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THE ROYAL ENGINEERS JOURNAL.

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DEEDS OF THE ROYAL ENGINEERS

Now ready, *Deeds of the Royal Engineers*, compiled in the R.E. Records Office. Extract from the Preface :—

"It is hoped that the following pages may assist lecturers on Royal Engineer history, and may help members of the Corps generally to become familiar with some of the more striking events and personalities in the long and illustrious history of the Royal Engineers."

Chapter 1.—A Short History of Military Engineers in England.
,, 2.—The Soldier Artificer Company at the Siege of Gibraltar.
,, 3.—The Royal Engineers and the Battle of Waterloo.
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,, 7.—The 23rd Company, Royal Engineers, at Ladysmith.
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WORK BY R.E. UNITS IN THE WAR.

(Continued),

251ST TUNNELLING COMPANY, R.E.

Report on enemy operation of March 18th, 1918, which resulted in the loss of 3 officers and 30 other ranks, 251st Tunnelling Co., and temporary occupation by enemy of exits from Bunny Hutch Subway and Caledonian Dugout System.

On the morning of 18th April, the Infantry garrison at Givenchy "stood to" from 4 a.m. to approximately 6.35 a.m., at which time the order to "stand down" was given by O.C. Co. in and around Caledonian Road. Our people "stood down" upon receipt of the order. At that time the number of Tunnellers in mines and dugouts was 3 officers—Capt. Walker, Lieut. E. B. Rees, and Lieut. Marsland, and 39 other ranks. A large shift had intentionally been sent up in order to act as guides to the 1st Battalion Black Watch, who were not acquainted with the line, and ins and outs of the dugout system. The Tunnellers were all told off to special stations to assist infantry garrison in case of attack, and at other times were engaged in their ordinary occupations of pumping, listening, maintenance, etc. The battle positions were detailed with the knowledge and approval of the infantry Co. commanders, the dispositions being as follows :—

(*a*). Lieut. Marsland, 1 N.C.O., and 3 other ranks at Piccadilly Exit to assist Infantry, with orders to close exit by means of charge fixed in side of gallery for that purpose, should the enemy attempt to enter in force.

(*b*). Capt. Walker, 1 N.C.O., and 6 other ranks at Moat Farm entrance to assist Infantry.

(*c*). One N.C.O., and 4 men in Givenchy Keep dugout system to act as guides and maintain liaison between garrisons in Givenchy Keep and Mairie Redoubt.

(*d*). Lieut. Rees and remainder of Tunnellers to man No. 4 Shaft Penthouse and the Sap leading thereto, this being an excellent position from which to protect north side of Caledonian Road Penthouse and Moat Farm entrance.

These dispositions were approved by Colonel Evans, 1st Battalion, Black Watch, on evening of 17th April.

About 7 a.m. enemy shelled Givenchy Ridge, but especially vicinity of Caledonian Road exits and Moat Farm entrance very heavily, advancing to the attack in great strength. One officer Captain of

the Black Watch with 15 other ranks, reached Piccadilly Trench through Bunny Hutch Subway, but were overwhelmed with the exception of 3 other ranks, who escaped to Caledonian Road dugouts, badly wounded, at 8 a.m. After this, the defence of Piccadilly Exit devolved on Lieut. Marsland and 4 other ranks, R.E. They held position by rifle fire until there was danger of them being overwhelmed, when Lieut. Marsland fired the demolition charge and closed the exit. The long stretch of Subway, west of the Piccadilly Exit was then commanded by a Lewis gun posted at a turn in the gallery. Meanwhile, at Moat Farm entrance, a Captain of the Black Watch, O.C. Co., was holding the surface approach and as the garrison in Caledonian Road Penthouse was in difficulties, he organized an attack against the enemy in vicinity of that point to relieve the pressure. He was killed in the attack which recoiled. Capt. Walker, R.E., immediately re-organized the attack, and led remnants of the Black Watch from the Moat Farm entrance in an easterly direction against Caledonian Road. While so doing he sustained a wound, fracture of shin bone, from M.G. fire, which put him out of action. The attack failed, and Capt. Walker was assisted into the dugout system by Sergt. Newell, R.E., about 9 a.m. From this time, apparently the Tunnellers were the sole guard of Moat Farm entrance. They were ultimately beaten back from the stairway near the surface by bombs, and retreated behind the gas door, where they erected a barricade of sandbags, from behind which they fired their rifles thus denying entrance to the enemy.

