line). Some of the spans across ravines were nearly half a mile in length, most of the poles were nearly rotted through, 6 inches below the ground, and "bell-hanger" joints in the wires were quite common. At this time the Greeks were using 2 wires to Seres; we appropriated the other two, and the French ran two 100 lb. bronze wires for their own use.

At 2.30 a.m., on May 6th, 1916, a German Zeppelin was reported over Karasouli, 45 miles N.W. of Salonika. Signals had reported the information to G.H.Q. and distributed it to the Royal Navy and all A.A. defence units, ten minutes before the Zeppelin arrived over Salonika. As the airship approached the town it was caught by our searchlights, and after a good deal of shooting it was hit by a 6-inch shell from a monitor, and came down in flames over the Vardar marshes at 3.30 a.m. This was the first Zeppelin brought down in the war.

Lieutenant-General G. F. Milne, C.B., D.S.O., took over command of the British Salonika Army on May 9th, 1916 from Lieutenant General Sir Bryan Mahon, K.C.V.O., C.B., D.S.O., who proceeded to Egypt.

By the end of May, 1916, the general position in Greece had been consolidated, and General Sarrail had been able to push French troops up to the Greco-Serbian frontier, west of the River Vardar.

The right-hand sector from the Vardar to the Gulf of Orfano, a 90-mile front, was gradually handed over to the British.

XII Corps Advanced Report Centre moved via Mirova and Kirec to Janesh, where it remained for over two years. The XII Corps, composed of the 22nd and 26th Divisions, (Captain G. E. Sampson, D.S.O., R.I.F., and Major A. C. J. Stevens, R.E., commanding the Signal Companies respectively), took the left half sector, from the Vardar to Lake Doiran, a 10 mile front, where they found the Bulgars well dug in across the "Pip" ridge, and in front of the "Petit Couronne," in what was possibly the strongest natural defensive position ever occupied in history. The whole of our line was dominated by a hill called the "Grand Couronne," some two miles behind the enemy's line. Here the Bulgars built an O.P. (16 feet of concrete), from which they could observe practically every movement on the XII Corps front, and on a clear day could see the ships entering and leaving Salonika Harbour, forty miles away.

The inevitable result was that position warfare, exactly similar to that in France, was immediately established, and lasted until September, 1918.

During this long period, work for Signals never ceased. The XII Corps area was extensive, and it was soon well intersected by permanent routes.

Heavy artillery required signal communication, O.P. exchanges and flash spotting instruments were made and installed, and lines were built for sound ranging. Listening sets and screening sets were installed along the front line, and a pigeon loft was established at Janesh, Corps Headquarters.

A Corps Signal School was formed, and trained a large number of regimental officers and men.

Cables laid along the ground did not last long as a rule, being frequently destroyed by grass fires. Cables were laid across Lake Ardzan and lasted well, and were often the only means of telegraphic communication to troops in the Vardar area, as main routes running parallel to the front line were often damaged by shell fire and by bombing from the air.

Wireless communication was established between Corps and Army Headquarters, and also for anti-aircraft purposes. Power buzzer amplifiers were also used with success in the forward areas in the later stages of the campaign.

#### DIVISIONAL SIGNALS.

With regard to Divisional Signals, the rocky nature of the ground in the Doiran sector made all trench digging very difficult, so that special cable trenches for buried cable were rarely constructed.

It was found that cable was best protected by laying it in shallow trenches about 9 inches deep and as narrow as possible. This protected it from everything except as a direct hit, and also from what was more often the cause of faults, the impedimenta of digging parties. "Laddered" cables were largely used by Brigade Sections.

When cable was laid on the ground it was liable to destruction by an invention of the R.A.M.C. consisting of a mule dragging a kind of stretcher, the end of which trailed on the ground, with a spike attached. The result may be imagined.

During actual operations backward Visual Signalling by lamp was used as an additional means of communication from the front line to Brigade Headquarters. This was found particularly useful because Brigade Command Posts were usually situated on hill tops. Within the Battalions visual was little used, owing to the dust caused by the enemy's H.E. shells. In some cases forward visual signalling was made possible by using lamps with a long tube to prevent the rays spreading, and on some occasions the heliograph proved most useful.

As soon as position warfare was reached, Divisional Signals were chiefly concerned in replacing the original cables laid to Brigades by semi-permanent routes. This was a long process, owing to the shortage of stores, shortage of men, owing to malaria, and the long distances to be traversed.

The presence of a German listening set on the Doiran front was a cause of much annoyance. There is no doubt that it obtained much valuable information before it was possible to instal a complete metallic system of circuits. Even then the leakages caused by cable rubbing on rock edges did not make them by any means immune from over-hearing. It took many months to impress on Staff and Regimental officers the importance of this, and it was really only brought home to them when our own listening sets were installed. Our listening sets obtained little of value from the intelligence point of view, but their "Police" work was most valuable. Screening buzzers were used with some effect, it is believed, at any rate, by their means, Divisional Signals soon got to know whose lines were faulty, as complaints were received from irate Brigade, Battery and Battalion Commanders, that they could hear nothing on these telephones except a .....buzz!

First a French, then an Italian Division, and eventually our 28th Division (Major H. C. Saunders, D.S.O., R.E., O.C. Signals), held the portion of the line from Lake Doiran to Lake Butkova known as the Krusha Balkans, or the Snevece position.

In May, 1916, the XVI Corps Signals (Major C. H. Prickett, D.S.O., R.E.), took over the lines up the Seres Road to Orijak—Advance Corps Headquarters being at Kilo 70—and, later on, the whole Corps established itself along the line of the Struma, from Lake Butkova to the sea. On this front conditions were entirely different.

The total frontage was nearly 50 miles long, but this included Lake Tahinos, which was 20 miles long.

The line was held sometimes with three divisions, and sometimes with two. The first summer that we were up there, all the units in the plain were decimated by malaria, so the next year both the Bulgars and ourselves retired to the foothills, and left a 'no-man's-land' ten miles wide to be patrolled every night.

The 28th Division were on the left with their divisional headquarters at Turica. One of their brigades was at Bashanli, some 20 miles away, in the Krusha Balkans.

The chief problem for the Signal Companies was distance. "Comic" lines were used extensively. The 10th Divisional Signal Company R.E. (now Captain H.C.B. Wemyss, D.S.O., R.E.) improvised insulators by using the necks of bottles. They ultimately established a system of perfect telephonic speech on metallic circuits throughout their division, thereby enabling all units to telephone messages direct from one to another. This saved their signal offices a very considerable amount of traffic.

The 27th Divisional Signal Company, R.E. (Major E. H. Varwell, D.S.O., R.E.), had their divisional headquarters on the Seres Road, and one of their brigades at Ano Krusoves, between Lake Tahinos and the Gulf of Orfano, 25 miles away. This brigade had to maintain communication with the Navy and the R.F.C. at Stavros. The Signal Company made good use of the locally designed apparatus for laying D5 cable from pack mules (already described) on more than one night attack. The great fear of the infantry that the mules would give them away by braying was guarded against by a specially designed muzzle, which proved most effective.

#### ARMY AND L. OF C. SIGNALS.

During this time the Army Signal Company had been steadily building up a permanent system of both telegraphic and telephonic communication, supplemented by regular D.R.L.S., and reinforced by Wireless and Pigeons. By the end of 1916, eight signal offices and telephone exchanges were in operation in and near Salonika. The Army also maintained signal offices at Stavros, Langavuk, Guvesne, Likovan, Salamli and Sariguel. All divisional and corps headquarters and all the above army signal offices, were in telephonic as well as telegraphic communication. The practice of building well-balanced pairs of wires for telephone use, and superimposing the telegraph circuit, was found to be most satisfactory, and resulted in a great saving of wire, as several of these lines were 20 to 30 miles long.

The average number of messages handled daily at G.H.Q. Signal Office was 3,000 telegrams and 1,800 telephone calls.

Plate II is a diagram showing the main telegraph and telephone circuits in use at this period.

Early in December, 1916, a L. of C. Signal Company was formed under Major A. C. J. Stevens, D.S.O., R.E., \*to take over the great development of services at the Base and in the L. of C. Area.

At the same time a Signal Depot was established under command of Lieut. W. A. Young, R.E. Instructional classes for visual signalling and forward cable work were started there, while classes were held at the Army Telegraph School at G.H.Q., for Office Telegraphists and Permanent Linemen.

The 60th Division, with its Signal Company (Major A. G. L. Sladen, R.E.), had now arrived from France. Two Brigades were sent north of the Snevece area, and one Brigade south to Katerini. A telegraph line to the latter place was taken over for certain hours of the day from the Greeks. A pigeon service from there to Salonika was also established, and worked well to begin with, but after a few months the birds became involved with local birds, and several failed to home.

The greater part of 1917 was spent by all Signal units in consolidating and improving their lines. The 7th and 8th Mounted Brigades, and the 10th and 60th Divisions were sent to Egypt.

From 18th to 21st August, the whole of the centre portion of the town of Salonika was burnt to the ground; this included the Base Signal Office, so a new telephone exchange was opened at the Docks, for the many subscribers in that area. It is interesting to note that during the whole of these four days important communications from the G.H.Q. Signal Office were never seriously interrupted, thanks to the alternative lines in existence, and to the excellent work of the Signal Service personnel.

By the end of the year, a new line of L. of C. had been put into operation via Bralo and Itea, on the Gulf of Corinth, to Taranto in Italy. A telegraph line was constructed from Salonika along the railway to the Rest Camp at Bralo, and a telephone line from there to Itea. Telegraphic communication was also established from Bralo to Athens. The lines maintained in this area amounted to 180 miles of permanent line, carrying 294 miles of wire.

The number of signal offices in G.H.Q. and L. of C. area had increased to 33. The average daily traffic through the G.H.Q. Signal Office was 3,600 messages, and 3,660 telephone calls. There were 25 telegraph instruments working in that office, and 139 subscribers connected to the Telephone Exchange.

During the period January, 1916, to December, 1917, the Signal Park issued 12,300 miles of cable, 6,000 miles of bare wire, 27,300 poles of various sizes, 2,540 telephones, and 53,000 cells of all types.

\* Captain R. A. C. Henderson, Cameron Highlanders, succeeded to the command of the 26th Division Signal Company, R.E.

The above issues do not include stores brought out to the country by units, nor stores or wire obtained locally. Owing to the difficulty in obtaining a regular supply of stores from home, due to submarines and other causes, the manufacture of cells and buzzer telephone exchanges was inaugurated at Signal Park.

#### WIRELESS.

Very little has been said concerning the use of Wireless as a means of communication. It would naturally be assumed that in warfare in a country such as Macedonia, possessing practically no means of communication, such as roads and railways, and where the difficulties of erecting and maintaining ordinary line communication were very formidable, that wireless would afford an admirable method of communication.

The chief difficulties lay in the comparatively large distances to be covered and the types of apparatus available.

Great progress had been made in France in the development of W/T communication, but these developments were almost entirely along the lines of forward communications (*i.e.*, small Trench sets for communication between battalions and brigades or front line to support trenches), and practically nothing was done with modern type transmitters for longer distances.

The apparatus available was limited to the half kilowatt pack wireless sets, designed primarily for mule transport, and with a range of only 20-30 miles.

A complete system of alternative wireless communication was, however, established and maintained between each of the Corps Headquarters and G.H.Q. at Salonika.

A Wireless Company was formed under Captain K. J. Hayward at G.H.Q., and a permanent wireless station erected at Kalamaria, just outside the town of Salonika. This station was a "built-up" set with a range of about 50 miles, and standard sets were installed at each Corps Headquarters.

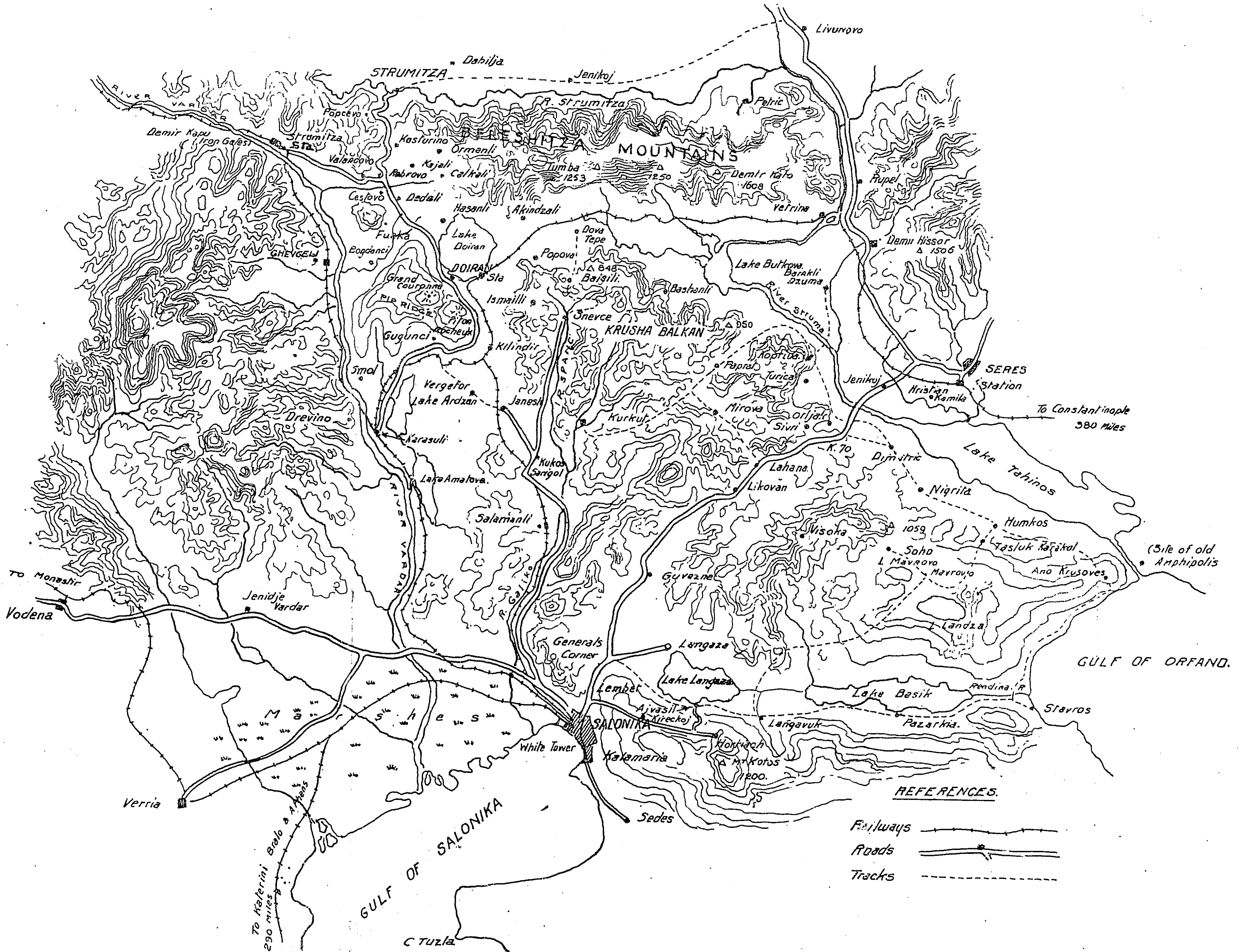
In addition to this, each Corps had its own Wireless organisation, and mobile Pack sets were sent to important strategic positions as alternative means of communication when the situation required.

In 1917, a system of W/T communication was inaugurated in co-operation with the R.A.F. and A.A. units to deal with enemy aircraft. Wireless stations were placed along the high ridges behind the front line commanding a wide view of No Man's Land. Trained R.A.F. observers were attached to each station. By means of code messages the approach of hostile aircraft was rapidly reported to aerodromes and A.A. gun positions, and so our fighting machines were able to get away from their aerodromes and meet the enemy machines before they reached our lines. This system proved very effective, as it not only enabled warnings to be given without loss

# SKETCH MAP OF THEATRE OF OPERATIONS.

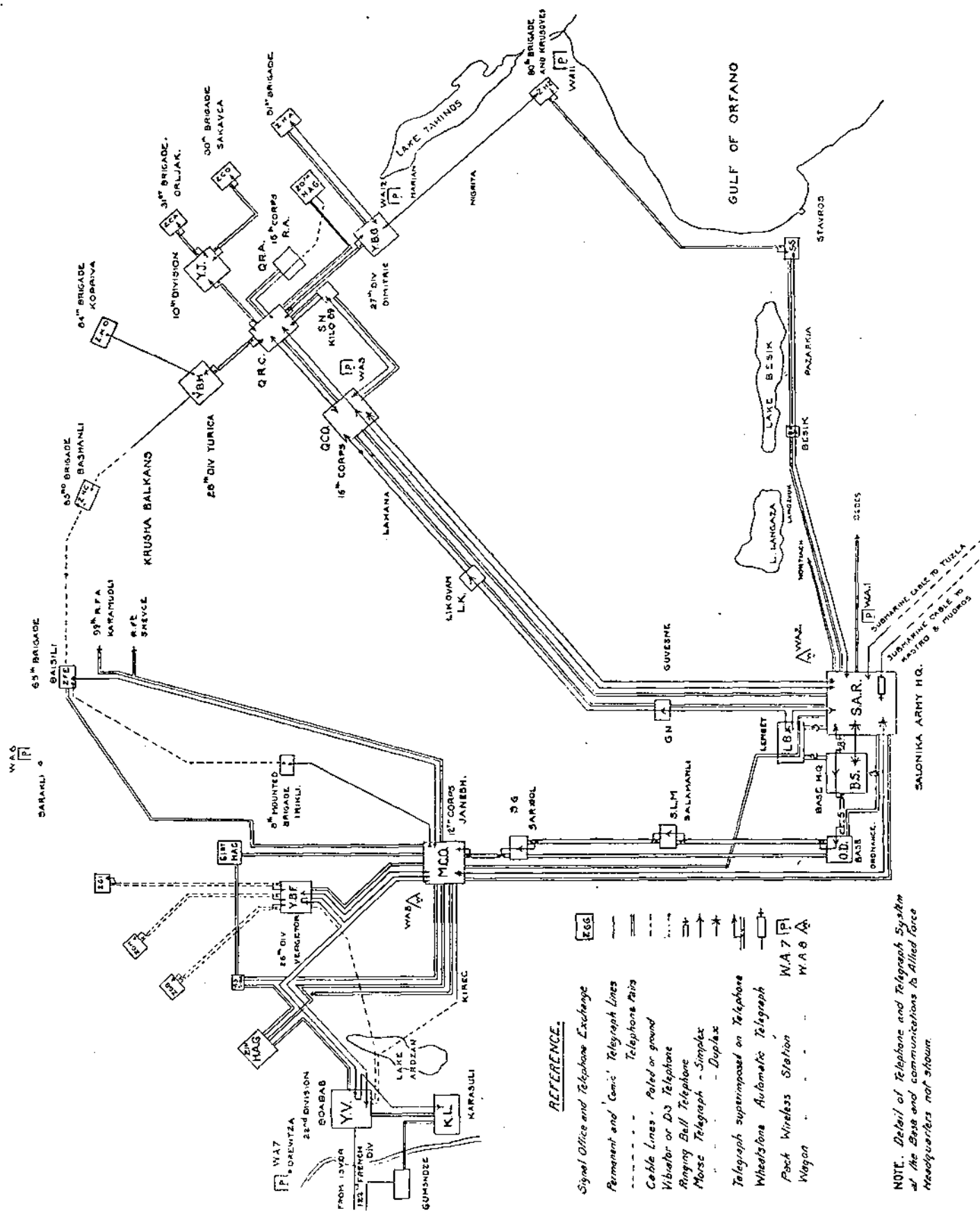
SCALE  
MILES 5 10 15 20 25 30 35 40 MILES.

1" To 9.48 Miles - Heights in Metres.





CIRCUIT DIAGRAM.  
SALONIKA ARMY SIGNALS 31<sup>ST</sup> DEC 1916.