Going back to the hour of 7 a.m., the first attack of the enemy, advancing southward from Festubert flats, was apparently beaten off, whereupon he retired and subjected Caledonian Road Penthouse Shelter area to an intense bombardment by Heavy How. Shell (estimated at 8 ins. or 10 ins. diameter). This knocked out those of defenders who were manning the trenches—one platoon of 1st Black Watch was wiped out by one shell. About 12 Tunnellers, who were endeavouring to dig out the few survivors, were knocked out within two minutes by another shell. This action of the enemy had the effect of disorganizing the surface defence of the penthouse shelters, those who remained on top of shafts being bombed down below into the deep dugout system. All penthouse shelters, with exception of No. 4 (never used by Infantry garrison), were at this stage in the enemy's hands. Sapper Turner continued to hold the sap approach to No. 4 Shaft Penthouse till about 1 p.m. He was assisted by Sapper Stewart who loaded while Sapper Turner fired. Lieut. Rees superintended this part of the defence. All surface defence of the Caledonian Dugout Penthouse Shelters ceased about 10.30 a.m., with the exception noted above. The action taken below ground by the Tunnellers was to build sandbag barricades at the bottom of

stairways of Shafts Nos. 1, 2 and 3. These were manned by composite parties of Black Watch and Tunnellers.

This brings the history to about 10.30 a.m. From that time to 1 p.m. the enemy continued to throw bombs down all entrances in their possession except Piccadilly Exit, which had been effectually blocked by the blow. Both Sergts. Newell and Menadue report that the enemy used gas, either in bombs or spray, and threatened to use it in quantities unless the garrison surrendered. This apparently decided the officers, both Infantry and Tunnelling, to surrender on account of the large number (estimated at 70) of wounded men lying around the tunnels. Capt. Walker, though wounded, urged a policy of no surrender. After a parley, the surrender was arranged about 2 p.m. About 1.30 p.m. Sergt. Newell had gone to the top of No. 4 Shaft and accompanied by Sapper Turner had reconnoitred the surface in that vicinity, finding no enemy, though they could be heard talking in Caledonian Trench near by. On Sergt. Newell's return to communicate information obtained, he found three enemy officers in charge of dugouts ordering the removal of the garrison. All N.C.Os. were ordered under pain of death to precede other ranks up No. 3 Shaft. In spite of this, Sergts. Newell and Menadue decided to stay with Capt. Walker, he being a stretcher case, could not be evacuated through a spiral stairway. Lce.-Corpl. Morgan decided to take his chance in hope of escaping by lying hid in the engine room off Bunny Hutch Subway. On orders being received from the enemy officers to evacuate Capt. Walker through Moat Farm entrance, Sergts. Newell and Menadue constituted themselves his stretcher-bearers, and accompanied by Sapper Turner and another sapper left the Subway by Moat Farm entrance. Finding the way clear, they decided, after consultation with Capt. Walker, to endeavour to escape to Ponte Fixe, which they succeeded in doing safely. Before leaving the Moat Farm entrance, they called to some men standing by in the subway to come to the surface and escape with them. Only three sappers availed themselves of the chance and escaped safely, also Lce.-Corpl. Morgan lay *perdu* for some two hours and escaped by the same route.

Meanwhile there had been heavy fighting in the vicinity of Givenchy Keep. Of the five Tunnellers assisting this garrison, Corpl. Knowles and 1 other rank were killed and 2 other ranks wounded, only one sapper returning to billets. I was in Givenchy Keep on 20th April, and was informed by the O.C. Keep that our men had put up a stout fight.

Total casualties in the fight were :—

Killed.—3 other ranks.

Wounded.—Capt. Walker and 2 other ranks.

Wounded and Missing.—5 other ranks.

Missing.—Lieuts. Rees and Marsland and 20 other ranks.

55TH DIVISION.

I. Corps.

I should like to bring to notice the excellent work done by the 251st Tunnelling Co., under Major Church, and the Australian Electrical and Mechanical Boring and Mining Co., under Capt. A. J. Auret, during the recent operations about Givenchy. The 251st Tunnelling Co. took part in the defence of Givenchy which, during the 9th April, the initial day of the German attack, was overrun by the enemy. The arrangements made by them for the defence of the mined galleries and dugouts enabled a very effective counter-attack to be made from the latter. In addition the whole of the details who were not below ground took part in the fighting on top, and a detachment of them which was at rest and was put under my command, enabled me to strengthen my very extended left flank, which reached westward to the Lawe Canal, and by occupying trenches near this canal for several days were instrumental in preventing the enemy from overlapping or penetrating.

The pumping and lighting of the galleries and dugouts were in the hands of the Australian Electrical and Mechanical Boring and Mining Co. The danger to which this plant was exposed in the event of serious attack was represented by me some time ago, and application made for the installation of an effective plant below ground to replace or reinforce that at Pont Fixe, from which power for pumping and lighting had to be carried by a cable overground for 1,000 yards. I was, however, informed that no action of this sort was possible, and that it was not deemed necessary. There was a small auxiliary plant in the galleries, only sufficient to keep the dug-outs habitable for about four days, and of doubtful reliability. Had it been impossible to keep the pumps running the garrison would have been drowned out in a few days. During the eight days that the Division held Givenchy, subsequent to the German attack on the 9th, the cables were cut repeatedly by the intense shelling. But in spite of all difficulties, the Australian Electrical and Mechanical Boring and Mining Co. succeeded in keeping both lighting and pumping machinery going up to the time that we were relieved, thus materially assisting the defence by allowing troops to be kept under cover where their presence was required.

H. S. JEUDWINE, *Major-General,*
Commanding 55th Division.

55th Division Headquarters,
April 17th, 1918.

3RD AUSTRALIAN TUNNELLING COMPANY.

Report on Operations No. 1 Section from 9th—18th April, 1918.

I have to report as follows on the operations of No. 1 Section of 3rd Australian Tunnelling Co. from the 9th to 18th inst.

April 9th.—Heavy enemy bombardment commenced on 8th and lasted all night (8th to 9th gas and H.E shells, very heavy on right). Rumoured that enemy had broken through our line at Laventie. At 8. a.m. the day relief of 19 other ranks went to work as usual, Lieut. Campbell with them. At 3.30 p.m. I stopped the 4 p.m. relief from going to work. Acting on instructions received from Lieut. Campbell I telephoned the C.R.E., 34th Division, for orders at 4 p.m. Ordered to report to 101st Brigade at once. Lieut. Campbell returned with off-coming relief at 4.30 p.m. I fell men in with full kit, 48 hours' rations, two officers and 38 other ranks in party. Marched to assembly point, No. 3 Series M.G. emplacements whilst Lieut. Campbell reported to 101st Brigade per motor bicycle. Lieut. Campbell was ordered to report with party to 102nd Brigade at Erquinghem; marched men to Erquinghem, and reported to 102nd Brigade at 7 p.m. 102nd Brigade ordered us to report back to 101st Brigade Marched men back to No. 3 Series emplacements (very heavy shelling on both marches) and again reported to 101st Brigade at 8 p.m., who ordered us to again report to 102nd Brigade. Lieut. Campbell, self and four men went back to Erquinghem and reported to 102nd Brigade at 9 p.m., leaving balance of party in charge of Corpl. Barsby at No. 3 Series. G.O.C. 102nd Brigade ordered us to report to Major Osborne of 15th Royal Scots Regt. Did so and sent runners back to Corpl. Barsby and party; when party arrived at 11 p.m. Major Osborne told us to report to Lieut. Young (Company Commander) who showed us a position and ordered us to dig in. This position was facing S.W. on the right flank of and at right angles to the front of the X Battn. (A composite battalion of pioneers, engineers, 18th N.F., and attached infantry.) Lieut. Young told us we were behind the reserve line. Posted sentries and stopped there all night. Apparently no one on our right flank.

April 10th.—Erquinghem heavily shelled until 1 a.m. 10th. Stood to at dawn. About 7 a.m. enemy appeared to be advancing—our right flank still in the air. Reported this to Lieut. Young. At noon enemy seen crossing our front from left to right about 600 yards away. Right flank still unprotected. Again reported this and sent out patrols to get in touch with our nearest troops. Patrols reported a gap of 200 yards between us and some pioneers. Patrolled gap myself and found it to be as reported. Lengthened our line to try and link up. Enemy getting closer, opened fire at 400 yards. At this stage a German was seen crossing our front about 900 yards away. Sappers No. 5786 J. Muir, No. 5858 J. A. Watson, and No. 4434 J. Nunn-Pendle, stalked him and took him prisoner. An officer then reported that a battalion of Royal Scots (?) was coming to reinforce and fill the gap reported. Met the officer and showed him the position. Another battalion (?) came up and took up a position parallel to the railway line and on our left flank. Enemy