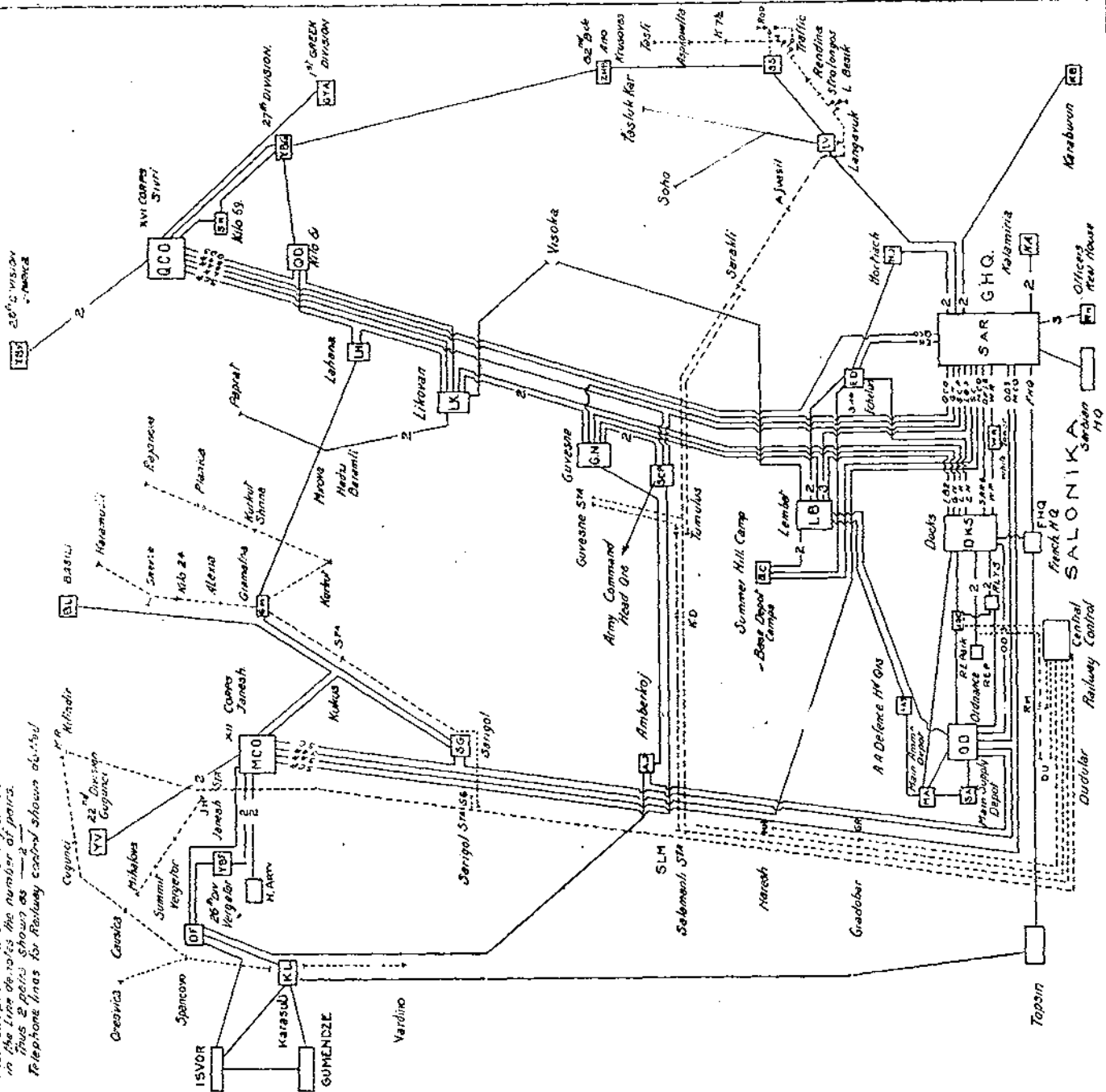
NOTE. Detail of Telephone and Telegraph System at the Base and communications to Allied force Headquarters not shown

# SALONICA ARMY SIGNALS TELEPHONE TRUNK LINES.

APRIL 23<sup>RD</sup> 1918.

## REFERENCE.

Each line denotes a Telephone Pair. Where there is more than one pair between two exchanges the number inserted in the line denotes the number of pairs.  
Thus 2 pairs shown as — 2 —  
Telephone lines for Railway control shown dotted.



of time, but obviated the necessity for clearing main line routes for the transmission of aircraft warnings. Previous to this, considerable difficulty had been experienced in dealing effectively with the enemy aircraft, as the number of sites available for aerodromes was extremely limited, owing to the wild and mountainous country, and consequently they had often to be placed at a great distance behind our line, whence machines were unable to get away in time.

A special long range receiving set was installed at XVI Corps Headquarters (Kilo 6r), by means of which the official news transmitted from Carnarvon was received each night. This news was sent to Salonika by despatch rider each morning, and served to form a basis of news from which the "Balkan News," the daily newspaper, was printed.

During the final stages of the campaign wireless communication was extensively used for inter-Corps and Corps to Division communication, and also proved useful in linking up the advanced units to advancing line connection back to G.H.Q. Relay working was adopted. The advanced station moved forward during the day with the "G" and "A" branches of the Corps, and sent back traffic during the night to a second station situated at the Corps signal office. At daybreak the first station moved forward with advanced Corps Headquarters, while the rear station moved at the same time along the newly completed section of line, and opened up again in the evening at the new Corps Signal Office.

#### DESPATCH RIDING.

The motor cyclist despatch rider was also handicapped by the difficult terrain and the extreme climatic variations. The position gradually improved as existing roads were taken in hand and fresh roads and railways were constructed; but so far as concerned the working of a D.R.L.S. by motor cycle or car, it has to be appreciated that the Macedonian highways, as they existed on the arrival of the Allied Armies, were designed for the passage of no vehicle swifter than a bullock wagon, and that the mountain tracks, which the D.R.'s came to negotiate with such commendable reliability, had hitherto been innocent of traffic, save that of the mountain goat or the nimble-footed and long-suffering native pack-donkey.

The conditions, especially over the longer distances, imposed no small physical strain upon the riders, weakened as they often were by successive bouts of malaria. One of the most trying routes of all—though it had the redeeming feature of variety of scenery—was perhaps that from G.H.Q. to Stavros, on the Gulf of Orfano. This service was commenced twice weekly in October, 1916, and the double journey was roughly 150 kilometres. The route lay over the Hortiach Plateau, down either the Ajvasil or the Azrameri

Pass to Langavuk, along the southern shore of Beshik Lake, and through the narrow and picturesque gorge followed by the little river Rendina on its short course from Beshik to the sea at Stavros. In the early days, particularly on this route, motor cyclists found it necessary—sometimes at the revolver's point—to protect themselves against savage attack by semi-wild dogs.

When heavy rain or snow made the roads impassable for motor-cycles, the despatch riders, mounted on horses or mules, and riding in relays, had to make the best possible time in very adverse circumstances. On occasions a light car—usually a Ford van—equipped with non-skid chains, succeeded in making the journey where a motor-cycle would fail; and it may here be said that in normal times, too, the actual bulk of correspondence to be carried sometimes necessitated the despatch of a car, or two motor cyclists riding in company. So far as concerned the services between G.H.Q. and the XII and XVI Corps Headquarters, once the Naresh and Seres roads respectively were thoroughly established, nothing short of heavy snow prevented the motor cyclists or cars from getting through.

#### BLIZZARD, 1918.

The telegraphic communications of the British Army were seriously interrupted on the 16th and 17th February, 1918, owing to a violent blizzard on the 16th, followed by a heavy fall of snow on the night of 16/17th. On the morning of the 17th all the trunk lines to the XII and XVI Corps were down, and nearly all the permanent and "comic" lines in the XII Corps area were completely broken. The lines in the XVI Corps area did not suffer to anything like the same degree. It is interesting to note that, whereas the lines in many cases successfully weathered the blizzard, they capsized during the steady fall of snow, as the poles and stays became overloaded by the snow and ice loading on the wires. All communications were speedily restored with D5 cable.

The original lines were replaced by stronger routes of heavier poles and shortened spans, not exceeding 60 yards.

#### SECOND LINE DEFENCES.

No sooner had the work of reconstruction been completed than the Germans started their March attacks in France; so the question of second and third lines of defence for Salonika became a serious problem. Signals built permanent lines along all roads and tracks by which withdrawals would be effected. A diagram showing the main trunk lines as they existed at the end of April, 1918, is appended. (Plate III).

*(To be continued).*

## TANK ASSAULT BRIDGE.

By MAJOR G. LE Q. MARTEL, D.S.O., M.C., R.E.

The object of this trial was to produce a design for a very light bridging expedient that would enable tanks to cross rivers in the face of enemy opposition. The proposal was to use light skeleton timber boxes which would be carried forward rapidly and laid in the river to act as "stepping stones" for the tanks. These boxes were to be capable of being placed in position in a few minutes, so that the enemy would be taken by surprise and the tanks would be enabled to cross before he could concentrate against them. It was only intended that the boxes should be strong enough to take a few tanks across at each place; these tanks would assist in forming a bridgehead, and a proper tank bridge could then be constructed. In fact, the device was intended to provide for tanks what the Kapok bridge provides for infantry.

In a device of this nature exact calculations for strength are not possible, but an attempt was made to construct boxes which would just take the stress, with practically no factor of safety. It was then hoped that the trial would show where the weakness lay, whereas boxes which were known to be strong enough would probably be unnecessarily heavy, and would provide no real information. The bracing is in compression (except for the longitudinal bracing), and no reliance has, therefore, to be placed on the holding power of the nails.

Two trials were carried out, the first being with a Birch gun, and the second with a fully-loaded tank weighing just over 12 tons. In the first trial the river was 3ft. 6ins. deep and 50 ft. wide. Five boxes were used, three being rectangular, and the remaining two were "shore piers." The boxes were spaced 4ft. 3ins. apart and connected by ropes along each side, at the bottom of the boxes. The boxes were lined up on the edge of the river and four sappers carried each box, the ropes being taken across to the far side of the river. On the word to advance the whole moved forward, and the boxes were in position in  $1\frac{1}{2}$  minutes. The middle three boxes were floating and the outer boxes were aground; light lines were fastened up stream to each box to dress the bridge. The Birch gun then crossed on the boxes without any difficulty or damage. On the second trial, which took place ten days later, the same boxes were used for the test with the tanks. The water

level had fallen, which made it more difficult to launch the boxes. On this occasion the operation was carried out as in war. A Kapok assault bridge was launched to enable six sappers to cross the river with the ropes, and the boxes were then hauled across, the whole operation taking three minutes (this time would be much improved on with practice). The first tank then crossed and slightly damaged the first box, and forced the last box deep into the muddy bank, but nevertheless the tank crossed the river without difficulty or delay.

A second tank was then sent across, but it did not steer very accurately, and the left-hand track was half over the edge of the first box; this caused the box to collapse and ended the test. If the tank had steered accurately it might just have crossed, but the margin of safety was very small. A tank was then taken over a single box on dry land to ascertain what part would fail first. In a river the weight is distributed over three boxes, but the whole weight might come momentarily on one box. The tank advanced over the edge of a bank and stood momentarily with the full weight on the box; then the box suddenly collapsed endways, showing that the longitudinal bracing was insufficient.

The conclusion is that this bridging device can be made satisfactory for wide and shallow rivers. A depth of six or seven feet is probably the maximum which could be negotiated; there are many rivers which have only this depth and yet form serious tank obstacles. As regards the detail design the lessons learnt were:—

- (a) More longitudinal bracing is required.
- (b) The boxes should be longer, to allow for inaccurate steering on the part of the tank (the present design demands very precise steering which could not be expected under war conditions).
- (c) The capsills should be bound with hoop-iron, to reduce splintering.
- (d) Further trials are necessary to determine whether a tank can change direction to a small extent while crossing these boxes; if not, then a very wide shallow river cannot be crossed without using unduly long boxes, because the tank is bound to lose direction to the extent of a few degrees as it crosses over the boxes.

It is estimated that two carpenters could construct one of these boxes in one hour. For transport purposes the two trestles which form the sides of the box can be carried separately, and the bracing is carried loose and nailed on *in situ*. In this way five boxes can be packed in one G.S. wagon, and the boxes can be assembled in about five minutes.

The boxes were designed and the trials carried out by the 17th Field Company R.E., and further tests are to be made.



The Bridge in position.



A Tank about to cross.



A Tank crossing.

## TANK ASSALT BRIDGE

### LIEUTENANT-GENERAL WILLIAM SPRY.

The Institution has recently obtained possession of the ten commissions of William Spry, an engineer officer who died as a Lieutenant-General in 1802. He saw little active service, except that he took part in the very interesting and successful expedition against Cape Breton and Louisburg in 1758, and apparently remained in the island carrying out demolitions and new works for some years, and was also employed at Quebec after its surrender. In his later years he became one of the chief authorities on fortification, and remodelled the Thames defences. He is credited with the project of the Chatham Lines. His death occurred as the result of a chill caught when witnessing a balloon ascent during the Peace of Amiens. His commissions give an interesting record of the proceedings of the War Office and Board of Ordnance at that time.

The *first*, as *Practitioner Engineer*, was issued by the Board of Ordnance on the 17th December, 1755, and reads as follows:—

"By the Right Honourable Sir John Ligonier, Knight of the Bath, Lieutenant General, and the rest of the Principal Officers of his Majesty's Ordnance. To William Spry, Gent., Practitioner Engineer.

By Virtue of the Authority to Us by the King's most Excellent Majesty in this behalf given (in the Absence or Vacancy of a Master General of the Ordnance) upon the good Testimony and Assurance which We have received of your Loyalty, Integrity and Ability, We do hereby nominate, constitute and appoint you the said *William Spry* to be one of the Practitioner Engineers belonging to this Office upon the Establishment approved of by Order in Council 22 August, 1717, and his Majesty's Warrant 16 December, 1755. You are therefore to improve yourself in the Study of the Mathematicks, Fortifications and other Sciences which may render you capable to serve as an Engineer upon any Occasion, and likewise to observe and follow such Orders and Directions as you shall from time to time receive from the Master General of the Ordnance, the Lieutenant General and Principal Officers of the same for the time being, the Chief Engineer, Directors, or any other your Superior Officer, according to the Rules and Discipline of War, in pursuance of the Trust hereby reposed in you. Given at the Office of Ordnance under Our Hands and Seal of the said Office this seventeenth day of December, 1755, in the Twentyninth Year of his Majesty's Reign."

Signed by J. L. Ligonier; Charles Frederick; A. Wilkinson; W. R. Earle; F. J. Charlton. "Enter'd in the Office of Ordnance 26th day of December, 1755." Signed, W. R. Earle, "Cl. Ordn'ce." The document has Ordnance Seal and stamps to value of 7/6.

Two months later, on 26th February, 1756, Spry received from King George II his *second* commission as "Ensign to that Company, whereof Esqre. is Captain in Our Third Regiment of Foot,



or the Buffs, Commanded by Our Trusty and Welbeloved Colonel George Howard."

This Commission is signed "George R." and, underneath, "Entered with the Secretary at War, Thos. Sherwin," "Entered in the Office of Thomas Gore, Esqre., Comry. Genl. of Musters, John A. F. Hesse;" "By His Majesty's Command, H. Fox." This document has the remains of the Royal Seal and 7/6 stamp.

On 14th May, 1857, he received from the King the *third* commission:—

"George R.

George the second by the Grace of God King of Great Britain, France and Ireland, Defender of the Faith, &c. To Our Trusty and Wel-beloved *William Spry* Gentleman Greeting. We reposing especial Trust and Confidence in your Loyalty, Courage, good Conduct and Ability, do by these Presents constitute and appoint you to be one of the Practitioner Engineers upon the Establishment of Our Office of Ordnance and to take your Rank as Ensign in Our Army. You are therefore to improve yourself. . ." etc., as before.

"Entered with the Secretary at War, Thos. Tyrwhitt"; "By His Majesty's Command, Marlborough"; and entered as before by W. R. Earle. There is no seal on this document, but stamps as before.

The *fourth* Commission is from the King, dated 27th September, 1757, appointing him "Lieutenant to that Company whereof

Esqre. is Captain, in Our Third Regiment of Foot, or the Buffs, commanded by Our Trusty and Welbeloved Colonel George Howard," and is entered as before by Thos. Tyrwhitt and John A. F. Hesse, and issued "By His Majesty's Command, W. Pitt." It is signed by the King and sealed and stamped like the second.

The *fifth* Commission, dated 4th January, 1758, is like the third, and appoints Spry "to be one of the Sub-Engineers upon the Establishment of Our Office of Ordnance and to take your Rank as Lieutenant of Foot in Our Army (in the room of Charles Hubert Herriott promoted)" It is signed by the King, entered by Tyrwhitt and Earle and issued by Marlborough. It is not sealed, but bears 7/6 stamps as the others.

The *sixth* commission was issued by the Board of Ordnance three days after the fifth. It reads as follows:—

"Charles Duke of Marlborough, etc., One of His Majesty's Most Honourable Privy Council, Knight of the Most Noble Order of the Garter, Lieutenant General of His Majesty's Forces and Master General of the Ordnance, etc., to *William Spry*, Engineer. By Virtue of the Authority to Me, by the Kings most Excellent Majesty in this behalf given upon the good testimony and assurance which I have received of your Loyalty, Integrity and Ability, I do hereby nominate, constitute and appoint you, the said *William Spry*, to be one of the Engineers on the Expedition to North America. You are, therefore carefully and diligently to discharge the Duty of an Engineer in the said Service by doing and performing al

manner of Things thereunto belonging, likewise to observe and follow such Orders and Directions as you shall from time to time receive from Me, or the Master General of the Ordnance for the time being, the Lieutenant General, Principal Officers of the same, the Commander in Chief on the said Expedition, or any other your superior Officer according to the Rules and Discipline of War in pursuance of the Trust hereby reposed in You: And for your Care and Diligence to be taken herein you are to have and receive the Allowance of Eight Shillings p diem to be paid to you out of the Treasury of this Office—the said allowance to commence the First Day of this Instant and to continue so long as shall be thought requisite and necessary for His Majesty's Service. Given at the Office of Ordnance under my hand and Seal this Eighth Day of January, 1758, in the Thirty-first Year of His Majesty's Reign."

It is signed "Marlborough," issued "By Command of His Grace the Master General of the Ordnance," by Jacob Bryant, and "Entered in the Office of Ordnance 10 day of January 1758 for the Honble. the Clerk of the Ordnance," by Dan. Kemp. The seal bears His Grace's private coat of arms and the stamps are the same as before.

The *seventh* Commission, dated 17th March, 1759, appoints Spry "To be one of the Engineers Extraordinary upon the Establishment of Our Office of Ordnance and to take your Rank as Captain Lieutenant of Foot in Our Army." It is signed by George II and by Geo. Sackville and entered by Thos. Tyrwhitt and W. R. Earle, "with the Secretary at War" and "in the Office of Ordnance" respectively. There is no seal, but the stamps are as usual.

The *eighth* is the first of the Commissions granted by George III and is dated 1st January, 1783. It appoints Spry "to be one of the Lieutenant Colonels of Engineers upon the Establishment of Our Office of Ordnance and to take your Rank as Lieutenant Colonel of Foot in Our Army." It is signed by the King and by "Richmond, etc., Master General," "Entered with the Secretary at War" by M. Lewis, "Entered in the Office of Ordnance, 25 Janry, 1783," by "G. Crawford, Clerk of the Ordnance," "Entered with the Comry. General of Musters" by John A. F. Hesse," not sealed, but stamped like the others.

The *ninth* Commission appoints Spry a "Major General in Our Army." It is dated 20th December, 1793, signed by the King and Henry Dundas, "entered with the Secretary at War" by M. Lewis, and "with the Commry. General of Musters" by Wm. Woodman. It bears the royal seal, a stamp of 5 shillings, and is endorsed on the back "Fees £12."

The last commission, appointing Major General William Spry to be a Lieutenant General, is dated 26th June, 1799, and is signed by the King and "Portland." It is entered by Lewis and Woodman and bears the royal seal and a stamp of 12 shillings and sixpence. The endorsement on the back is "Paid Fees £17 2 0."

## ROLL OF THE CORPS OF ROYAL ENGINEERS OF IRELAND, 1251-1801.\*

*Compiled by* MAJOR W. P. PAKENHAM-WALSH, R.E., F.R.S.A.I.

PREVIOUS to the Parliamentary Union of Great Britain and Ireland in 1801, the latter country possessed its own corps of Royal Engineers, which, with the Royal Regiment of Artillery of Ireland, was under the orders of an Irish Master-General of the Ordnance.

The history of this Corps has been greatly neglected, only a few passing references being made in General Whitworth Porter's "History of the Corps of Royal Engineers," while the roll, as given in Edwards' "List of Officers of the Corps of Royal Engineers, 1660-1898," is not complete.

The present writer, in the course of family genealogical researches some years ago, came across some interesting facts in connexion with the Corps, which have suggested to him the idea of collecting materials for a history; and he was surprised at the early date to which the Corps could trace its ancestry.

The present compilation does not profess to be by any means complete, but is put forward in the hope that it may be of interest to members of the Corps, and that some of them may be able to assist with further information as to the Corps in general, or individual members of it, for which the writer will be most grateful. To avoid unnecessary trouble, the following list of works already consulted is appended:—

- Calendars of State Papers, Ireland.
- "Dictionary of National Biography."
- "Liber Munerum Publicorum Hiberniae."
- Porter's "History of the Corps of R.E."
- Edwards' "List of Officers of the Corps of R.E."
- Stafford's "Pacata Hibernia."
- Crawley's "Cæmentaria Hibernia."
- Gilbert's "History of Dublin."
- Gilbert's "Parliament House, Dublin."
- Irish Army Lists and Dublin Directories, 1730-1801.

\* This article which appeared in *The Journal of the Proceedings of the Royal Society of Antiquaries of Ireland*, is reprinted by permission of the Council of that Society.

The following articles by the same author have appeared in *The Royal Engineers Journal*:—

Lieut.-Col. Thomas Burgh, 1700-1730. (Aug. 1907). The Irish Houses of Parliament, Dublin, (Sept. 1907). Capt. Sir Josias Bodley, 1612-17, (Oct. 1906). Capts. Sir Thomas Rotheram and Nicholas Pinnar, 1617-44, (Aug. 1909).

## ROLL OF OFFICERS.

1251. *June 22nd.* The King directs the justiciary of Ireland to "cause the King's castles, houses and fortresses to receive the repair they require by view of good and lawful men who shall answer therefor at the Exchequer."—*Clarendon, Patent 35 H. III m. 7.*

"Keeper of the King's Works of the Castle of Dublin."

1279-85. Thomas Burel.

(No titles mentioned.)

1293. { John de Stratton.

{ John de Ideshal, Clk.

1296-7. { John de Ideshale.

{ Richard de Ponteyse.

1297-9. { John de Ideshale.

{ John Boet.

1299. { John Boet.

{ John de Colewells.

1300. John Boet.

"Supervisor of the Works of the Houses of the Castle of Dublin and the Exchequer."

1304. John Matheu.

"Superintendent of the King's Works."

1325-6. Robert Ingmainacon.

"Keeper of the King's Works of the Castle of Dublin."

1326. { Luke de Hynkeley.

{ Thomas Dyere.

1334. John de Mauncestre. . . . .

"Keeper (Garnefour) of the Castle of Dublin and also of the King's Works of the said Castle and Houses of the Exchequer."

1342. John de Wiltoun.

1344. John de Carleton.

1358. John Scrop.

1371. William Spaldynge.

1372-81. John More . . . . .

"Clerk of the King's Works" (with jurisdiction all over Ireland).

1388. Walter Eure.

"Keeper of the King's Palace within the Castle of Dublin and Clerk of the Works of the said castle."

1415-1447. John Coryngham.

"Carpenter of the Castle of Athlone."

1270-72. Nicholas de Gloucester.

1280. In this year "250 Camentarii Carpentarii, Operarii, et Fossatores" were sent into Ireland for the King's Works.

"The King's Carpenter."

1293. Adam de Claverle.

He was also Keeper of the Ordnance.

"Chief Carpenter of the Castles, Manors, and other the King's Works."

1343-57. Adam de Carleton.

He had jurisdiction throughout Leinster.

1441-1508. No records found so far.

| "Clerks General of the Works and Buildings, viz., of all the King's Honours, Castles, Manors, and all other his works."<br>(By Patent.) | "Clerk, Comptroller, and Surveyor-General of the Ordnance."<br>(By Patent.)   | "Surveyor-General of the Lands, Plantations, and Mines."<br>(By Patent.)                  | Other appointments.<br>—   |
|---|---|---|--|
| 1. Hen. VIII Nicholas Wilson, Gent.   |   |   |  |
| (Appointments held conjointly.)<br>1. Hen. VIII (regranted 1546)-1553.  |   | 1548. Walter Cowley.  | "Employed for the furtherance of the Fortifications."              |
| Edward Wallcis, Gent.   |   | 1551. Robert Record.  | The above two served in both England and Ireland.                  |
| 1553-64. Peter Ford, Gent.  |   | 1552-73. Michael Fitzwilliams.  | 1551-79. Mr. F. Rogers.  |
| 1564 (28th July). George Tresham, Gent.   |   |   |  |
| 1564 (8th Sept.). Stephen Erbery, of London, Merchant Taylor.   |   | 1573-90. Lancelot Alford.   | "Clerk and Surveyor of the Works and building at Carrickfergus."   |
| 1565-83. Nevill Sands, Gent.  |   | 1590. "Office passed to meet man" (? Sir G. Fenton).                                      | 1576. Owen Langford, Gent.   |
| 1583-93. Michael Kettlewell, Gent.  | 1593. Stephen Jennyns, Gent.  | (?)-1602. Sir Geoffrey Fenton, Knt.   | —  |
| 1593- Francis Capstoke, Gent.   |   | 1602-43. Sir William Parsons, Knt.  | 1601-2. Seige of Kinsale.  |
| 1594-99. Stephen Jennyns, Gent.   | "Comptroller of the King's Works."<br>(By Patent.)                            |   | Trenchmaster.  |
| 1599. Sir Geoffrey Fenton, Knt.   | 1606. Fras. Annesley, Gent.   |   | Captain Josias Bodley  |
| 1600-12. Samuel Molineux, Gent.   |   |   | "Ingeneere."   |
| 1612 (Mch. 16)—   |   |   | Paul Ive.  |
| { Samuel Molineux, Gent.  |   |   | —  |
| { Tristram Gawen, Gent.   |   |   | 1602. Seige of Dunboy.   |
| Office combined with that of Superintendent of Castles in 1612 and renamed,   |   |   | Trenchmaster.  |
| "Directors General and Overseers of the Fortifications and buildings." (By Patent.)   |   |   | Capt. Francis Slingsby   |
| 1612-1617. Capt. Sir Josias Bodley, Knt.  |   |   | "Superintendent of Castles."                                       |
| 1617-34—  |   |   | (on the Establishment of the Army.)                                |
| { Sir Thos. Rotheram, Knt.  |   | 1643. Office combined with that of Director-General of Fortifications and held by Pynnar. | 1607-12. Captain Sir Josias Bodley, Knt.                           |
| { Captain Nicholas Pynnar.  |   |   | Office incorporated with Director-General of Fortifications, 1612. |
| 1634-44 Capt. Nicholas Pynnar.  |   |   | —  |
| 1644-61. Colonel John Payne (appointed temporarily by the Marquis of Ormond, Lord Lieutenant of Ireland).                               |   |   | "Master Carpenter."<br>(By Patent.)                                |
| —   |   |   | 1618-?. John Bannister.  |
| "Directors-General and Overseers of the Fortifications and Buildings and Surveyors-General."<br>(By Patent.)                            | "Comptroller of the Ordnance" (under the Director-General of Fortifications). |   | —  |
| 1661-70—  |   |   | "Our Engineer."  |
| { "Capt." John Paine.   | 1662. Capt. Hugh Magill.  |   | 1625. Capt. Noon.  |
| { Capt. John Hullam.  |   |   | —  |
| —   |   |   | "Master Carpenter."<br>(By Patent.)                                |
|   |   |   | 1661. John Mills.  |

*In 1669 the Engineer Establishment was definitely fixed at 3 officers.*

| <i>Chief Engineer of Ireland; also styled, Director, Surveyor, and Overseer-General of the Fortifications, Buildings, Roads, Mines, Plantations, &amp;c.</i> | <i>Second Engineer of the Fortifications.</i>                                | <i>Third Engineer of the Fortifications (for service with the train.)</i> |   |
|--|--|---|---|
| 1670-84. Sir William Robinson, Knt.  | 1669-1698. No names traced so far.   |   | <i>Engineers on the Irish Establishment, 1689-91.</i><br>Rudolph Corneille.<br>Thomas Burgh.<br>Wolfgang W. Romer.<br>(Transferred to English Establishment.)   |
| 1684-88—<br>Sir Wm. Robinson, Knt.<br>William Molineux.  |  |   |   |
| 1688-1700. Sir Wm. Robinson, Knt.  | 1698-1705. Rudolph Corneille.  | 1698-1700. Thomas Burgh.  |   |
| 1700-30. Thos. Burgh, M.P. (Lieut.-Col. 1706.)   | 1705-1710. John O'Bryan.<br>(Transferred to the English Establishment 1710.) | 1703-19. James Wybault (Major 1719, transferred to Irish Artillery 1719). | <i>Engineers of the English Establishment, who served in the Wars in Ireland 1689-91.</i><br>Col. Fras. Philippanneau de la Motte.<br>(Acting Chief Engineer of the English Establishment in Ireland.)<br>Col. du Cambon.<br>Martin Beckman.<br>Jacob Richards.<br>Holcroft Blood.<br>John Bodt.<br>. . . Browne. |
| 1730-33. Captain Sir Edwd. Lovet Pearce, Knt. (From Nevill's Dragoons.)  | 1714. John Corneille.  | 1719-33. John Corneille, Jr.  |   |
| 1734-44. Arthur Dobbs, M.P.  | 1733-62. John Corneille, Jr.   | 1733-63. Lewis Marcell.   |   |
| 1744-52. Arthur Jones Nevill.  |  |   |   |
| 1752-66. Thos. Eyre. (Lieut.-Col. 1763.)   |  |   |   |
| The Office of Surveyor-General was abolished 1762.   |  |   | <i>Additional Engineer.</i><br>1761. Chas. Vallancey  |

#### SUBORDINATE OFFICES, 1739-63.

Engineer Office, Lower Castle Yard, Dublin.

| <i>Deputy to the Chief Engineer.</i> | <i>Clerk of the Works.</i> | <i>Clerk of the Accompts.</i>   | <i>Storekeepers.</i>                          |
|--------------------------------------|----------------------------|---------------------------------|---|
| 1753. Joseph Jarratt.                | 1747-52. Geo. Ensor.       | 1744-51. John Wilkin-son, Gent. | 1739-48. John Favier<br>1748-63. Thos. Coote. |

The Establishment was reorganised on a military basis on the 30th June, 1760, as the "Corps of Engineers of Ireland," and received the title of "Royal" in 1789-90. The Corps was abolished in accordance with the Act of Union on 1st April, 1801, the officers being given the option of retiring on full pay or joining the English Establishment. Only one, Lieut. George Armit, accepted the latter alternative.



## MEMOIR.

*CAPTAIN RICHARD DURRELL PANK, M.C., R.E.*

RICHARD DURRELL PANK was born on September 26th, 1893, the second of the three sons of Lieut. Col. P. D. Pank, I.M.S., and Mrs. Pank. The eldest, Captain P. E. D. Pank, is in the R.A.M.C., and the youngest, Lieut. A. D. Pank, also a Sapper, was killed in France in 1915.

He was educated at Wellington College and the R.M.A., and was commissioned in the Royal Engineers on October 1st, 1913. His Y.O. course at Chatham was interrupted by the outbreak of war, and he sailed from England in October, 1914, with the 3rd Field Squadron, with whom he served, first under Sankey and then under Simon, until January, 1916. During this period he was twice wounded; the first time by a shell which burst on the road beside him and blew him over the hedge; the second time, while out wiring at night in front of the Hohenzollern Redoubt, by a bullet through the arm. As a result of the latter wound he was invalided home in January, 1916, and, though at the time he did not know it, left France and the Squadron for good.

For some time it was feared that he would lose his arm, but he made a good recovery, and in the autumn of 1916 was passed fit for service and joined the 65th Field Company at Salonika. He remained with them till the summer of 1917, when he was transferred to the 66th Field Company of the same Division as second-in-command. A few weeks later the Division was sent to Palestine to take part in the third and successful attempt to take the Turks' position covering Jerusalem.

A year's service on the Struma was a certain introduction to malaria, and in May, 1918, he had to go into hospital at Cairo. On his return, a month later, he was posted Adjutant to the 53rd (Welsh) Division R.E., where he remained till the Armistice.

While in Egypt his attention had been drawn to the possibilities of service in the Sudan, and in December, 1918, he went down to Khartum to join the Military Works Department of the Egyptian Army. After a short stay at Khartum he was sent to Malakal, on the White Nile, to carry out some building work, and while there he succeeded, by a lot of hard work and some little good luck, in bagging three elephants and three lions, as well as leopard, various buck, and other game, in less than six months.

In June, 1919, he was recalled to Chatham to join No. 3 Supplementary Class, and on its conclusion in December, 1920, returned to



the Sudan, this time to Kassala, with a large visiting area round Gedaref and Gallabat. Here he got some more shooting, and also began to play polo, of which he became very fond.

After the war he had bought land in South Africa, at Addo, on Sundays River, thinking of retiring to farm there when his fifteen years' service for pension should be completed. In 1923 he spent his leave there, planting trees and making plans for the development of the farm; and in the summer of 1924, after a year at Fasher, in Darfur, he left the Sudan for good. He returned to England, and in September married Miss Meta Berent, a marriage which brought him happiness as great as it was to be brief.

With two years to serve before retiring on pension he was posted to command a Company of the Training Battalion at Chatham, but in the spring of 1925 he broke down and was sent on sick leave. His health had been undermined by recurrent malaria, in addition to his wounds, and by severe concussion, the result of a nasty fall at Khartum in 1921. During his sick leave, he and Mrs. Pank again visited his farm at Addo. He was then posted to Aldershot, but at once broke down again, and after a stay at the Osborne Convalescent Hospital was given leave until the date of his retirement.

He sailed for South Africa for the last time on August 13th, greatly looking forward to life on his farm. On the 9th September, a week after his arrival, he was taken ill, and died on the morning of the 11th.

Though still comparatively junior in rank, he had made his mark as an officer of the finest type that the Corps or the Army produces. Well-built and active, he was a good all-round athlete, playing, and playing well, cricket, rugby, polo, racquets, tennis and golf. He was an exceptionally good shot with both gun and rifle; the three lions which he killed in the Sudan were shot with an ancient .303 rifle, with which, in his own words, he had 'to aim a foot low and a foot right at a hundred yards,' and of which the ejector was broken. He appeared not only indifferent to danger but unconscious of it, and to be with him under fire was an ordeal to those of less steady nerves. Thorough himself in everything he undertook, he would never pass slovenly work by those under him. Humbug of every kind he detested. He was keenly interested in life, and read widely and deeply outside his profession. The last things he ever considered were his own advancement or his own convenience.

This very brief memoir has to fill the place of the two-volume biography accorded to men who have figured more prominently in the world's affairs; but it will be sufficient to recall to his friends an able and gifted officer, a gallant and selfless gentleman, and a most generous and loyal friend.

A.C.D.



**CAPTAIN RICHARD DARRELL PANK MC RE**

## BOOKS.

## "INUNDATIONS."

Major R. Deguent, of the Belgian Corps of Engineers, Professor at the *Ecole d'application de l'artillerie et du génie*, has been kind enough to present to the Corps Library a multigraph copy of his "Cours d'Inondations," comprising text and maps. It forms a succinct manual of the subject. His lectures deal first historically with the inundations of the Belgian front in 1914-18, and then treat the subject of flooding an area theoretically from the point of view of hydraulics and the preparations and works required. The last two lectures show how a project for an inundation should be prepared and recorded, and work out a scheme for an inundation in the Senne valley above Hombeek.

In 1914, the drainage of the Yser area was in operation and the getting rid of surplus water was thoroughly understood; the converse problem of flooding it had not been considered. There were two distinct water systems: the first of the navigable canals, the second, independent of the first, was the more complicated one of the "wateringues," "vaarts," or "fossés," a network of ditches designed to drain the area of rain or sea water, and at the same time to provide for irrigation of the "polders." As a rule the canals and the *wateringues* were connected at places by means of sluices, drop gates and weirs; sometimes the *wateringues* passed under the canals by siphons. The key of the whole system was the locks and sea-locks at Nieuport. One problem, when it was decided to let in the sea at high water, was how to keep dry the area behind the inundation, on which the Belgian Army and its communications were established.

Major Deguent gives a diary of the operations at Nieuport in October, 1914. The personnel of the *Ponts et Chaussées* had left the region, and it was the master lock-keeper, Cogge, in charge of the Furnes *Wateringue*, who provided the engineers of the army with the necessary information. An attempt on 26th October, 1914, to open the gates of the old Furnes canal, which enters the tidal Yser below Nieuport, was a failure; on the 28th, a second one succeeded; but, owing to the smallness of the channel, the result of three tides was "presque nul." It was therefore decided to open all the sluices of the weir of the Noordvaart, the principal evacuation channel, and this was done by an engineer detachment, covered by a party of cyclists, on the night of the 29th at 7.30 p.m., and the sluices closed again at 1 a.m. at low water. This manœuvre had to be repeated under fire at each tide until the night of the 1st November, by which time the inundation required was definitely established.

The Blankaart and Knocke inundations, nearer Ypres, are also described; but there is no reference to the "pump ships"—barges with pumps—stationed by the British at Fintelle Lock in summer, to raise water from the sea inundation to that of the next level, in order to maintain the flooding there. Nor is there mention of the six great pumps established at Dunkirk, so that sea water could if necessary be pumped to supplement the inundations at all times of the tide. Descriptions of these installations will no doubt be found in the "Miscellaneous" volume of "Work of the Royal Engineers in the European War, 1914-1918," now in the press.

The next lectures considered the theory of the subject, and provide all the formulæ required as regards flow of water, tides, etc.

The general conclusions to be drawn from the Yser inundations are :—

(1) In order to avoid delays, mistakes and failure, the hydraulic system of the region to be inundated must be thoroughly known (ground, works—canals, locks, bridges, etc.—relations between the various works, possible effects of any water manœuvres).

(2) To assure rapidity of execution, there must be thorough preparation in time of peace, and a permanent *dossier* containing all the information required for creating the inundation.

(3) There must be a geological examination of the ground, not only from the point of view of making the inundations, but the retention of the water in the area.

(4) The inundations having been created, the work of maintaining them, and guarding against enemy operations against them, must be taken in hand. These include :—

Constant watch on the level of the inundation and the works that maintain it (gauges and inspection) ;

Precautions against damage, whether by floods, bombardment or enemy operations (doubling important barrages, reinforcing banks, etc.);

Provision against any manœuvre or incident which might modify the level of the water.

(5) The technical work required for the creation and maintenance of an inundation is considerable. There is a perpetual struggle to prevent the failure of the banks and lock sills and walls, owing to the increase of the velocity of the current during formation of the inundations and water manœuvres that follow it. On the other hand, reduction of the velocity leads to channels silting up. The arrangements of peace conditions seldom provide for the above.

The "dossier" or records should include :

(a) Maps (generally 1:10,000) showing the works available to hold up water and barrages required, the area covered by inundation at various levels, the sites of the works either used or constructed to form the inundation, and the railways and roads ;

(b) Plans of all the above works ;

(c) The *Mémoire* containing a general description of the ground and the works, an account of the various inundations that can be formed, justification for the choice made ; the measures required to be undertaken ; a schedule of the work to be done in time of peace and in time of war on receipt of the order to prepare to make the inundation, and during the formation of it ;

(d) Detailed tables of work (order of urgency, material and time required) under the above schedule, for the maintenance of the inundation ; summary of personnel, material and tools, and tables of the times required to form the inundation to various levels at various seasons of the year. The effects of evaporation and infiltration must not be overlooked.

(e) Orders and instructions for the personnel.

It might have been added that what the Commander-in-Chief will want to know is : How much inundation can I have in one day, two

days, a week? What communications will be affected? Can I use the roads in the inundated areas, say, on the third day, will they still carry heavy traffic?  
J.E.E.

### SOLDIERS AND STATESMEN, 1914-18.

By Field Marshal SIR WILLIAM ROBERTSON, Bart., G.C.B., G.C.M.G., K.C.V.O., D.S.O. (Cassell, 2 vols., 1926.) Price £2 10s. od.

DURING a round of golf five years ago, Sir William Robertson, ignoring for once the principle of concentration, broached the subject of the propriety of soldiers and statesmen writing their reminiscences of war. He judged that it was as well that they should do so, for otherwise much information would be lost and the true history of a war would never be written.

In his preface, he states why he feels justified in using information which he acquired in the course of his career as a public servant and which, under other circumstances than those of the Great War, might be regarded as too confidential to be published. "The present book," he says, "deals with events none of which are less than eight years old, and so far as it may be held to disclose documents or discussions which were once classed as confidential, it cannot, I think, injure any public interest now existing. On the contrary, to place on record for the guidance of future generations of soldiers and statesmen the experiences gained in the first war in which the General Staff, as such, took part, should be to the benefit, not to the detriment, of the State." The author's opinions are not written "after the event," but are fully substantiated by memoranda written by himself, or by the G.S., at the time.

To attempt to review a book written by a past-master of conciseness, is, to say the least, difficult; the reviewer can only quote from the author's account of the conduct of the war and call attention to his considered opinions on, and reasons for, the action that was taken.

Sir William Robertson was Chief of the Imperial General Staff from December, 1915, to February 26th, 1918. None of the four other officers who occupied the post during the war held it for more than a few months; three of them are dead. Few men have the stamina to undergo the tremendous strain of such an office in the stress of war. Sir William held it for over two years, and those years covered the period in which the issue of the struggle was always in the balance. Trained to hard work, he had to face more than hard work in London. The responsibilities of Q.M.G., and then of C.G.S., of the B.E.F. in France during 1914-15, were comparatively child's play. At the War Office he had to battle with Ministers—all experienced politicians: some, men of outstanding intellect. Unfortunately few, if any, had any deep knowledge of military affairs and the conduct of war.