came nearer and occupied a farm in front. Heavy enemy machine gun and rifle fire 6 p.m. Very heavy short-range fire from enemy light artillery. Lieut Campbell now put in command of the company of the X Battn. to which we were attached, in place of Lieut. Young. At 7.30 p.m. Lieut. Campbell received written orders from C.O. X Battn. to retire and report to Colonel Stephenson, 16th Royal Scots. at Jesus Farm. Corpl. Barsby states that as the runner with this order came along the line, he called out to the men—" Jerry is over the Canal, get back quickly." Although I did not hear this personally the statement has been corroborated by several men of the detachment. A number of men then retired without orders. Lieut. Campbell did not seem satisfied and told me to hang on, while he saw about it. He then walked towards Headquarters and was lost to view behind a burning estaminet. He was not seen afterwards by any of the party. Both companies on our flanks then retired and I ordered my company to retire in conformity. During retirement Sapper Kelly was hit and fell—believed to be killed. Enemy were then very close and enemy machine gun, rifle and artillery fire very heavy. Took Sapper Ashford and went to Battalion Headquarters (15th Royal Scots) to look for Lieut. Campbell, found Headquarters deserted. Picked up Corpl. Barsby and 29 other ranks at rendezvous and reported with them to Jesus Farm at 8 p.m. Balance of party missing. Looked for Colonel Stephenson and found Colonel Lloyd of 12th Suffolk Regt., 40th Division who took charge and posted us on left of Wigan Post. Called roll. Lieut. Campbell and the following other ranks were missing :—Sappers 6891, G. F. Burke, 5858, J. A. Watson, 6668, F. H. Brownhill, 1057, E. Kelly (believed killed), 4518, D. R. Wilson, 6876, C. W. Cook, 4808, A. G. Yaxley.

April 11th.—Stood to till 2 a.m. then fell in and marched to Nieppe, still under Colonel Lloyd's orders. Arrived Nieppe at 3.30 a.m. Called the roll and found Lce.-Corpl. Mayne, Sapper Ahern and Sapper Roberts missing. Rested till 5 a.m. : fell in and marched to mill off Armentiéres-Bailleul Road. Dug in here. At noon ordered to fall in as platoon attached 12th Suffolks. Marched across main road and took up position. About 1 p.m. advanced as a wave in support of 12th Suffolks to hold enemy. South Wales Borderers (?) forward on left front twice retired and were collected and sent back by Sergt.-Major Macey of 12th Suffolks and myself. Lay out all day in field under fire. M.G. and snipers very active. No. 4765, Sapper A. W. Hogan sniped through left breast. At dark (8.30 p.m.) 12th Suffolks retired as ordered through my position and my platoon covered retirement and followed on as rearguard, in accordance with instructions from Colonel Lloyd. We marched towards Bailleul and rested for a few hours on Bailleul Road.

Called roll : Three sappers missing. Fell in at 5 a.m. and marched

to Strazelle. Rested till 3 p.m. After thanking the men for the support they had given, Colonel Lloyd ordered me to report with my party to 1st Australian Brigade Headquarters at Pradelles, did so and bivouacked with Australian L.T.M. Battery.

April 13th.—Brigade Major 1st Australian Brigade ordered me to report to 1st Field Co. Australian Engineers at Borre under Capt. B. Dowling, did so and rested that day.

April 14th.—8 a.m. marched to forward billets 1st Field Co. Australian Engineers at Pradelles; men attached to Nos. 2 and 3 sections 1st Field Co., worked on Strazeele defence and spitlocking and digging trenches. Heavy bombardment of billets. Sent report by D.R.L.S. to O.C., 3rd Australian Tunnelling Co. stating position, nominal roll, and asking for orders.

April 15th.—Reconnoitred positions for charges to mine roads at Strazeele, Section Bois, and Railway.

April 16th.—Excavated for above; no explosives to complete charging.

April 17th.—Digging strong points and alarm posts. Heavy enemy shelling. At 8 a.m. orders received from O.C., 3rd Australian Tunnelling Co. to meet transport at Wallon Cappell at noon of 18th, to rejoin unit.