Like his right hand man and Director of Operations, Sir Frederick Maurice, in his recently published book, "Governments and War," Sir William Robertson reminds us of the warning given by the late Lord Salisbury in 1900, as to the unsuitability of the British Constitution for war purposes; how that warning remained unheeded; and how it had occurred to no one in authority that the organization of peace would have to be completely changed in time of war. The two

books are complementary to each other, but the C.I.G.S. should be read first. The importance of the human factor, not only within the staffs and High Commands, but also between the governments, of allied nations, cannot be underestimated, and both writers have earned our gratitude for drawing attention to this important matter.

General Maurice has told us how in the American Civil War both Lincoln and Jefferson Davis had to learn much about military affairs, from McClellan and Grant on the one side, and from Lee and Johnston on the other. So had Mr. Lloyd George to learn from his C.I.G.S. in 1916. Both Lincoln and Davis frequently made suggestions as to plans of action to their military advisers in the later stages of the Civil War, but they did not persevere with them when those advisers proved them to be unsound. They dropped them once for all. Not so Mr. Lloyd George. He sometimes gave way, it is true. But even if he dropped the proposal for a time, he took the earliest opportunity to revive it and to attempt to upset or modify a decision to which he had already given his approval. It required a disaster of the first magnitude to teach him to leave military affairs to be dealt with by military experts. Sir William Robertson's book gives example after example of his failure to grasp the essential principles of strategy. The obvious deduction is that he distrusted his military advisers, and, instead of changing them at once, allowed himself to listen to all sorts of advice and suggestions from irresponsible officers and others.

It is Sir William Robertson's opinion that :—"The war afforded no confirmation of the view sometimes held that the War Minister ought to be a professional soldier. On the contrary, Lord Kitchener's occupation of the post showed that the appointment of a soldier, especially of very senior rank, must necessarily be attended, both at Government headquarters and at the front, with certain disadvantages which it is desirable to avoid. The country undoubtedly gained more than it lost by having had Lord Kitchener at the head of the W.O. ; and most people will agree that no one else could have raised, or would have thought of raising, the great armies, without which, humanly speaking, victory could not have been secured. But Lord Kitchener was an exceptional man." It will be remembered that the author refused the position of Secretary of State for War, and a peerage, which were offered him by Mr. Lloyd George in 1916, on his becoming Prime Minister.

In Chapter I, the development of the Expeditionary Force is traced from the time of the Cardwell reforms in 1870-1 up to 1914. In referring to the second attempt to improve matters, in 1888, he mentions the somewhat laboured objection of Sir Henry Campbell-Bannerman, one of the members of the abortive Hartington Commission of 1888-90, to the creation of a "Chief of the Staff," though he concurred in the abolition of the office of "Commander-in-Chief." As a consequence, there is no doubt that Lord Wolseley, before the South African War, must have been greatly hampered by being deprived as he was, of the powers which, as Commander-in-Chief, he was entitled to possess, and which his predecessor, the Duke of Cambridge, did possess but did not exercise.

Sir William Robertson states his opinion—though he does so with great regret—that Lord Roberts, on becoming C. in C., missed a great

opportunity after the South African War for getting matters placed on a more efficient footing. "Lord Roberts must be held accountable, no less than the Government, for the small progress in reform accomplished after the South African War. The efforts which he subsequently made (about 1906-7 and later) to introduce military training, unfortunately lost something of their weight because he had made no such recommendation to the Government when C. in C. and in a position to press officially for its acceptance." But there was another reason, which did not exist in 1902, and Sir William Robertson quotes Mr. Asquith, Lord Grey and Mr. Haldane in support of it. "From 1908 onwards it was considered too dangerous by the Government to adopt a new military system which would have taken some years to build up. The temptation to a foreign General Staff to make an early end of what it might insist on interpreting as preparation for aggression on our part would be too strong to be risked."

After discussing the relative responsibility of statesmen and soldiers for our unpreparedness in 1914, and giving his view on the question whether soldiers should resign if their advice is not followed by Ministers, Sir William Robertson concludes the chapter with the following words: "From whatever angle their action is viewed, those soldiers who held the office of Army councillor in the years preceding 1914 were, no less than the Ministers, accountable for the inadequacy of the means with which the Great War was begun."

Chapter II, "The Western Front, 1914-15," commences with the sentence: "The policy to be adopted in the circumstances—what British policy was likely to be should Belgium be invaded by either belligerent, in the event of war between France and Germany—must necessarily be settled by the Government of the day when the time comes. It cannot be decided now. All that can be said now is that the fulfilment of our treaty obligations will follow, and will not precede, the national inclination." Such was the reply of the P.M., the late Lord Salisbury, to a W.O. Memorandum (written by Colonel Robertson, as he was then) in the year 1902. Col. Robertson cannot be accused of want of foresight.

From 1910 onwards, when Germany's aggressive designs had become more pronounced, and our relations with France and Russia had been put on a more friendly footing, the difficulty of supplying the information asked for by the W.O. in 1902 should have been less, while the need for supplying it was certainly greater. "But," writes Sir William Robertson, "it was not supplied. . . . In other words, we were without the means required for enforcing the policy in which we had become involved. . . . The French were, consequently, forced to frame their plan of campaign not knowing whether they would or would not receive British assistance, while we on our side were not able to insist upon our right to examine the French plan in return for our co-operation. When the crisis came, there was no time to examine it, and our military policy was for long wholly subservient to the French policy, of which we knew very little." There was a divergence of views at the very start. Lord Kitchener thought our position at Maubeuge would be too exposed, and he favoured a concentration further back in the neighbourhood of

Amiens. But he felt obliged to yield to the opinion of the combined French and British staffs, some members of whom had studied the subject in conference unofficially for several years. Lord Kitchener proved to be right. Before the B.E.F. fired a shot, the question of a change of base had to be considered, owing to the Line of Communications to Boulogne and Havre being threatened, and on Aug. 27th the order had to be given by the Q.M.G. (Sir William Robertson) to transfer the main base to Nantes, further south and west. This was only possible thanks to our assured naval supremacy, and the author considers that all we had ever spent on obtaining that supremacy was more than justified by the fact that we were able to effect the change of base without interference.

Sir William Robertson, as Q.M.G. of the B.E.F., has naturally a good deal to say about the shortage of gun ammunition throughout the autumn and winter of 1914-15. He lays particular stress on the paralysing effect which uncertainty as to ammunition supply had on plans for operations, and mentions the fact that while operations were in progress, in May, 1915, 20,000 rounds had to be sent to Gallipoli, showing that secondary offensives were already beginning to affect operations on the decisive front. The question of the policy to be followed in the following year (1916) was discussed at a joint Conference at French G.H.Q. at Chantilly as early as June, 1915. The British Government was in favour of remaining inactive on the Western Front in 1916, presumably to give time for the development of the New Armies and the supply of munitions, but the proposal was promptly rejected by the French, and the decision arrived at was:—"A passive defence is out of the question, because it is bad strategy, unfair to Russia, Serbia and Italy, and therefore inadmissible." Was it only the losses in the Second Battle of Ypres and our premature commitments in the Dardanelles and in Mesopotamia, that caused the British Government to put forward the proposal? Or, was it visions of a great Balkan campaign as our main effort, against Austria, and the simultaneous landing of 100,000 British soldiers "in Syria" to cut off the 80,000 Turks said to be advancing from there on Egypt, that prompted it? Sir William Robertson refers more than once to the famous memorandum produced by the Chancellor of the Exchequer on Jan. 1st, 1915, proposing these eccentric campaigns, to enable which to be carried out he also proposed to transfer the whole B.E.F., with the exception of a general reserve to be left in the vicinity of Boulogne, from France to Macedonia and Syria. "These proposals found no favour with the French. Moreover, the safety of France, and of the Channel ports in particular, was vital to us."

This opportunity may be taken of stating that Sir William Robertson deals summarily of Lord Fisher's scheme for making a combined naval and military attack on the coast of Schleswig-Holstein. "This plan," he says, "had often been mentioned before the war, and as often rejected. From a military standpoint it was not a practicable proposition."

Chapter III. "The Dardanelles Expedition." As C.I.G.S., Sir William Robertson had only to deal with the evacuation of the Peninsula, and he relies chiefly on the Report of the Dardanelles Commission for his information. But what he has to say is extremely valuable,



and should be read by all who wish, or have, to study the campaign, for it may save them wading through the Commission's Report.

In Chapter IV, "War Organization," we find a most valuable document, in the form of a letter written to Lord Kitchener, and at his request, on Dec. 5th, 1915, in which the C.I.G.S.-designate gives his views, after preliminary discussion with the Secretary of State, on the status and duties of the C.I.G.S. (Vol. I, pp. 168-170). The Memorandum necessitated a change in the Order of Council of 10 Aug., 1914, but the suggestions therein set forth were adopted in their entirety within a year, and resulted in military responsibility for the whole Empire being centralized in the War Office alone. Its provisions were unreservedly accepted by Mr. Lloyd George when he became Secretary of State for War. At the time, Mr. Lloyd George said that no Minister was likely, and certainly not himself, to wish to alter it during the war. Nevertheless it was Mr. Lloyd George who, as Prime Minister, altered it on February 11th, 1918, in the Note (see Vol. II, p. 232) in which he virtually dismissed Sir William Robertson. Pages 174-8, Vol. I, should be read in this connection.

One of Mr. Lloyd George's first acts, and one of which Sir William Robertson thoroughly approved—he always gives the Prime Minister full credit for right decisions—was to replace the traditional Cabinet of about a score of members by a "War Cabinet" of five. It formed, together with the naval and military chiefs as advisers, the Great General Headquarters of the Empire. The French copied the organisation in 1917, when they formed a Great General Headquarters at the capital, with a Chief of the General Staff (first General Pétain and then General Foch) to carry out duties similar to those which devolved on the C.I.G.S. of the British Army. Pages 168-190, Vol. I, on the working of the organization are some of the most instructive in the book.

Chapter V. "Unity of Command." Co-operation, in the earlier stages of the War, was obtained on the basis that France was the predominant partner of the Entente. Plans were co-ordinated by means of conferences between the military chiefs or their representatives. The results achieved were not completely satisfactory. The next development was a system of regular ministerial conferences, but as their function was civil, not military, it was suggested by the French that a Combined General Staff should be formed, with General Foch as C.G.S., with a view, perhaps, of his some day developing into a Generalissimo of the Allied Armies. Both the P.M. and C.I.G.S. were opposed to the idea of a Generalissimo, but before the French proposal could be discussed, the Italian disaster at Caporetto led to a Conference at Rapallo in November, 1917, at which it was eventually decided to form the "Supreme War Council." The Premiers of the Great Powers fighting on the Western Front were to be members, with a subordinate Minister from each country; and there were to be "military representatives" whose function it was to advise. Here was the crux—they were to advise over the heads and independently of the Chiefs of the General Staffs of the Armies. These military representatives were to form an "Executive Committee" to take charge of the handling of the reserves of the several armies and co-ordinate their disposal.

The "Executive Committee" completely broke down when put to a practical test at the end of March, 1918, and on the 26th General Foch was appointed virtual, and three weeks later, actual Generalissimo of the Allied Armies.

As to the necessity of that appointment, in the circumstances, Sir William Robertson agrees, but he points out that, however successful the result proved, there was no guarantee that it would have been justified, say a year before—in view of the opposition of Mr. Lloyd George, who had declared in the House of Commons the appointment of any Generalissimo "would lead to real friction, and might produce not merely friction between the Armies, but friction between the nations and Governments."

Chapter VI. "The Western Front, 1916." The Allied General Staffs had no difficulty in agreeing as to the probable course of events during 1916, but the Ministers were somewhat divided. The French government was still in favour of strengthening the Salonika armies in the hope of bringing in Rumania, and they were also listening to somewhat frequent suggestions from Russia in favour of an advance in strength through the Balkans. However, the policy agreed upon was to expect a powerful German offensive on the Western Front, and to be prepared to take the offensive energetically, on a properly co-ordinated plan, on all three main fronts. The German assault was launched on Feb. 21st, 1916, on Verdun, where it was expected, but the early date came somewhat as a surprise.

Sir William Robertson thinks that, with the exception of a much larger detachment than necessary in Macedonia, where the Anglo-French armies amounted to 200,000 men, the principle of concentration in the decisive theatre had been well observed during the winter of 1915-16.

The objects of the Somme Campaign were, firstly, to ease the pressure on the French at Verdun; secondly, to give relief on the Russian and Italian fronts; and thirdly, to wear down relentlessly the German armies on the Western Front.

The operations lasted from July 1st till the middle of November, when they were stopped by bad weather.

As to the results, Sir William Robertson states that the General Staff agreed with General Haig in considering that the three objects of the campaign had been achieved, and that the enemy had been dealt a staggering blow from which he would find it very hard to recover. But they were of opinion that there was still much to be done before his final overthrow could be accomplished. The consideration of these further measures was immediately taken in hand by the General Staff. First and foremost was the question of Man-power.

This question is dealt with in Chapter VII. Ministers had always approached the question of universal service in a half-hearted manner. It can, perhaps, be understood why the proposal was rejected in August, 1914, when there had not been time to prepare a scheme—belated as it would have been—but that reason did not hold good later. The policy of National Service was actually accepted in principle towards the end of Mr. Asquith's tenure of office in 1915, and it had been hoped to pass

the necessary legislation before the end of the year. But within a week Mr. Asquith had resigned, and the question was again shelved by Mr. Lloyd George. From 1916 onwards, the necessity for universal service was frequently urged by the soldiers. Various make-shifts were tried, but it was not till the disaster to the Fifth Army in March, 1918, that the principle was put fully into practice.

Chapter VIII. "Home Defence." On the whole, Sir William Robertson is of opinion that the number of men retained in this country for Home Defence was not excessive.

The question of whether invasion was possible or not depended naturally on the Admiralty.

In August, 1914, two regular divisions were held back temporarily, so as to give the Territorial troops more time to get into their places. The later dispatch of Territorial troops to the front was made subordinate to the retention of an adequate number at home, and although this policy was slightly modified during 1916-17, after Jutland, and when the Americans entered into the War, the requirements of Home Defence continued to take priority over the reinforcement of the armies abroad, until the great German offensive in March, 1918.

Sir William Robertson mentions the effect of the air raids, which caused us to withdraw temporarily two squadrons from France and permanently to retain one. In concluding the chapter, Sir William Robertson says: "The attitude of Ministers responsible for protecting the homes and lives of the people is easy to understand, and attention is drawn to it, not by way of criticism, but in order to emphasize the fact that when war is afoot the requirements of Home Defence, whether on land, on sea, or in the air, will, except perhaps in the case of a great crisis, such as that which occurred in March, 1918, invariably have to be given precedence over requirements connected with operations abroad."

Chapter IX. "The Mesopotamia Campaign." This chapter, based on the Report of the Commission on its conduct and on the Official Account, is of great value to all officers who may have to study the campaign, and of special value to those interested in staff duties.

As regards the strategy, Sir William Robertson, whose experience of India and the East is by no means superficial, says:—"From first to last, both in London and India, the advantages to be derived (from the occupation of Baghdad) were over-rated, and were too often allowed to obscure the practical difficulties (chiefly of communications) that stood in the way of their attainment."

Lord Kitchener was opposed to the project from the beginning. But permission was given for General Nixon to march on Baghdad if that officer was "satisfied that the force he has available is sufficient for the operation." The Home Government thus placed on General Nixon the sole responsibility for deciding whether the scope of the campaign was or was not to embrace the capture of Baghdad—an operation which the Viceroy had said would "probably determine the Turks to send large forces to attack us." . . . "To the layman it may appear that as Nixon was left with a free hand, he had only himself to blame for what followed, and to some extent that must be admitted. But there was much to be said on the other side, for the question was not merely one of going to

Baghdad, or even of remaining there. Much wider issues were involved. The question was essentially one of policy and general strategy, and not merely one of tactics. Therefore it was beyond the power of any local Commander properly to decide. Moreover, Nixon was without good information either as to the probable strength of the enemy's reinforcements or the date of arrival of his own."

The disaster of Kut led to the control of the operations being vested in the General Staff, but administrative control was left to India. It was not till July, 1916, that both administrative and operative control was taken over by the War Office, and it was not till then that "the railways were really pressed forward with the vigour which the situation demanded (Mesopotamia Commission Report)."

"Supreme responsibility," says Sir William Robertson, "for the two functions of operations and administration ought, in fact, never to be separated, and it was a mistake on my part not to have asked for War Office control of both at the same time (Feb. 3rd, 1916)."

His final criticism on the campaign is as follows:—

"Considered as a military measure, and in its relation to the war as a whole, the campaign greatly exceeded in scope the requirements of the situation, and left us a legacy of increased military responsibilities of which the full consequences cannot yet (1926) be seen. . . ."

Chapter X. "The Salonika Expedition." The only possible arguments in favour of our going to Salonika were (1) the moral obligation to help Serbia—as we helped Italy in 1917—an ally in distress, and (2) the denial of the littoral as a submarine base for our enemies.

The first miscalculation was the failure of Greece to fulfil her treaty obligations to go to Serbia's assistance. Next, Serbia was invaded before she could be supported, by some 200,000 Austro-German troops from the north and by the Bulgarian Army of 250,000 men from the east, and within 2 months was overwhelmed.

Sir William Robertson, in his narrative of what happened subsequently on this front, gives General Sarrail credit "for preventing any movement of Bulgarian troops northwards during our Somme Offensive in 1916. Admittedly Sarrail was in a very difficult position.

"Firstly, the indecision of Rumania and the persistent endeavours of France to bring her into the war led to his receiving many perplexing orders and counter-orders, entailing constant changes in his plans. Secondly, affairs in Greece were in such a state of chaos that he never knew from hour to hour what policy the Entente Governments might adopt for dealing with the situation."

Rumania eventually entered the War, but the three months' delay in making up her mind had been fatal. Moreover, her strategical dispositions at the outset of the campaign were faulty and seemed to incite defeat. When matters came to a deadlock on the Salonika front and Mr. Lloyd George began to realize that no benefit, political or other, could be derived from them, he apparently ceased to take interest in them, but it was not till the spring of 1918 that all efforts were concentrated on the object of main importance—the defeat of the German main armies—and a considerable reduction made in the Salonika army.

Chapter XI. "The Campaign in Palestine." Sir William Robertson considers that the operations directed against the Turkish forces based on Palestine were, in their early stages, both appropriate and profitable, in that they helped to secure the Suez Canal. Later, they became objectionable, for they absorbed troops which ought to have been sent to the Western Front.

As regards the defence of Egypt, Lord Kitchener was in favour of indirect defence, his idea being that we should operate from Alexandretta, making use of the troops to be withdrawn from Gallipoli. But the Alexandretta project had already been considered and turned down. The combined staffs, therefore, decided that Egypt must be defended by direct methods, and in Sir William Robertson's opinion, the conclusion was sound from every point of view. He incidentally mentions a project, which was fundamentally unsound and fortunately did not materialize, namely, the proposal to send a force to Rabegh, a place on the Red Sea coast between Jeddah and Yambo, in order to support the Sherif of Mecca and the Arab revolt against the Turks.

In Palestine Mr. Lloyd George hoped to gain the dazzling success which had been denied to him in the Balkans, and he did all he could to persuade the General Staff to get matters pushed there, first by Sir Archibald Murray, and then by General Allenby. The latter was taking no risks, and his estimates of troops required was so discouraging that his mission was limited "to defend Egypt and by such offensive action as he deemed feasible, compel the enemy to divert to Palestine troops that might otherwise be used against General Maude in Mesopotamia." The wisdom of this policy was demonstrated. A week or two after it had been laid down, five British and five French divisions had to be withdrawn from the Western Front to assist the Italians after Caporetto. It was not till September, 1918, that General Allenby was able to commence the advance, which resulted in the overthrow of Turkey's military power in Asia and the occupation of her territory up to and including Aleppo.

Chapter XII. "The Western Front, 1917," deals with the operations on the Western Front subsequent to the Battle of the Somme.

On November 15, 1916, that is, during the Battle of the Ancre, an important conference took place at Chantilly to decide upon a plan of campaign for 1917. It was agreed that the plan should be of a decisive character, and that it should comprise a series of offensives on all fronts to commence not later than the middle of February. The French were late with their preparations, whereby much of the advantage gained on the Somme was lost, while the revolution in Russia, beginning in March, made a simultaneous offensive on all fronts impossible.

During a conference held at Rome early in January, 1917, "the Prime Minister surprised all present by producing a plan for a combined French-British-Italian offensive through the Julian Alps to Laibach and Vienna, the object being to put Austria out of the war."

Who drew up this plan? The British C.I.G.S. says that the British General Staff had previously heard nothing about it, and none of the other Entente staffs had any knowledge of it.

The French took no risks. On the way home, the British and French

delegates were met at a railway station near Paris by General Nivelle, who had just succeeded Joffre as C.-in-C. He came to ask the co-operation of the British Government in another plan, the one which he proposed to substitute for the Chantilly plan (backed by Joffre). It is unnecessary here to go into the Nivelle controversy: Sir William Robertson gives a detailed account of it which amplifies what is generally known about it. The British attacked at Arras and Vimy on April 9th. The French offensive further south failed, and matters were further complicated by the mutinies in the French Army, of which, fortunately, little or nothing was heard at the time in England or on the British front. By June 20th, General Pétain was reported to be satisfied that he now had the trouble well in hand, and although Mr. Lloyd George once more brought forward and pressed strongly his Austrian scheme, it was decided to persevere with the original plan and transfer the main offensive to Flanders in the autumn and endeavour to clear the Belgian coast. Eventually, on July 31, 1917, the British Second and Fifth Armies attacked on a broad front, with limited objectives. The writer can well remember standing in the rain at 2 p.m. on that day in the trenches captured by his Division, in a very limited objective on the extreme right of the battle front, and discussing with his G.S.O.I. (Dill) the disastrous effect of a downpour of rain at this juncture if it persisted. It did persist, and August, 1917, had the worst rain record for many years.

Sir William Robertson says with regard to Paschendaele that: "The decision to persist with the operations has been widely criticised, and it may be said at once that responsibility for the error, if error there was, must be shared by the Imperial General Staff, since it was their duty, in communication with G.H.Q. in France, to call a halt immediately that course became advisable. . . . But there were strong reasons why activity had to be maintained. We had to give the French Armies time to recover their strength and morale, make every effort to keep Russia in the field in some form or other, and try to draw enemy troops to Flanders which might otherwise be sent again to Italy, especially after her defeat at Caporetto. All these purposes of distraction were achieved, and in addition heavy losses were inflicted upon the German armies."

Chapter XIII. "Preparations for 1918." The first question was whether we should aim at finishing the war in 1918, or defer the attempt until 1919. "The answer to this," says Sir William Robertson, "was easier to give than to apply. Obviously we should, if we could, defer the attempt until America was ready. But could we defer it?"

The answer which he gave to the War Cabinet is contained in a memorandum given on p. 269, Vol. II, which ends with the following sentence: "I therefore submit that the only practicable thing to do is to make ready to the full extent of our power by the early spring and decide then to what extent we should fight." He laid stress on the point that a defensive policy in the distant theatres was particularly to be desired because it would enable American troops to be brought to France with greater rapidity.

That Germany intended to prevent us deferring our effort to 1919

became more and more certain during the winter. The War Cabinet could not, or would not, see the seriousness of the shipping position. If they had done so they could not for a moment have countenanced, as they did, the Palestine project, again revived by Mr. Lloyd George.

On February 1st, 1918, at a meeting of the Supreme War Council, the "technical advisers" reported, after many weeks of delay, and recommended that "subject to the Western Front being made secure" a decisive offensive should be undertaken—against Turkey, with a view to the annihilation of the Turkish armies and the collapse of Turkish resistance.

Before putting the resolution to the meeting, the chairman asked if anyone present wished to offer any observations on it. The British C.I.G.S. made the following statement: "It is not for me to approve or to oppose any resolution of the Council as I am not a member of it, but as I have been summoned to attend, I feel compelled to submit, in view of the state of the Entente's resources, especially in men and shipping, and of possible events on the Western Front this year, that the Council ought to adopt a defensive policy in all secondary theatres, and to keep no more troops there than are necessary for that purpose. I am also of opinion that to undertake the campaign in Palestine as recommended by the technical advisers of the Council is not a practical plan, and to attempt it will be very dangerous and detrimental to our prospects of winning the war." No one else appears to have spoken.

M. Clemenceau then suggested that the Council should take note of the objections raised by the C.I.G.S., British Armies, and asked whether they involved any modification of the resolution. Mr. Lloyd George said that he still adhered to it, and as no one else had any further remarks, it was accepted.

When the C.I.G.S. expressed his regret to the P.M. for having opposed his plan before the foreign delegates, and explained that if he had said nothing they might have thought he had no objection to offer, "Mr. Lloyd George angrily disagreed, saying that, as I had already acquainted him with the General Staff's views, there was no necessity to repeat them before the Council." It will be remembered that before the Dardanelles Commission, a year or so earlier, Mr. Lloyd George agreed with the Commissioners that if naval and military advisers present at Ministerial Councils did not express dissent, it was legitimate to assume that they agreed with what was being done, (pp. 286-7, Vol. II). Sir William Robertson submits that naval and military officers holding the position of professional advisers to the Government ought not to be deterred by these or any other considerations from plainly stating what they think. "Of course, they must do all they can to cultivate good relations with their ministerial masters, and endeavour to meet their wishes, but, when a state of war exists and men's lives are at stake, they will be disloyal to their country if, knowing that a plan is bad, they do not speak and condemn it." "Napoleon is credited with having said: *'Tout Général en chef qui se charge d'exécuter un plan qu'il trouve mauvais, est coupable. Il doit représenter ses motifs, insister pour que le plan soit changé, enfin donner sa démission plutôt que d'être l'instrument de la ruine de ses troupes.'*"

In conclusion: the reviewer craves indulgence in that time does not permit of a further effort to condense this attempt to give the readers of the *R. E. Journal* a fore-taste of the distinguished author's valuable and intensely interesting work. He ventures to hope that, as there are so many of his brother Officers, serving and retired, at home and, more particularly, abroad, who will wish to read the book as soon as they can get hold of a copy, this humble attempt at a review, too lengthy though it be, will serve to whet their appetite. They will never regret it, even if they have to present themselves with the volumes. The author's "From Private to Field Marshal" is, and will long be, a favourite gift book to the boy who wants to be a soldier. So "Soldiers and Statesmen" will always be an acceptable present to the man who aspires to be a Field Marshal, or a Prime Minister.

H.B.-W.

#### IMPERIAL DEFENCE, 1588-1914.

By COLONEL J. F. C. FULLER, C.B.E., D.S.O. (Sifton Praed & Co., Ltd., 1926). Price 3/6.

A timely and instructive volume of a hundred pages, in which the author traces the growth of Imperial Defence from the sixteenth century to the Great War.

He manages to bring into it an account of the Holy Alliance and the inevitable comparison between it and the League of Nations. Of the futility of the latter he is in no doubt. He ends with an appeal to substitute for it a League of British Nations, which will set the Empire on a securer footing than ever before.

In the opening chapter, Colonel Fuller enunciates the principles on which he believes that the British Commonwealth has been built up, namely—

(1). The establishment of domestic peace in the first instance in Great Britain after the union with Scotland (1707), and, later, in the several British oversea possessions.

(2). The maintenance of the balance of power in Europe.

(3). The establishment of secure frontiers, again in the first instance in Great Britain, and subsequently in our colonies.

(4). The maintenance of the Command of the Sea.

(5). The self-government of self-controllable Colonies.

In Chapter II, the author traces the childhood of Imperial Defence. Its birth he dates to the time when "after the union with Scotland the entire frontiers of the realm became surrounded by the ocean and an all but un-attackable frontier was gained. Nearly contemporaneous with the establishment of this boundary the instinct of expansion urged the English beyond their shores. Expansion prevented decadence, it enabled hostile minorities to escape from tyrannical majorities, it supplied a vent for adventurers, those truculent hunters after Eldorados, who, if forcibly kept at home, revolt against their surroundings.

"This expansion carried with it, as a necessity, command of the sea, which, in the Dutch Wars of the seventeenth century, passed to England, and has ever since remained an instrument of peace in the hands of the British nations.



"With the growth of sea power, which alone cannot guarantee the integrity of oversea possessions, there developed from the time of the first great Imperialist, Oliver Cromwell, the theory that international war may be restricted by the institution of a balance of power between civilized nations and that international peace can best be maintained by a majority of nations, which through preparedness for war and threat to use physical force, keep in check the aggressive tendencies of a would-be aggressor.

"From Cromwell's time to the present, the maintenance of the balance of power, therefore, formed the keystone of British foreign policy, except for short periods of pacificity which have invariably been followed by international conflicts. But though the maintenance of the balance of power between the nations of Europe has guaranteed the integrity of the Empire as a whole, it was unable to secure distant portions of the Empire against local attack. The consequence was that the instinct of expansion in our oversea possessions forced them to push out their frontiers to impassable obstacles. Separated by sea from her colonies, the Home Government has never been able to impose its will on our oversea possessions, the only attempt to do so resulting in the loss of our American Colonies. The impossibility of exerting control based on physical force has resulted in our having to maintain alliance by means of sentiment. Herein lies the cohesive force which holds the Empire together—very different to that found in all preceding Empires, which have been held together by tyranny, by federalization or by confederalization. The British Empire as we see it to-day, is actually a family partnership held together, as every family is, by a bond of family-preservation and sentiment, preservation not only of the family as a whole, but of the family as the inheritor of traditions, customs and a literature which it is considered honourable to maintain because they have proved their worth.

"The supreme test of the British Empire has been, in the past, not the disruptive but the consolidating effect of foreign wars. Every great foreign war has given new lease of life to the intricate partnership which, for over two and a half centuries, has succeeded in reconciling 'diversity with uniformity.' The secret of the success of the British system of rule is that it has tended its colonies in infancy, and freed them on coming of age. It has, in fact, reconciled security and liberty in a manner totally unapproached by any former empires."

The author goes on to give an outline of British history and of the growth of her sea power, to the fall of Napoleon. From 1815 to 1874, Colonel Fuller considers that there was a period of decadence. He attributes it to the effects of the sufferings consequent on twenty-two years of war. He says:—"European politics lost all vision, and a period of dementia supervened. The statesmen of Europe congregated together to seek a national solution of international problems. The cure proposed was none other than that of a League of Nations called the Holy Alliance, from the faults and failures of which every European war since the Congress of Vienna (1814), may be traced."

England did not subscribe to the Holy Alliance. Its failure Colonel Fuller attributes to the fact, common to both the Holy Alliance and to

the League of Nations, that they are essentially communistic and consequently impractical and dangerous. "The Holy Alliance," he says, "was in fact a conspiracy against popular liberty, consequently a standing irritation."

Though renewed in 1833, but only by Russia, Austria and Prussia, the Holy Alliance died a natural death in the early fifties. In 1854 England went to war with Russia, and then followed the Indian Mutiny. There was then a temporary recrudescence of military fervour in Great Britain, and, in 1859, a Committee was appointed to consider the cost of the military defences of our Colonies. The result was the recognition of the principle of Imperial partnership by Mr. Gladstone, which led to the Colonies undertaking their own defence and so permitting the regular garrisons being gradually withdrawn. The renaissance of Imperial Defence dates from 1875. In 1879, a Commission was set up to enquire into the defence of British possessions and commerce abroad. In 1885, a standing Colonial Defence Committee was created.

The first Colonial Conference took place in 1887, Queen Victoria's Jubilee year. It is memorable as being the first occasion on which defence was brought prominently before the Colonial Governments as the most important "common interest" and "common responsibility" of the mother Country and daughter States.

Colonel Fuller traces the course of our foreign policy throughout the period and shows how, when the South African War broke out, England stood alone in the world completely friendless, and as an Empire totally unprepared to wage a war even against "embattled farmers." He has a dig at the system of conducting war which led to our troubles in that campaign, and hits the nail on the head when he quotes Colonel G. F. R. Henderson's "The Science of War," on the subject. The reference awakes one's regrets at the fact that perhaps not a single copy of Col. Henderson's printed draft for the political chapter for the official History of that war now exists. Every copy was ordered to be destroyed. One copy survived for some years, but that has now disappeared.

Henderson pointed out that up to this period Imperial Defence had never been approached from the standpoint of Imperial strategy. But good came out of evil, for the South African war was a war of Imperial education. It demonstrated that the Empire did exist, and that it intended to continue to exist as a united brotherhood in arms should its frontiers be threatened.

We now reach the period of the Reformation of Imperial Defence. The South African War awakened the Imperial spirit amongst the peoples of the Empire. The Colonial Conference held in 1902 was notable from both a naval and a military point of view, for the Canadian Premier announced that the Dominion contemplated the establishment of a local naval force, and Mr. Seddon submitted a resolution suggesting the formation of an Imperial Reserve Force in each Dominion for service, in case of emergency, outside the Dominion or Colony, the cost to be shared between the Imperial and Colonial Governments. Though the resolution was not accepted by all the Dominions, New Zealand had pointed the direction in which the defence of the Empire was to be sought, and her action was not wasted. Shortly afterwards, the Defence Committee of the Cabinet

was remodelled to include both the Political and Professional Heads of the Navy and Army. The labours of the Committee led to the establishment, in 1904, of the Committee of Imperial Defence and the creation of a General Staff; and in 1906-8 came the reorganization of the Army and Territorial Force by Mr. Haldane. Simultaneously military reforms were initiated in India by Lord Kitchener.

The first "Imperial Conference" met in 1907. To it, the Government submitted a memorandum, prepared by the new General Staff, on the reorganization of the Colonial Defence Forces on the lines of the reorganization of the British Army. Politically the most important resolution passed was the establishment of the Dominions on a status as "national entities distinct from the British Isles." It was recognised that "the basis of Imperial organization was the co-operation of five nations, not the centralization of power in the hands of the British, acting as the Imperial Government," and it destroyed once and for all the older conception of Imperial development, "as a gradual reunion of the Colonies with the Mother Country through representation in either of the British Houses of Parliament."

Colonel Fuller then gives an interesting *resumé* of events from 1907 to the outbreak of war in 1914, and concludes with a chapter on "The Value of Past History," in which he compares the aftermath of the Great War with the corresponding period after 1815. He says:—"After Waterloo the balance of power vanished. We retired behind our sea wall, our unattackable frontier, and the most formidable land power—Russia—with probably the best intentions in the world, tried to guarantee perpetual peace on earth by the establishment of the Holy Alliance.

"After the Armistice of 1918, the balance of power again vanished. Unfortunately, so I think, we did not retire behind our sea wall, but became entangled in the new Holy Alliance, the League of Nations. The establishment of this league was the idea of the strongest land power, the United States, but eventually, when level-headed people in America saw clearly where it would lead, they cast off their moorings and sailed in the opposite direction.

"Financially we are the leading power in the Old World, but the very terms we have bound ourselves at Geneva to support are diametrically opposed to the principles wherein our Empire has been born and nurtured.

"Self determination is the antithesis of the policy of domestic peace; not only has it been used to split Europe up into nations without economic resources or military frontiers, but it has had a disruptive effect in Ireland, Egypt and India. Self-determination of people who cannot guarantee their own domestic peace is synonymous with anarchy.

"Self-determination has already done us more harm even than the Germans did during the whole period of the Great War, yet, ironical as it may seem, self-determination of nations who can determine their own security has been a governing principle of British rule.

"Not content with abandoning principles (1) and (5) (as tabulated at the commencement of this review), we have, by agreeing to a one-power naval standard at the Washington Disarmament Conference, abrogated principle (4), and by doing so, not only have we undermined principle (3), but we have rendered it next to impossible to carry out principle (2).

"If this old established policy is to be scrapped, what policy is to replace it?"

Col. Fuller's answer to us is to get behind our sea wall, establish a League of British Nations, and let the League of Nations die the death, the sooner the better, of the Holy Alliance.

H.B.-W.

### A GREATER THAN NAPOLEON, SCIPIO AFRICANUS.

By CAPTAIN B. H. LIDDELL HART. (Blackwood. Price 12s. 6d.)

Comparisons are odious, but we doubt if there are many soldiers who have not debated at some time or another the relative merits of the great captains, with a view to a decision as to who was the greatest soldier in history. Following the lead of Napoleon, place may be given to Alexander, Hannibal, Cæsar, Gustavus Adolphus, Turenne, and national pride will have added Marlborough and perhaps Wellington, but few will have considered the claims of Scipio Africanus. It is with great interest, therefore, that we open this latest book of Captain Liddell Hart, and we are not disappointed. A strong case for a place among the military immortals has undoubtedly been made. Also the author has presented a live portrait of his hero, and on the whole a convincing one, whatever our views may ultimately be of his place in comparison with others.

Evidence has been drawn from probably all of the limited sources available. Unfortunately, all of these are written from the Roman point of view, and are, on the whole, favourable to Scipio. When the author claims Polybius as his chief authority, and a comparison with this historian's work shows that his text has been closely followed throughout, the reader may be excused if he tends to become hypercritical. Polybius was a personal friend of Scipio's boon companion and faithful lieutenant Laelius, and admits that much of his information was derived from that source.

Armed with this knowledge, however, the most ardent critic cannot but admit the greatness of the unbeaten Roman general. The author attributes partly to this invincibility his hero's lack of lasting renown, and formulates the paradox that "the road to failure is the road to fame." The thesis is an interesting one and would repay a more extended study.

Captain Liddell Hart examines his subject from the widest point of view: as a man, a strategist, a tactician, and a statesman. Generous to his opponent, faithful to his subordinates, and wise in his support of constitutional power in the abstract, Scipio became the hero of his army, cemented the allegiance of allies, and strengthened his own position when resistance to political machinery seemed advisable. As a strategist Scipio will rank high, but the author's claim for a unique position for Scipio as an originator of new ideas seems rather overdone when the campaigns of other generals of his era are examined. In the realm of "logistical" strategy Scipio certainly stands out as a judge of the character and probable actions of enemy leaders, rulers and people. The tactical studies of the various battles are well done. A study of Zama makes one wish there were further evidence available to explain Hannibal's extraordinary inertia while Scipio re-organised his army, and reformed it into line formation. Was the Carthaginian army more

disorganised than Polybius would seem to imply, or was Hannibal smitten with one of those inexplicable fits of inertia such as possessed the great leader, with whom his opponent is in this book compared, on 17th June, 1815?

We are, however, not completely convinced by the author's replies to certain criticisms which have been levelled against Scipio as a general. There is no doubt that he failed to achieve the objective given to him by the Government in Rome. This was to contain the Carthaginian armies in Spain, and prevent their junction with Hannibal in Italy. Excuses, and good ones, are given; but the fact remains that, if Scipio was never beaten in battle, he failed to carry out the role assigned to him. The reconnaissance in force sent to Africa under Laelius seems to bear some resemblance to the premature naval attack on the Dardanelles in 1915, though the latter had the merit of possessing a decisive objective.

As a statesman, conditions never placed Scipio in the position of an Alexander or a Napoleon, and so comparison is difficult. His foresight and breadth of view in dealing with allies and conquered peoples show him as centuries ahead of his time; indeed, the framers of the Treaties of Versailles and the Trianon might well have studied his principles.

Captain Liddell Hart makes frequent and valuable comparisons between the actions of Scipio with similar events of the last two centuries. The training camp at Syracuse is linked with that of Shorncliffe, and the entrenched camp near Utica naturally recalls its modern counterpart in the lines of Torres Vedras.

It is a pity that in lauding his hero the author has tended to slight the memory of other contemporary leaders. Quintus Fabius appears as the superannuated soldier-politician of clubland rather than the general who had led Roman armies to victory, and did more than most other generals to check Hannibal on what might be called "the western front in Italy," while Scipio gained his victories over other Carthaginian armies on the apparent "side show" in Spain.

Whatever we may think of Captain Liddell Hart's plea for pre-eminence for Scipio, we are grateful to him for having done honour to a great soldier and gentleman in a book which is at once delightful reading and a valuable biography.

R.P.P-W.

#### LA GUERRE TURQUE DANS LA GUERRE MONDIALE.

By COMMANDANT M. LARCHER. Préface by Marshal Franchet d'Espérey. (Paris: Chiron. 57 fr. 60).

Commandant Larcher is a staff officer and Turkish scholar, who had already translated into French the Turkish official account of the Dardanelles campaign. Here he has undertaken an enormous task: to describe all the military operations in which Turkish troops took part between 1914 and 1918, to estimate the importance of Turkey's efforts in the Great War, and those of the other belligerents who were her allies or her opponents, particularly Britain, France, and Germany. His work has considerable value, since it is largely based upon Turkish accounts, which few European soldiers can read, and also because he has taken it very seriously. His bibliography covers 15 pages, with

about 25 volumes or periodicals to a page, though, curiously enough, he has missed the most important contribution to the Palestine Campaign yet published, the seventh volume of the Australian official history—perhaps because this was published in Sydney. He gives us 65 sketch-maps, and what is still more useful, a large number of tables, orders of battle, etc.

On the whole he cannot be said to be particularly friendly to Great Britain. He exclaims at the contrast between British and Turkish strengths in Palestine—rather exaggerating the disparity in numbers—without explaining how largely that campaign was an engineers' war, and how, time and time again, only the lack of water and the extraordinary difficulties of supply prevented the destruction of the Turkish forces. He writes:

"The operations from the 31st October to the 9th December, 1917, had cost the Turks 12,000 prisoners and 100 guns, mostly abandoned for want of teams. These were light enough material losses. The Turks had twice escaped the encirclement carefully prepared by an army incomparably superior."

Granted, but he might have added a rather fuller account of the causes, which were not entirely British lethargy, as he seems to suppose. He might also have added that the casualties of the enemy between the 31st October and 31st December of that year, according to the admission of the Turkish Historical Section, were: Officers 1,039, Other Ranks 27,034, Animals 5,270. These cannot be called "light material losses," as they represent very nearly the Turkish rifle strength on the earlier date. His book is nevertheless well worth study as a remarkable general picture of Turkey at war. Many hints also can be gained from it as to the causes of the country's military and moral renaissance after a series of great disasters.

C.F.

### TASCHENBUCH DER TANKS.

(Price 12 marks).

The firm of J. F. Lehmann, of Munich, which has published its 23rd annual pocket-book of War Navies and its 5th annual pocket-book of Air Fleets, has broken fresh ground with a pocket-book of the Tanks of all nations. It was a happy idea thus to bring "Land-fleets" within their province, since it has collected in a small and really portable form a vast amount of information important to officers in general and to staff officers in particular. To all ranks of the Royal Tank Corps the book should prove a fascinating study and a mine of knowledge and ideas. The author, Capt. Heigl, late of the Austrian army, dedicates his book in the first instance to the German and Austrian armies, since they, being forbidden at present the possession of tanks, must specially study a weapon to be reckoned with in future wars—a weapon, moreover, so powerful that in conjunction with the aeroplane it may well be decisive. He thereupon divides his book into three parts. The first part is technical and deals in 50 pages and 5 plates with the principles of the construction of the most important types of tank, paying special attention to those things which distinguish the tank from other motor vehicles, e.g., chain-drive, steering, armouring. The 2nd part is devoted to tank identification

under the headings of the various nations, each important type getting a photograph and a plate of 5 figures, showing side and front silhouettes, side, front and rear elevations, and also two small-scale bird's-eye views, differently illuminated, *i.e.*, throwing shadows of widely differing shapes. Under the nations, we find that Great Britain leads with 57 pages. It is not known what secrets, if any, are here disclosed, but the War Office will no doubt have taken cognisance thereof. France follows with 36 pages and the U.S.A. with 32. Russia 21, Poland 13, Latvia 11½, Italy 10, come next. Belgium, Roumania, Spain, Czecho-Slovakia, Lithuania, Finland and Japan receive quantities varying from 9 to 3½ pages, while Brazil, Chili, Germany, Esthonia, Grece, Jugo-Slavia, Persia, Sweden, and Switzerland also receive mention. There follows a chapter on the identification of tanks in aeroplane-photographs. Part 3 is devoted to the methods of employment of tanks, as exemplified by British and French formations and attacks in the past, in order to work out the best means of defeating tanks in future. It deals first with active defence and then shows what a tank can do and cannot do, in order to arrive at the best means of passive defence. This part with its numerous plates and photographs is carefully worked out and rich in examples and instances.

In short the whole work reflects great credit on author and publisher. No English would-be reader need be deterred from ordering the book through a deficient knowledge of the language, since the publishers have wisely chosen Roman type instead of German, and the numerous plates and photographs speak for themselves. F.A.I.

#### CRITICAL STUDY OF THE CAMPAIGN IN MESOPOTAMIA UP TO APRIL, 1917.

Part I—Report. Part II—Maps.

For official use only. Published by the GENERAL STAFF, A.H.Q. India (1925).

THIS study comprises the results of a visit of students of the Staff College, Quetta, to Mesopotamia, in 1923, together with a reprint of the accounts of the actions at Sheikh Saad, Wadi and Hanna, by Major-General Sir W. D. Bird, previously published in the *Journal of the U.S.I. of India*, and notes on the L. of C. by Lieut.-Gen. Sir G. F. MacMunn.

Representing as it does for the most part the results of detailed investigation on the spot, the publication is of great value to any student of the campaign. It is, however, only obtainable from official sources, and as the number of copies available is limited, its usefulness is, unfortunately, likely to be restricted. C.A.B.

#### A BRIEF OUTLINE OF THE CAMPAIGN IN MESOPOTAMIA, 1914-1918.

By MAJOR (Temp. LT.-COL.) R. EVANS, M.C., *p.s.c.*, Royal Horse Guards. (Sifton Praed & Co., Ltd. 7s. 6d.)

IF full value is to be obtained for the time spent on the detailed study of any campaign, a sound grasp is necessary of the general outline of policy and strategy underlying it. The publication of this outline of the campaign in Mesopotamia is, therefore, most opportune.

Criticism and consideration of alternative plans are restricted to a minimum, presumably in order to limit the size of the book and to encourage the student to work these out for himself.

The addition of a few test questions to assist such study would enhance the value of the book to candidates for promotion and Staff College examinations.

The full Table of Contents obviates the need for an index, but the use of marginal or paragraph headings would facilitate reference in the letterpress.

C.A.B.

#### NOTES ON THE CAMPAIGN IN FRANCE, 1914.

By LIEUT.-COLONEL A. KEARSEY. D.S.O., O.B.E., *p.s.c.* (Sifton Praed.)  
Price 3/-.

THIS is a small book intended for use in preparation for promotion examinations. The first two chapters present appreciations from the German and Allied points of view at the outbreak of war. These are not complete, as they assume concentration dispositions which in turn depended on the general plans. The German plan given, however, is rather Schlieffen's original plan than that actually adopted by Von Moltke. Other chapters contain an outline chronology of the period up to 23rd September, with lessons to be learnt from the principal engagements. Appendices are added to enable students to draw diagrammatic sketches to illustrate the major movements. Finally the student is left with 29 questions to consider. A useful skeleton map printed in grey is attached. The book will give the student points for consideration in the study of the period.

R.P.P-W.

#### THE CHINESE ARMY AS A MILITARY FORCE.

By LAWRENCE IMPEY. (Tientsin Press, Ltd., 1925). Price 12/6.

The author of this short account of the fighting which took place in Northern China during 1924 and 1925 has attempted to estimate, by European standards, the military value of the forces employed by the three principal Northern "War Lords."

In this he has chosen a difficult task, because European standards are so often inapplicable in China. Factors which, in other parts of the world, would be decisive, are either inapplicable or of little importance to the Chinese "wars." These are usually decided by conditions and actions of which the European can have little knowledge, and would not consider as important if he had.

Mr. Impey acted as "War Correspondent" during the short campaigns which he describes, and his remarks and photographs are interesting. His conclusions, however, appear to be, sometimes, rather contradictory. This may be accounted for by the effect of that curiously widespread and infectious "Yellow Peril" obsession, which at times seems to get the better of him. When, however, the logic of what he has really seen for himself is allowed to influence him, his conclusions are much more reasonable. He then admits, what all who have studied the question will agree with, namely, that there is no possibility of China waging a war with any foreign power with any measure of success for at least 50 years.



A few facts extracted from his book will show that he has not made an under-statement.

Wu-Pei-Fu, reputed one of the best generals in China, allowed his principal lieutenant, of whose loyalty he was doubtful, or, rather, of whose disloyalty he was convinced, to remain, with his best troops, in command of a vital position. The lieutenant duly betrayed and ruined his master. The same story could be repeated a hundred times; in fact, it is not too much to say that no campaign has, in recent years, been decided by anything except treachery. Fighting has had little to do with it.

Although the Chinese soldier is capable of some personal loyalty to a leader, the latter feels no corresponding impulse towards his men. Wu-pei-fu, when defeated near Tientsin in 1924, left his troops in the lurch and fled by sea, with the few more or less serviceable cruisers still existing in the Chinese Navy, to the Yangtze, picking up a little money en route at Che-Foo by threatening to bombard the port unless it was forthcoming. It was one of his own ports too.

The troops of Wu-pei-fu varied very much, in quality, amongst themselves. If compared with those from more distant parts of China, even greater differences would be observed. But even the crack 3rd Division, probably the best in China, is put at only one-third as good as a European Division. For most divisions the writer records complete absence of officers whenever fighting or a job of work was in sight; cowardice; lack of tactical enterprise or skill; lack of discipline, loyalty, or fighting spirit. Even of the 3rd Division he says that very few officers stayed with their men when things began to look bad.

Of the Chinese horsemen little was seen, and that was chiefly mounted infantry. The Chinese can ride very well, at any rate in the North, and both they and their mounts are wonderfully hardy, but as fighters they do not amount to anything more than their brethren in the Infantry. In the far west, in Mongolia and Turkestan, good looking mounted soldiers have been reported, but they are probably bandits fighting for their living, not armies fighting for someone else's cause.

The Artillery on both sides is reported as having "displayed a most lamentable ignorance of the first principles of gunnery." "Forward observation was practically non-existent; discipline extremely lax"; no telephones, etc., etc.

It should be noted that as there are no roads in China, field artillery is the heaviest that can be moved. Very often a kind of pack trench mortar has to take its place. Ammunition is naturally not plentiful, so that the heavy artillery bombardments, of which the newspapers sometimes speak, are not so serious as they sound.

For the Air Forces on either side, the writer can find no good word to say. They brought no information and took no photographs. They did not fight each other, perhaps because they were unarmed except for pistols, and produced practically no results by bombing, in spite of very favourable targets. As for the Anti-Aircraft guns, there was only one, of apparently about 1½" calibre, and that soon ran out of ammunition.

Of the transport, administrative and medical services "lamentable failure" is recorded. Any officer or soldier would dictate how trains

should run, and brutally illtreat the railway staff if the latter demurred. Hundreds of trucks were used as dwellings, and while there was a block of some 200 trains on one line, that running beside it was empty. The writer does not mention what he might also have seen, that is, trucks crammed with ponies of which many had died of starvation or thirst, but what he did see was enough to justify him in terming the transportation service "absolutely incompetent."

One of the Army commanders did, in 1924, make a crude attempt to supply his men with rations. It was thought to be, and was, a wonderful innovation. Though the Chinese soldier can probably exist where any other would starve, yet even he objects to having to rely on roots pillaged wherever they could be found, and eaten raw for lack of fuel.

Wu-pei-fu's men had only their thin cotton summer uniforms, though a winter of arctic severity was rapidly approaching. Chang's men were better off in that respect, and also had boots in place of the miserable felt-soled cloth shoes of their opponents.

The Medical Service was what one would expect from a people described as "entirely indifferent to it from a humanitarian point of view," and considering it "practically useless as a military adjunct." Dressing stations, where they existed, were in charge of corporals equipped only with buckets of water and a few bandages. Medical officers and stretchers were equally scarce, and numbers of wounded died of exposure while waiting for or travelling in the cattle trucks composing the "hospital train." Few if any wounded men ever return to their units, at any rate until the next campaign, and then, probably, on the opposite side.

The contrast between the utter worthlessness of the Chinese Armies and the many valuable military virtues of the individual soldier is most puzzling. The latter is, at any rate if he is a Northerner, docile, cheerful and indifferent to hardships which would kill a European. He is sturdy, intelligent, and not without a good share of courage, though this is of a special kind. He will not go to meet danger, but he does not much mind danger coming to meet him. This makes him far less formidable in attack than in defence. But he is not really very formidable in either, and no one seems able to make much of a soldier out of him. The most successful attempt was probably that of the British with the Wei-hai-wei Regiment; but its men were the pick of Shantung, from which province come the best fighting men in China.

The Southern Chinese Armies possess all the weaknesses of the Northern and many others as well. In them the individual soldier is often of wretched physique, and soaked with malaria and opium. Though possibly of a quicker intelligence than the Northerner, he is less amenable to discipline and more appreciative of danger.

Both the Northern and the Southern Armies are quick to acquire the outward forms and mannerisms of foreign troops, for no one can copy so well as a Chinese, but of the meaning and purpose of these forms they have little idea. The "Christian General" has battalions whose close order drill compares favourably with that of the best foreign troops, but they appear to think that nothing more is required.

They are also quick to acquire the very latest technical equipment, but this, if not already fit for the scrap-heap when sold by the gun-runner

soon becomes so after a few months of Chinese neglect. Even when it is serviceable they have no idea of how to use it, and appear to think that its mere possession is sufficient. Yet they are by no means devoid of technical skill, and can make things work in a sort of way long after anyone else would have condemned them as worthless. Since life is so cheap, and material so valuable, factors of safety need not be considered, and if an aeroplane or an armoured car can be patched up with string and sticking plaster, it is made to go.

It is, however, the never-failing treachery in the leaders of these armies which, more than anything else, makes them so worthless. Since every general is at war for the sole purpose of gaining a position in which he will be able quickly to make money from his unfortunate countrymen, it follows that his price is fairly well known, and the question of when and by whom he will be bought is openly discussed.

It may be said that this would not apply if the Chinese Armies were engaged with foreign troops, but even in the past, when China was more or less united, they could effect very little against the foreigner. They could not even capture the Foreign Legations at Peking in 1900, though these were most unfavourably situated for defence, and garrisoned by little more than a handful of mixed foreign troops hastily collected from any available source. Similarly, against the Japanese in 1894, their efforts were puerile. In both these cases infirmity of purpose, divided counsels, and lack of control, were the principal causes of failure. Now that China is every year disintegrating into smaller fragments, a conflict between the leader of any one of these and a foreign power would probably be regarded as a Heaven-sent opportunity by his rivals.

The "Yellow Peril" idea has been attributed to Wilhelm II. He seems to have been as mistaken there as he was on another subject.

L.C.-T.

### THE ENGINEER AND THE PREVENTION OF MALARIA.

By HENRY HOME, M.INST.C.E. (Chapman & Hall, Ltd.) Price 13/6.

In undertaking any anti-malarial measures, the engineer is confronted with the problem of how to obtain the best results with the least expenditure of money. There are many reference works on drainage of swamps and marshes and on river training, and also many publications on public health, entomology and parasitology, but very seldom can one find specific references to anti-malarial schemes.

The volume under review is an attempt to show how co-ordination between the engineer and the medical authorities is necessary in order to carry out efficient and economical anti-malarial measures.

Until the actual species of *Anopheles* which is dangerous to the district concerned is identified, and its actual or potential breeding places discovered, it is a waste of time and money to carry out an attack on mosquitoes in general. This point is clearly brought out in the book, and Chapters I to III give a short description of the habits of the more common malaria carriers and the general principles on which anti-malarial schemes should be carried out.

It is a pity that Chapter III is so short, and more examples of successful anti-malarial measures might well have been given.

Chapters IV to VIII are an engineering treatise on drainage, with occasional reference to points which arise in connection with *Anopheles* breeding places. This subject is so large that it is of necessity very much condensed and the author cannot do more than give a brief description of various methods of drainage.

In some instances he goes into details and recommends specific appliances which may or may not be useful in any particular scheme. These chapters would have been more useful if the author had confined himself to broad principles.

The remaining three chapters dealing with anti-malarial services and preventive measures, are useful. D.K.E.

### GUN RUNNING IN THE GULF AND OTHER ADVENTURES.

By BRIGADIER-GENERAL H. H. AUSTIN, C.B., C.M.G., D.S.O. (John Murray). Price 7/6.

General Austin has had an adventurous career and he also has the art of telling a good story well. These tales of his experiences when on secret service in the Persian Gulf and in various responsible posts in Iraq, Africa and the North-West Frontier of India, will be read with interest as showing some of the extraordinary problems that may confront an officer of the Corps. A sketch map, after the manner of John Buchan, would have been a useful addition to the account of the gun-running adventures.

### WARRIORS AT EASE.

By A.A. (ANTHONY ARMSTRONG). (Methuen and Co.) Price 3s. 6d. tales, collected from *Punch*, illustrating the peace time life of "that astonishing infantry."

### FRENCH MILITARY ORGANISATION AND MODERN FRENCH-ENGLISH MILITARY TERMS.

By J. PSOMADES (Librairie Hachette). Price 4s.

An attractive little book, but M. Psomades' pupils could have corrected many of the *English* military terms. F.E.G.S.

## MAGAZINES.

### REVUE MILITAIRE FRANCAISE.

April, 1926.—The fifth number of Lieutenant-Colonel Grasset's *Verdun—Le Premier choc à la 72e Division* describes the evacuation of Brabant on the left of the line and the counter-orders of the higher command on the decision of the divisional commander to evacuate this village, which had become untenable. The Corps and Army Commanders appeared obsessed with G.Q.G.'s order to give up no ground, and in consequence the recapture of Brabant was ordered, after hours of hesitation on the part of the Corps Commander, who, however, instructed General Bapst, commanding the 72nd Division, not to use up too many

troops! The author evidently considers that General Bapst, who was the man on the spot, was perfectly justified in his decision.

In *Réflexions Suggérées par 6 Mois de Campagne au Maroc en 1925*, Général Dosse gives an interesting résumé of the characteristics of the Rifis and the lessons learnt from the campaign. The resemblance of the tactics of the Rifis to those of the Afghans and the tribes of the North-West Frontier is striking; the article brings out most of the principles of mountain warfare as laid down in our regulations.

*La Prise de Contact et l'Engagement*, by Commander Nalot, is completed in this number. The writer again expands various regulations on the subject, drawing particular attention to the distinction between an advanced guard action intended to pin down the enemy and obtain information, and a divisional attack intended to break through the enemy's dispositions.

The second instalment of *Les débarquements Alliés aux Dardanelles*, by Commandant Desmazes, deals with the attacks of May and June on the Helles front, and the appearance of a condition of stalemate and consequent trench warfare. During this period General Gourand took over command of the French troops from General d'Amade, and suggested a fresh landing about Gaba Tepe, with the object of outflanking the Achi Baba position and gaining Maidos. The culmination of this idea in the Suvla operations is described in the next instalment.

Général Camon, in his *La Division Légère Automobile, Son Organisation*, bases his suggested "Light Division" on Napoleon's organisation of a cavalry division. The proposed organisation consists of three groups: The first, for reconnaissance, consisting mainly of motor cyclists with a proportion of automatic and anti-tank weapons; the second, forming the main body and composed of infantry in lorries and mechanicalised artillery; the third group being similar to the second and available as a reserve. It will be noticed that tanks are omitted and the horse eliminated.

Chef d'escadron Paul Block begins an article entitled *La Guerre Chimique* in this number. The first instalment is devoted to a detailed description of the various forms of gas which may be employed offensively in war. A considerable part of the article is devoted to technical descriptions of the types of projectile employed and the component parts of the different gases.

May, 1926.—Lieutenant-Colonel Grasset describes the resumption of the German onslaught on February 23rd in the sixth instalment of *Verdun—Le Premier Choc à la 72e Division*. It was a day of soldiers' battles, in which nearly all commanders were continually out of touch with the situation. The Commander of the 30th Corps ordered a series of counter-attacks, each by not more than a battalion; but all of these, doomed to failure from the outset, had to be given up before the German advance. The close of the day finds the division about to be relieved, after a magnificent resistance, owing to which the second line of defence is still generally intact.

The third instalment of *Les débarquements Alliés aux Dardanelles*, by Commandant Desmazes, describes the Suvla Bay operations in some detail. The operations are clearly outlined, and the section on the

Turkish dispositions, drawn from the Turkish history and Liman von Sanders' book, emphasises the lost opportunities of August 7th and 8th, when the objectives allotted to our 9th Corps were to be had for the asking. Finally, the vigorous action of Mustapha Kemal was mainly instrumental in holding up the British attack when it materialised.

Commandant Schneider's *Etude sur l'Artillerie Légère Puissante* describes the value of the mortar as a trench warfare weapon, and at the same time forecasts the use of the same weapon in mobile warfare. The writer deplors the fact that the mortar is now in a state of suspended animation (as in the British Army) and considers that, even in mobile warfare, mortars on light carriages will be essential for close support of the infantry. He considers, however, that the mortar is essentially an artillery, not an infantry, weapon.

*La Question de la Limitation des Armements Devant la Société des Nations*, by Commandant "S," is a somewhat academic discussion of the various phases of the disarmament problem, culminating in the Commission, appointed by the League in December, 1925, to prepare for a conference on the limitation and reduction of armaments. The chief interest of the article lies in the continual divergence of the French and British points of view, which crops up at nearly every turn.

The second number of Chef d'escadron Paul Block's article, *La Guerre Chimique*, is far less technical than the first. The writer, while affirming that gas will never be used by France unless she is forced to do so in self-defence, evidently considers that chemical warfare has come to stay. The tactics best suited to the employment of gas are described, and the instalment concludes with a discussion of the prospects of an unscrupulous nation springing a technical surprise on its adversary, a surprise which might have decisive results.

June, 1926.—Lieutenant-Colonel Grasset completes his most interesting and instructive article, *Verdun—Le Premier Choc à la 72e Division*, in this number. Two outstanding features of the operations of February 24th were the shelling by French guns of the remnants of the heroic garrison of Samogueux under Lieutenant-Colonel Bernard, of the 351st Regiment, and the brilliant counter-attack of the 35th Regiment of the 37th Division on Hill 344, thereby preventing the Germans from breaking right through the second line of defence. This operation illustrates the effect of an *immediate* counter-attack, compared with the futility of previous counter-attacks carried out by units after the enemy had had time to consolidate his gains. When finally relieved by the 37th Division, the 72nd had practically ceased to exist, but it had earned undying honour by preventing a break through by immensely superior numbers at the first onset.

The fourth instalment of Commandant Desmazes' *Les débarquements Alliés aux Dardanelles* is particularly interesting in its description of the various plans suggested by the French and British authorities between Suvla and the final evacuation. General Sarrail had been placed in command of the French forces, and operations on a large scale on the Asiatic shore had been practically decided on, when Bulgaria's entry into the War upset all previous calculations. The various points of view are well and clearly put with a refreshing absence of criticism.

In completing his *Etude sur l'Artillerie Légère Puissante*, Commandant Schneider points out that, as long as infantry are required in battle, a close support weapon will be essential. The various requisites for this weapon are fully discussed, and the writer comes to the conclusion that no modification of the existing 150 mm. mortar (originally a trench warfare weapon) will be satisfactory, and that a new type of mortar should be designed. His conclusions are of interest in view of the obvious limitations of pack artillery, as employed in our army, for close support of the infantry.

*Communications et Ravitaillements au Maroc*, by Capitaine Juin, clearly illustrates the administration difficulties of operations in undeveloped countries, especially against an active and well-armed enemy. The writer describes in some detail the measures which had to be taken by the "4e Bureau" ("Q" staff) in order to put the plans of the "3e Bureau" ("G" staff) into effect. A point of interest is the employment of a private firm, "l'entreprise Mazères," for providing a large proportion of the mechanical transport required.

In the third instalment of *La Guerre Chimique*, Chef d'escadron Paul Block discusses the various methods of collective and individual protection against gas. The number concludes with an estimate of the effect of gas on horses, which the writer considers to be far less affected by gas than by actual shell fire, and a short discussion on smoke shell and generators.

The greater part of the first instalment of *L'Armée Anglaise et ses Grandes Manœuvres de 1925*, by Commandant "T," is devoted to a description of the present organisation of the British Army. The writer points out how our present training is aimed at a war of movement, and comments on what he calls the "young school," which considers that the War Office is moving too slowly towards general mechanicalisation. The writer concludes with the statement that the "doctrinal ideas of our phlegmatic allies were, therefore, in the melting pot at the outset of the manœuvres."

H.A.J.P.

#### REVUE DU GENIE MILITAIRE.

(July, 1926).—*Exploitation of firewood in the Forest of Dreux during the War*. A short description of the supplementary organisation and output of this service in a forest already under exploitation by Canadian troops for constructional timber.

*Construction of a piled bridge over the Moselle at Pont-à-Mousson by the 9th Regiment of Engineers*. Details of the bridge, organisation, and methods of construction with comments—illustrated. The writer finds that recruit personnel rapidly adapted themselves to the use of the compressed air pile-driver—70 H.P. Ingersoll 2-cylinder compressor and two monkeys, 3,000 lbs. and 1,500 lbs., of which the latter was generally sufficient for the piles used, which were round, and 10 to 12 inches diameter, and some 40 ft. long. While the manual of instruction states that such piles can be driven in 45 minutes, it was found that two hours was the average time involved. Some of the pile driving was done with service equipment and the writer notes the

speed gained and the personnel saved by the use of a power plant as compared to a hand winch.

*The construction of a cast-iron bridge in 1863 at El Kantara, and its replacement by a ferro-concrete bridge in 1924-25.* A description of both bridges and details of the method of reconstruction (illustrated).

(August, 1926).—*Defence of Frontiers.* An extract from a paper prepared in 1818 for the Commission of Defence instituted in that year. The author discusses the advantages and disadvantages of defended localities prepared in peace time, and having satisfied himself that they are required under certain conditions lays down the points to be borne in mind, in locating and equipping such places.

*Destruction and repairs of roads, railways and bridges and devastation of areas.* A short historical summary of practice in the past with a more detailed account of the work done in the war of 1870-71; and in Belgium and France up to the Battle of the Marne. (To be continued).

*Demolition of a Brick Chimney.* The chimney was 40 metres high, the brickwork at the base 1 metre thick. The problem was to demolish it without injuring the neighbouring buildings. The chimney was damaged by a previous fire. The charges were placed with the object of throwing the chimney in an innocuous direction. Actually, on firing the charge, the chimney collapsed on its base.

*An anticipation of the Tank.* Reprint of a document written in 1774, describing and illustrating a wooden shield carried on a two-wheeled handcart. The shield is pierced with loopholes and when tilted up enables 12 muskets to be fired through the loopholes. H.G.K.W.

#### BULLETIN BELGE.

(1926. Tome I. Nos. 4 to 6 inclusive.)—*Operations of the Belgian Army, 1914-1818.* A scheme had been drawn up in 1913 for strengthening the defences of the "retrenched camp" of Antwerp on the left bank of the Scheldt, but, when the war broke out in the following year, no progress had been made with the provision of the additional permanent works projected; in consequence, the construction of the field works was at once begun in the early days of August, 1914, with a view to improving the defences of this "retrenched camp." A short description of the work carried out is given in No. 4; the troops told off for the defence of the 5th Sector of the Belgian Citadel, and the situation as it existed at October 8th, 1914, in the 6th Sector, are also dealt with in the same number.

An account of the operations of the Belgian Army on October 9th is given in Nos. 5 and 6. The Belgian 3rd, 4th and 6th Divisions, which had been covering the stretch of railway between Ghent and St. Nicholas, were able to slip away, without the enemy's knowledge, during the night of October 8th-9th, and on the latter date lay westward of the Ghent-Terneuzen Canal in the billets assigned to them, where they rested for the day—the bridges over the Canal at Selzaete, Terdonck and Langebrugge were still guarded and were prepared for demolition. Von Werder, who was in command of the Left Wing of the besieging force, had been ordered to push on to the Durme as quickly as possible and to seize Lokeren, but he had advanced with great caution, contenting



himself with a violent artillery duel, and his leading troops had, in consequence, at this time only reached Boxelaere and Everslaer. A report, which proved to be false, had led the Belgians to believe that the Germans had reached the neighbourhood of Moerbeke and St. Nicholas; the line of retreat of the R.N.D. and the Belgian 2nd Division seemed, in consequence, to be seriously threatened. The Belgian High Command, therefore, took steps to warn the formations in question of their danger, and, at the same time, caused measures to be adopted with a view to safeguarding the railway during the passage of the trains which were to convey the R.N.D. from Antwerp to the coast.

The hesitation of von Werder's troops to push rapidly on to the Dutch frontier enabled the R.N.D., the Belgian 2nd Division and certain fortress units to reach Scizacte in safety. The arrangements made for the protection of the Line of Communications from Antwerp are described in No. 5. Ghent was at this time held by a mixed force of British, French and Belgian troops totalling about 20,000 men. Reinforcements sent by the German Governor-General of Belgium to von Werder were directed on October 9th to advance on Ghent; in doing so they came at Quatrecht into contact with a small detachment of French troops, which fell back before superior numbers to Melle, where, after some skirmishing, the further advance of the Germans was temporarily checked. A brief review of the strategical situation at this time is contained in No. 5.

The events of October 9th in the Pays de Waes, and the arrangements in connection with the transport of the Belgian Field Army to the line of the Yser are dealt with in No. 6. At this time grossly exaggerated reports of the progress made by the Germans in the neighbourhood of Ypres reached Belgian Headquarters, and caused some disquietude, as it had been intended to utilise the railway line from Ghent, *via* Deynze and Thielt, to Dixmude, for the transport westward of the troops at Ghent. In view of the reports above-mentioned, the Railway Administration eventually decided to utilise the double track from Ghent to Bruges for the transport of the Belgian 3rd, 4th and 6th Divisions.

*The Frontier Battle.* The operations of the Allied Left Wing during the period August 21st-23rd, 1914, are dealt with in No. 4; the article is a continuation of a contribution by Major van Overstraten, on the opening phases of the Great War—the first of the series is published in No. 1 of the *Bulletin* for 1926. An account is given of the fighting on the Sambre and Meuse, at Charleroi, Namur and Mons, and in connection with the first Belgian sortie from Antwerp; the handling of the German Right Wing during these operations is briefly examined and the results summarised.

*Battle of Liège (1914).* Captain-Commandant Paquot gives an account in No. 4 of the German advance on Liège at the outbreak of the Great War. He deduces the principal reasons for the failure of the Belgians to hold the Germans at bay at this fortified centre for a longer period than was actually the case, and summarises the lessons to be learnt from the operations in question.

*The Proper Relations between Governments and High Commands.* In the case of a war in which the whole of the resources of the belligerent

nations must be brought into play in aid of the military effort, it is essential that the exact spheres of responsibility severally of Governments, Legislatures and the Supreme Military Commanders should be clearly understood by them, in order that in each case those on whom the responsibility rests may adopt measures for the effective and efficient performance of the duties, within their own respective spheres, in such a manner as to avoid improper interference with the recognised task of the one by the other or others, and thus jointly promote the success of the combatants in the field in the highest degree. Unfortunately, history tells of many instances in which improper interference in the sphere of responsibility of a military commander in the conduct of operations has been attempted by the politician—sometimes with disastrous results. It is well then that the subject should be amply discussed in times of peace; for this reason the article by Captain-Commandant Dendal, entitled *Des Rapports entre le Gouvernement et le Commandant*, which appears in No. 5, and in which the problem relating to the proper sphere of responsibility of a Government, the Legislature and a Supreme Military Commander, is ably dealt with, should be welcome alike to soldiers and politicians.

*The Role of the Engineers.* A lecture on the role of the Divisional Engineers in connection with the preparation of a defensive position was given in Brussels on January 9th, 1926, before the *Cercle d'instruction des officiers de réserve*, by Captain-Commandant Beaupain. A summary of this lecture is given in No. 6, under the title *Rôle du génie dans l'organisation, progressivement conduite, d'une position défensive*; it should prove of interest to the young Sapper Officer.

*Le Chef Officier.* In an interesting article under the foregoing title, published in No. 6, Captain Jacoby discusses the attributes of commanding officers of units as well as of formations. W.A.J.O'M.

#### MILITÄR WOCHENBLATT.

4th May, 1926. (1). *Technical Review.* An article dealing with recent technical developments of military interest, including a new self-calculating fire-control apparatus (U.S.A.), a Diesel-engine for Mechanical Road Transport (Germany), a "Stroboscope" for tanks (U.S.A. and France), pliable glass (Australia and Austria), and the preparations for an industrial mobilisation of the U.S.A.

(2). *Umpiring during Training.* The difficulties of the umpire's task are analysed and constructive suggestions put forward.

(3). "*Militär Wochenblatt*" and "*Army Quarterly*." A note on the review in the "*Army Quarterly*" for April, 1926, of General Wellmann's book "*Das 1. Reserve Korps in der letzten Schlacht*." The writer takes exception to a footnote in the review which asserted that the "*Militär Wochenblatt*" had invited subscriptions to "a new national daily paper . . . entitled '*Der Tag*.'" No such paper is known to the "*Militär Wochenblatt*."

11th May. (1). *Development of the Italian Air Service.* The new Italian air estimates show an increase of 180 million lire over the last budget. In this connection past and future developments are discussed.

(2). *The heavy machine gun in the attack.* The writer describes the

methods of employment of this arm in the attack and arrives at the conclusion that even more importance should be attached to its employment in the future than has been accorded to it in the past.

18th May. *The Tank of the Present and of the Future.* The first instalment of a detailed analysis of Tank developments in all armies. A short introduction is followed, by sections, on speed, mobility and armament. As regards mobility, great admiration is expressed of the performances of the British Medium Mark D Tank. High speeds are, in the writer's opinion, only obtainable with elastic tracks. Tanks should, in general, be heavily armed. The modern Tank in motion can produce effective M.G. fire up to 300 and artillery fire up to 1500 metres.

25th May. *The Tank of the Present and of the Future.* The article on this subject in the previous number is concluded. Modern tanks have a radius of action of as much as 1000 kilometres (625 miles). The tank of the future will probably be gas-proof. Present types of tank are shortly discussed and the value of the one-man tank is doubted. The effects of the employment of tanks on modern tactics are described and analysed. The article concludes with notes on inter-tank communication and anti-tank methods.

4th June. (1). *The Disarmament Conference at Geneva.* Progress is discussed. The writer concludes that the disarmament question will probably break down owing to its inherent difficulties. Neither England nor America are likely to use all their power to prevent this.

(2). *Entrainment of troops in retreat and the flight of the civil population.* The writer quotes war experiences, notably the retreat after Gumbinnen in 1914, to prove his thesis that railways should be kept absolutely clear for the transport of troops and war material in retreat and that civilians should be prevented from leaving their homes to the mercy of the advancing enemy.

11th June. *Tradition Companies.* The importance of traditions of the old army, as maintained by units of the present German army, is discussed in all its aspects.

18th June. *The Red Army.* A description of the present conditions of service in the Russian army. Russia will always be able on mobilisation to raise a trained force of greater strength than any combination which might take the field against her. Notes are appended on the militarisation of civilian higher educational establishments, the military budget, military attachés and the pensioning of officers.

25th June. (1). *France since Autumn, 1925.* A general survey of the foreign and inner-political situation in France. The favourable influence of Locarno and the surrender of Abd-el-Krim is discounted by the political situation in the Mediterranean and by France's position at the disarmament conference.

(2). *The Red Army.* Notes on Russian views on flame projectors, gas warfare and on the militarisation of the civil population.

4th July. (1). *Man and Material.* A dissertation on the psychological factor in modern warfare, with examples from the late war. The writer concludes that human courage will always keep pace with the development of technical weapons.

(2). *History of the German Eagle.* An interesting article on the national

badge, which was first reported on the standard of Otto II (967-983).

11th July. *The Legend of the superiority of the French Artillery in 1914.* A review of the merits and demerits of the most important pieces of German and French ordnance. A tabular comparison proves to the author's satisfaction that neither artillery could be considered to be definitely superior to the other.

18th July. *Horse, Motor and Bicycle.* The author regrets that in the frequent discussions on motorisation the bicycle has been apparently forgotten, and points out, with examples, its immense value in war.

25th July. (1). *The Disarmament Conference.* A review of progress achieved hitherto, culminating in the expressed opinion that, with the exception of Germany and America, the states involved only wish to "save the Versailles system" and are using the conference as a means of justifying the "military and political injustice" inflicted on Germany at Versailles.

(2). *Aircraft for military transport purposes.* The author is of the opinion that aircraft will play an important part as transport vehicles in a future war. Figures of comparative performance of Mechanical Road Transport, Horsed Wheeled Transport, Pack Transport and Aircraft are produced to support his thesis.

4th August. (1). *Italy's position in the Mediterranean.* The writer emphasises the growing strength of Italy in the Mediterranean. The time is not far distant when England will find it difficult to maintain her present strong position in these waters.

(2). *The Polish Army.* A review of the situation in the army since Pilsudski's *coup d'état*. Almost all his opponents have disappeared from the most important posts. Relations between army and civilian population and between officers and men are said to be very bad.

11th August. *Training Manuals of the German Army.* A description of the new German manuals, which have been compiled in the course of the last few years on the basis of war experiences. The writer points out that several years of training on the new basis will be necessary before effective criticism of the manuals is possible.

18th August. (1). *Covering fire by heavy machine guns in attack over flat country.* The writer recommends that Heavy Machine Guns should not be controlled by M.G. companies in attack over flat country, since the fire through gaps in the attacking infantry is not very effective and is dangerous. Heavy machine guns should be attached direct to front line infantry companies and used in a similar manner to light M.G.'s.

(2). *Electrification of Railways and National Defence.* The writer points out the danger of complete electrification of railways, which, if power stations were attacked from the air, might be brought to a standstill at a critical period.

R.V.H.

#### HEERESTECHNIK.

(April, 1926). *Progress in Concrete-Making* (continued). By Lt.-Col. Augustin. A description of the Gravity system of laying concrete, invented in America, extensively used in the locks, &c. of the Panama Canal and lately more and more adopted in Germany. The concrete is made with enough water—10 to 14% of the total weight—to be capable

of being poured into position. For this purpose a tower is necessary, whence the mixture is delivered through a system of traversable inclined gutters, to where it is required to be laid.

In Germany the process has been modified, in that, instead of hoisting the materials to the top of the tower already mixed, the mixing is done on top. This necessitates a stronger tower, owing to the weight of the mixing machine, but it saves the lifting of the water which is delivered at the top under its own pressure.

It has been found necessary to keep a constant check on the consistency of the mixture. This is done by taking samples at frequent intervals and measuring the lack or excess of water by a gauge, which shows to what extent the sample has subsided after the mould is removed.

*The Influence of the Earth's Curvature and of Refraction on Determination of Heights for Artillery Purposes.* By Survey Superintendent Lips. If  $h$  be the height of an object and  $d$  its distance from the observer,  $h = d \tan \alpha$  is accurate enough for all distances up to 856 metres.

Between 856 metres and 2,000 metres a correction of  $E$  must be added to  $h$ , owing to the earth's curvature; and above 2,000 metres a correction of  $S$  must be subtracted for refraction.

Gauss worked out an equation combining these corrections, viz.

$$E-S = .87 \times \frac{d^2}{2r}$$

where  $r$  is the Earth's radius.

Hence in latitude  $50^\circ$  N. where  $r = 6381$  km.,  $E-S$  works out to 15 metres when  $d = 14,858$  metres, or just over .1%.

*Gas-shelters and Gas-protected Rooms* (concluded), by Dr. Hanslian. Provision of ventilation with filters has been dealt with in the preceding article, but such means of protection are incapable of application to large buildings, on account of size and expense. It is none the less necessary to afford protection to the interior of large buildings against aerochemical attack. This article deals exclusively with this question. In blocks of Government offices, mobilization-centres, hospitals and institutions, central telephone exchanges and important factories it is insufficient to provide only places of refuge from gas. Such buildings must be protected so that work can be carried on without interruption. The first requisite for such protection is a chimney at least 160 feet high, i.e., above the height of gas-bomb contamination, where fresh air can be sucked in by electric or other motors. It is also necessary to provide a system for distributing the fresh air in halls, passages and corridors throughout the block, and special ventilation outlets to allow the gas to be driven out.

When gas danger threatens, all windows and doors are shut, and the chimney, which must beforehand have been sequestered from its normal use, is connected to the ventilation inlet and the ventilator is set running. The ventilator has a three-fold task. It has, by thinning the air, to overcome the resistance of the air-column in the chimney, it has to produce the necessary pressure to force the fresh air through the fresh air system of ducts throughout the building; and it has to maintain such an air-pressure in all the rooms as will force air to pass outwards through all

cracks and crevices and thus prevent gas-contaminated air from entering.

A large building should have its air entirely replaceable in one hour. It has been calculated that 100,000 cubic metres of air can be supplied per hour through an inlet  $1\frac{1}{2}$  metres wide, by a 40 h.p. motor doing 260 r.p.m. It is obvious that no Government, let alone private firm, could face the cost of such an installation *ab initio*. It can only be carried out where chimneys of sufficient height are not only present, but available.

(May, 1926).—*Progress in Concrete-Making* (concluded), by Lt.-Col. Augustin. It is admitted that the crushing resistance of concrete made by the gravity system is reduced, by the addition of 10 to 12% of water, to only one-half that of ordinary concrete. This, however, does not constitute a drawback, since the crushing resistance of rammed concrete is quite unnecessarily high. As regards keying, all that is necessary is to lay the second layer within 4 to 5 hours of the first, the number of mixing machines and gutters being calculated to allow of this. While laying is in progress, a separation of stones from liquid is guarded against by keeping the fall below 2 metres.

A homogeneity, unattainable by other methods, is claimed for concrete laid by gravity, and the author considers this homogeneity of greater importance in determining the strength of concrete structures than the results of tensile strain and crushing obtained from samples. Illustrations are given of three different types of mixer.

*The Physical Properties of Smoke for use in the Field*, by Dr. G. Stampe. In the war smoke was used for concealment on all fronts both by the Germans and by their opponents, though only to a limited extent. That its further development is being worked at is proved by the appearance of an English manual "On the use of smoke." It is necessary to understand thoroughly the physical and chemical properties of smoke and mist to find out how best to use them in war. Both smoke and mist are names not of a kind of matter but of a state. What is characteristic of this state is the extraordinary fineness of distribution of the smoke or mist-forming substance in the air. The separate particles are mostly too small for their shape to be recognised even with the best microscopes. The separate particles of which cigarette smoke is composed vary in diameter from .4 to 6 millionths of an inch. The most usual distinction made in speaking of smoke and mist is that the former consists of solid particles, the latter of minute floating particles of moisture. The decision whether a cloud consists of one or of the other is often not easy to arrive at, and sometimes impossible. Thick fog often consists of both. The limits to mist are vapour, when it becomes invisible, with particles about 4 thousand-millionths of an inch in diameter, and rain, with particles about 4 thousandths of an inch, when the floating particles start to fall.

It is characteristic of mist that the separate particles even in perfectly still air have a spontaneous oscillatory motion, and that this motion is faster, depending on the smallness of the particle. Friction is so great that the rate of fall of the smallest particles is extremely slow. Thus with particles up to 4 ten-thousandths of an inch in diameter there is no reason to fear that a mist will become ineffective through sinking to the ground. Collision of particles causes an increase of size which is the principal reason why a mist settles.

The minuteness of the particles makes it extremely difficult to remove mist from a stream of air by filtering. Generally the particles pass through the filter without any sieve-effect, but if the air passages in the filter are narrow and winding, as in textile materials and wadding, the particles are forced against the sides and stick there. Similarly the absorption filter of a gas-mask removes the particles of gas. It is true that the latter, being molecules, are much smaller than particles of mist, but this is compensated for by the far greater activity of the gas-molecules, which soon brings them against the walls of the passages.

As regards screening effect, all light-rays that strike a mist particle are lost to the eye, so that, although it takes to conceal one man from another 20 yards away, a pyramid, of which his outline is the base and the observer's eye the apex, containing 150 billion particles, the same effect would be attained with a screen, say 2ft. x 6ft. and the thickness of a single particle. This screening-effect is much less when the observer is looking with the light. Screening from the ground and screening from the air are thus two propositions, since an aeroplane-observer nearly always has the sun behind him, or at least well on the object.

As regards the effect of wind, a cloud of smoke or mist spreads out in the shape of a cone. With a steady wind and a ground surface not over-heated, as on summer evenings, it keeps to the ground.

"Industrial and Engineering Chemistry" gives the following formula from measurements by Walker,

$$h \text{ (height in metres reached by the cloud in } t \text{ minutes)} = \\ k \text{ (a factor depending on wind-velocity and wind-steadiness)} \times \\ t \times \sqrt{v} \text{ (} v \text{ being wind-velocity in metres per second).}$$

For steady winds (speed and direction)

$$h = 13.5t\sqrt{v}$$

The next article will deal with the possibilities of the preparation of sufficient quantities of smoke in the field.

*Extracts from the 1924-1925 Yearly Report of the State Office for Survey.* Depicts a sad state of affairs, since with a 14% reduction of German territory, the surveying and cartographic personnel has been reduced to 57% of its pre-war strength. Further, there has been no fresh blood introduced into the Department for about 10 years, resulting in a menacing increase of age of the serving officials, 7% of whom are over 60, 23.3% between 50 and 60, 58.9% between 40 and 50, while the remaining 10.8% are between 30 and 40. The present diminished staff has not only to do almost as much as the State Office for Survey did before the war, but to attempt to fill the gaps due to cessation of work during the war and to the diminished performances of the unfavourable years immediately following the war.

10,000 trig. points, one-fifth of the whole number, have been lost. If this decay continues it will be impossible to restore some of them and new triangulations will be necessary. Between seven and eight hundred points should be restored yearly for the work of restoration to be completed in fifteen years. During the year under review the State Office for Survey was able to restore only 127 points of the missing 10,000. It is not difficult to agree with the author that something must certainly be done.

(June, 1926). *Considerations on the Value, the Organization and the Tactical Employment of Tanks*, based upon an essay by Col. Invernizzi, Italian Tank Corps.

The author details the Tank units, parks, experimental branches, training battalions and schools possessed by Great Britain, France and the United States and considers that any doubts as to the effectiveness and value of the tank should be dispelled by the fact that the very practical nations inhabiting those countries are willing to spend millions on this weapon. Nevertheless he quotes, in order to combat in turn, several of these doubts:—

1. The next war will show radical changes both tactically and strategically, and the possibilities of aircraft and of chemical warfare are such that great expenditure on other weapons of uncertain capabilities should be guarded against.

2. The success of tanks in the Great War were only possible through surprise, effected by their being unfamiliar to the troops. This advantage will be lacking in future, and tanks will be unable to intervene in battle owing to the numerous and very effective anti-tank weapons.

3. The tanks suffered enormous losses, even when the means of fighting them were insufficient both in quality and quantity.

4. Armour will be defeated by the armour-piercing projectile because the latter will force the former to increase until mobility has to be sacrificed.

5. Tanks can easily be defeated by obstacles, natural and artificial.

6. Tanks are useless to a country (Italy) which has only mountain frontiers.

Col. Invernizzi disposes of these objections, and then, always giving English and French ideas on the subject, he deals with tasks and characteristics, organization, training, co-operation with infantry, co-operation with other arms (containing a formidable list of tasks for engineers), use of tanks in defence and use in retirements.

*The World-War, 1914-18.* (E. S. Mittler & Son, Berlin). The German official history.

Vol. III, movements and fighting from 26th August to the 4th September, 1914.

Vol. IV, the battle of the Marne, from 5th to 9th September and a sketch of the German retreat from 9th to 15th September.

The reviewer lets himself go: "The battle of the Marne was the turning point of the war. How it happened that out of a victory which was clearly taking shape on the battle-field there could develop, through the failure of some few persons, a momentous retreat of the whole army, with its immense moral and political consequences, is a problem the clear recognition of which the present fate of the German people cannot prevent it from facing, which it owes to itself and to its future to know in every detail. The leaders who failed in those days are fully responsible to the people for their actions. To my mind still more responsible are those individuals who, in spite of doubts as to their suitability, proposed men for commands or left men in command, who either never had or no longer had the capacity for such responsible tasks."

F.A.I.



### MILITARWISSENSCHAFTLICHE UND TECHNISCHE MITTELUNGEN.

(May and June, 1926).—*The Red Army of the Soviet Union*, by W. Kollosowsky, formerly Colonel of the Russian General Staff. The Red Army dates from 28th January, 1918, when a decree of the Soviet Government provided for the creation of an army on a voluntary basis. This attempt was a failure from the start, and in April of the same year Trotzky was obliged to introduce both universal service and the conscription of the technical personnel of the former Imperial Army. He further introduced the military hierarchy and strict centralization of command. The army based on these principles was used in the wars of 1918 to 1920, steadily improved in organization and took final form in 1924-25, when Frunse introduced certain changes, the most important of which was that the army was to be based upon the territorial militia, to which all cadres should be supplementary. The full title of the army is "The Red Workers and Peasants Army." It is most strictly centralized, in that the Soviet Republics have no right to dispose of the troops within their borders, a power which is vested in the People's Commissary for War, who is Commander-in-Chief of the Army, Navy and Air Force. The present holder of this office is Woroschilov. He is *ex-officio* President of the Council of the united Ministries of Army, Navy and Air Force, consisting of ten officials, of whom one only, Kameneff, is a professional soldier, having been a general staff officer in the Empire days. The remainder are of the working-class and their military experience dates from the Civil War.

The total strength of the army is given officially as 562,000, but it is believed to be over a million, and that the year's contingent amounts to 1,200,000, of which about 600,000 are taken to serve (250,000 in the standing army and 350,000 in the militia). Whether in the standing army or in the militia, the fighting formations are the Cavalry Division and the Rifle Division.

The Rifle Division consists of 3 Rifle Regiments of 3 Battalions each. A Rifle Regiment, corresponding thus to our Infantry Brigade, has a 6-gun battery, an Intelligence Company, a Signal Company, a Pioneer and Camouflage Detachment and a Chemical Warfare Detachment, besides commissariat and medical units. The Rifle Division amongst its Divisional Troops has a Signal detachment, a Pioneer company and an Engineer Train.

Corps Troops exist for every 3 Rifle Divisions, and include a battalion of Engineers, a battalion of Signals, a Tank detachment and a Kite Balloon detachment. In war each Corps also gets a flight of 8 aeroplanes. Amongst the special troops which exist outside the Division and Corps are troops for Railways, Camouflage service, Chemical Warfare, Pontoons, Electro-technics (including search-lights and electric-lighting), Signals (airline and wireless, also for carrier-pigeons and messenger-dogs), and for Meteorological Stations.

The Red Army has, in fact, been most thoroughly thought out and organized, but up to the present the technical troops have not been found in sufficient numbers. Especially in the Signal Service is the

Red Army well provided with formations. This is a result of the lack of communication felt in the Civil War.

Against this provision of technical troops the provision of Divisions and Corps with Artillery is on so small a scale that the Red Army would certainly be handicapped against any of its possible opponents. The Soviet Union hopes to make good this deficiency by superiority in Cavalry, of which it has the equivalent of 20 Divisions.

(July-August). *The Last Days before Königgrätz*, by Major-Gen. Steinitz. The author has discovered in the War Archives a hitherto unknown document, the draft of a letter to the Emperor Francis Joseph, written at Dubenetz, near Königinhof, on the 29th July, 1866, by Benedek, the Commander-in-Chief of the Austrian Northern Army. Events moved so quickly after this draft was written that the letter was never sent. It is published now, not in order to criticise a report of the state of affairs composed in a black hour by a man in mental anguish, but in order to trace its connection with the development of the situation up to the decisive battle. Major-Gen. Steinitz attributes the catastrophe of Königgrätz not so much to external circumstances or to a lack of ability on Benedek's part as to the fact that he had lost confidence in himself and his staff and that his *moral* had gone. Support is lent to this view by the document now unearthed, and the author points the moral that, in spite of all progress, the human factor remains the most important in war, and that the decisive factor is the education and correct choice of the Commander.

*Modern Manœuvres*. By Lieut.-Field-Marshal Gerabek. In the years since the war ideas have cleared, or rather, as after former wars, they have become to a certain extent international. Evidence of this is borne by the fact that training in all countries shows much the same features, especially in the matter of manœuvres. All arms have to be trained to co-ordination. Such training, the author says, stands and falls with the faultless performance of the means of communication of all kinds. So in all modern exercises there is not only special weight laid upon the signal service, but skeleton exercises are held with signals only. For the benefit of those whose armies are small and consist mostly of cadres, so that manœuvres on a grand scale cannot be held, the author recommends substitutes, *e.g.*, a marked enemy and the full use of signals, even without the troops and staffs to which they belong, but he does not explain how, when other units are missing or consist only of cadres, the Signals are to be exempted from the general weakness and enabled to function at full strength.

*The British Army Manœuvres, 1925*. By Major-General Büttner. One of the most essential features of modern preparation for war is the striving to create, by mechanicalization, light and very mobile fighting forces. The Great War, with its rigid fronts, gave little opportunity for testing the uses and capabilities of such forces: it remains for manœuvres to do so; and this was the governing idea of the 1925 Manœuvres in the South of England. The points to be brought out were the effect of mechanicalized fighting forces and rapid tanks upon the conduct of war and of battle and—as far as peace-exercises permit—the establishing of principles as to their value; improvements in air-reconnaissance;

improved co-operation between the troops and air-fighters. The directors of the exercise apparently expected the Western Army to make use of its superior mobility to defeat and drive back the advanced portions of the Eastern Army before the arrival of reinforcements.

On the first day, the attack by a mechanized infantry brigade was delayed  $3\frac{1}{2}$  hours owing to premature de-bussing. This could have been avoided by armoured car reconnaissance.

A skilful night retirement led to an attack being delivered upon positions already evacuated, a fact for which lack of air and ground reconnaissance were responsible and which can find only partial excuse in the bad weather which prevailed, and in the excellent concealment of the troops by day.

As regards the bussing of troops within striking distance of the enemy, this can only be done on the best roads and where both air and artillery are unquestionably superior. The new method of employing tanks, as tried on these manoeuvres, is worth mentioning. Contrary to prevailing ideas, they were rarely used on either side to support infantry attacks. The new Vickers tanks were chiefly used in wide turning movements in conjunction with cavalry and mechanized infantry and artillery. This use finds its justification in the consideration that their greater speed, when working with the slow-moving infantry, cannot be utilized and is thus sacrificed. Also there prevails in English military circles the view that infantry, when their attack is supported by tanks, come to rely upon them and thus lose their initiative. The English, here differing from the French, use the rapid tanks for independent tasks, especially when, by reason of their speed or by using smoke to conceal them, they can effect surprise.

In addition to the foregoing, the rapid tanks can be used as a very mobile reserve for supporting threatened points, or for the clearing-up of localities offering obstinate resistance, also for co-operation with advanced or rear-guards, and for warding off hostile tank attacks. Other conclusions drawn from the manoeuvres were that both cavalry and infantry must be equipped with effective anti-tank weapons; also that ground won by the tanks cannot be held without the support of the other troops.

The Western Army included an Armoured Car Company consisting of 12 Rolls-Royce cars. It was used for reconnaissance and for raids against the enemy's flanks and rear. One detachment of 4 cars carried out a 200 mile expedition in 28 hours, seized important hostile operation-orders, fired on convoys, baggage-columns and aerodromes and sent back its reconnaissance report by two aeroplanes at the hour and place arranged. Armoured cars are most suitable for such tasks, given that roads are good and free from troops.

Also these manoeuvres showed that the technical development of weapons and other aids, as well as the development of the methods of conducting war have been in uninterrupted progress since the Great War. The direction of this development is—in contrast to the progress during the Great War—more towards increasing the mobility of the weapons than their destructive effect. It strives to reconcile the differences of time and space and answers more to the requirements and needs of mobile warfare.

Austria and her German sister-nation have by the Peace Treaties been checked in their development in military affairs. Indifference and inactivity in the face of the enormous progress of foreign armies would be a grave mistake. Attention to and study of all novelties will increase their knowledge and prepare them for future possibilities. There can be only one answer to the very real question "Material or Moral?" and that is "Both." Modern weapons are for the time prohibited: no peace-treaty can set bounds to moral improvement.

*Aircraft Camouflage.* By R. Burger, ex-flying officer. Aircraft are protectively coloured with three objects in view, viz., to guard against observation from the ground, to guard against observation from the sky, and for night-flying. They have thus to assimilate themselves to three different backgrounds, the day-sky, the ground and the night-sky. As regards the first of these, the war provided no solution of effective protective colouring with the sky as a background. No protective colouring can screen under such varying conditions the dirigible, the kite-balloon or the low-flying aeroplane. With an aeroplane at a great height it is a different matter. As the under-side is always in shade it can be lightened by bronze paint. This has the disadvantage that, when the 'plane is circling, a flash of light may betray it. The greatest success hitherto obtained has been by means of aiming at a transparent effect.

As regards the second object, all aircraft need dazzle-painting to conceal them when on the ground, and aeroplanes when flying low need it to conceal them from 'planes flying higher. From one aeroplane it is extremely difficult to spot another flying much lower, if the latter is painted to resemble the country. It would generally be seen first when crossing a road or water, but even then it is not easy to keep it in sight, unless the observer has a ground-shadow to help him, the existence of which in many cases alone makes observation possible.

As regards the third object, much can be done. Night-working dirigibles must be painted. The night-sky has its colour, and blue-black and/or violet should be chosen, and not too dark, since these colours must be able to absorb as much as possible of the airship's shadow.

Every kind of protection loses in value when the eye has got accustomed to it. This dictates two things, secrecy in peace and changes of colouring in war.

F.A.I.

## JOURNAL OF THE SOCIETY OF ARMY HISTORICAL RESEARCH.

*Vol. V., No. 21.* July to September, 1926. Sheffield: Sir W. C. Leng & Co. 6s.

The most interesting features of this number are the "Articles of War, 1627," a "Memorial," by Sir Thomas Fairfax of his experiences in the Civil War, 1642-1644, and the usual notes, questions and replies. There is an attractive coloured print of a contemporary engraving of the battle of Dettingen.

The annual subscription to the Society is only one guinea, and back numbers of the Journal can be obtained very cheaply by new subscribers.

Information concerning the Society may be had from the Honorary Secretary, The Society of Army Historical Research, c/o The Library, The War Office, S.W.1.

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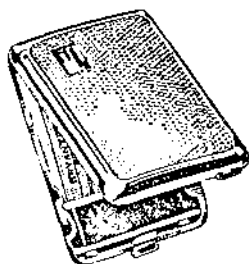
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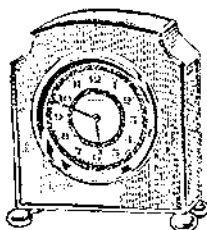


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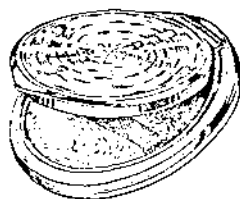
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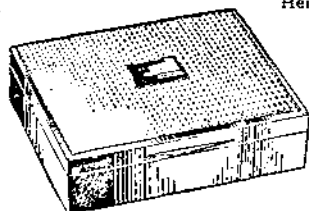
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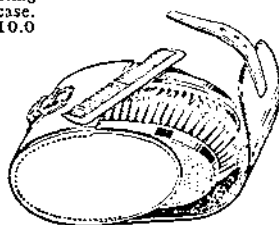
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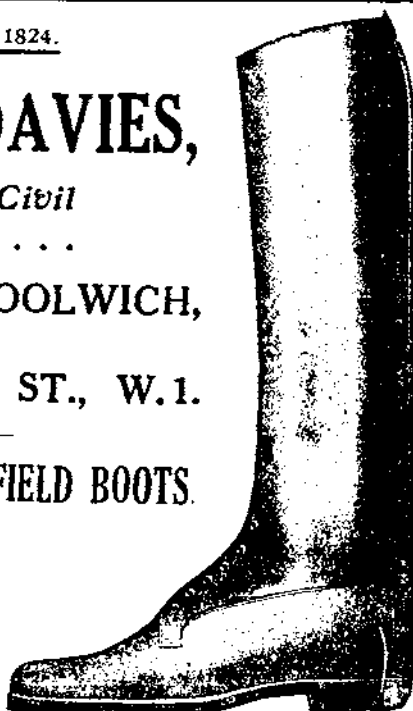
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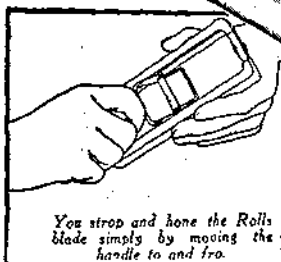
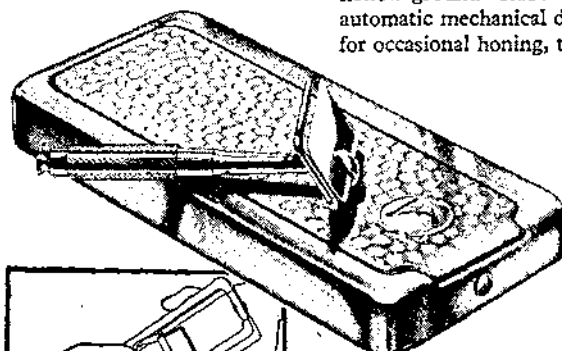
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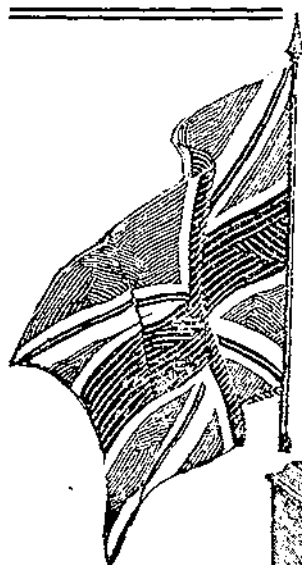
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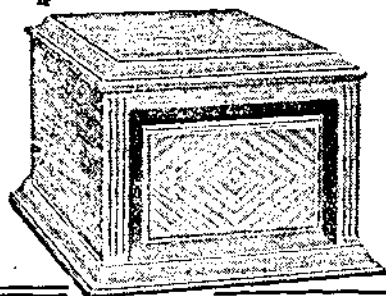
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|                                     |     |   |   |             |
|-------------------------------------|-----|---|---|-------------|
| CAPITAL SUBSCRIBED                  | -   | - | - | £73,302,076 |
| CAPITAL PAID UP                     | -   | - | - | 15,810,252  |
| RESERVE FUND                        | -   | - | - | 10,000,000  |
| DEPOSITS, &c. (31st December, 1925) | -   |   |   | 338,671,007 |
| ADVANCES, &c.                       | do. |   |   | 183,330,726 |

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