April 18th.—Fell in at 8.30 a.m. and marched to Wallon Cappell. Met lorry from 3rd Australian Tunnelling Co. Picked up Corpl. Mayne and 8 men at Ebblinghem. Arrived at Headquarters 3rd Australian Tunnelling Co. at 6 p.m.

The following is a nominal roll of the party at 4.30 p.m. on 9. 4. 18 :—

Lieut. N. Campbell, Lieut. J. Dow, 1251, Corpl. S. Barsby, 4395, Lce.-Corpl. E. Mayne, 5616, Lce.-Corpl. W. S. Stubbs, 910, Sapper R. T. Ahearn, 6688, Sapper F. H. Brownhill, 922, Sapper A. C. Bennetts, 6891, Sapper G. F. Burke, 4537, Sapper W. E. Burke, 4277, Sapper W. Bunning, 4746, Sapper G. Cahill, 6878, Sapper C. W. Cook, 6765, Sapper W. G. How, 4765, Sapper A. W. Hogan, 5337, Sapper F. G. Hanson, 1057, Sapper E. Kelly, 5363, Sapper C. H. Leaver, 4419, Sapper A. McLean, 4422, Sapper T. D. McLean, 1223, Sapper E. Marsh, 5786, Sapper J. Muir, 4434, Sapper J. Nunn-Pendle, 2395, Sapper S. Novok, 1215, Sapper J. Peach, 5819, Sapper T. Ritter, 6643, Sapper T. Ryan, 4462, Sapper W. Roberts, 4843, Sapper A. V. Symons, 1237, Sapper J. T. Smitheram, 4518, Sapper P. R. Wilson, 4516, Sapper J. Wilson, 5858, Sapper J. A. Watson, 1200, Sapper W. Williams, 4808, Sapper G. Yaxley, 1247, Sapper S. F. Ashford, 4282, Sapper S. Browne, 5794, Sapper P. McManus, 2891, Sapper D. N. Blizzard, 4511, Sapper H. Williams.

The behaviour of the detachment under trying circumstances was splendid. Their coolness and steadiness under heavy fire was

admirable. Their conduct, whilst acting as a covering screen in the retirement on the night of the 11th was worthy of the high traditions of the British Army. In this connection I should like to bring to your special attention the names of No. 1251, Corpl. Barsby, No. 4537, Sapper W. E. Burke, and No. 5794, Sapper P. McManus. Corpl. Barsby was coolness personified, and by his steadiness and devotion to duty gave me the greatest assistance. He commanded the second line of my platoon on the 11th, and handled it with courage and initiative. When Sapper Hogan was wounded, Corpl. Barsby, with Sapper How (No. 6765) went to his assistance, and dressed his wound at great personal risk. Nos. 5794, Sapper P. McManus and 4537, W. E. Burke, on all occasions by courage and cheerfulness encouraged the rest of the detachment. It is with very great regret that I have to report :—

Lieut. N. Campbell, missing.

No. 1057, Sapper E. Kelly, missing (believed killed), No. 4765, Sapper A. W. Hogan, wounded (G.S.W. in chest).

19. 4. 18.

C.R.E. 38TH DIVISION, C.E. VTH CORPS, C.E. THIRD ARMY.

C.E. Vth Corps.

Reference your No. E.6820/129 dated 27. 10. 18 the following are the principal bridging feats of the units under my Command during the crossing of the river Selle between Montay (inclusive) and Neuvilly (exclusive).

(1). These came under four headings :—

(*a*). Footbridges.
(*b*). Tank Crossing.
(*c*). Artillery Bridges.
(*d*). Heavy Bridges.

(*a*) and (*b*) had to be completed before Zero ; (*c*) and (*d*) were not required until after Zero. Zero was 0200 hours, 20. 10. 18.

(2) (*a*). *Footbridges.*—On taking over from 33rd Division 11 light pontoon bridges were in position, 2 footbridges were taken over from 66th Division, on the Right Boundary of 38th Division being moved South East. At least 24 footbridges were required before Zero. Additional cork float footbridges were put across on the nights 17th-18th and 18th-19th October, and at Zero there were 28 footbridges. Owing to damage by shell fire some of the bridges had to be repaired several times. The work was done by 123rd Field Co., R.E. (Major Pressey, M.C., R.E.) and 151st Field Co., R.E. (Major Borns, M.C., R.E.). The enemy was close, and the nights were very light.

(*b*). *Tank Crossing* was constructed of sleeper crib work threaded on vertical iron rods, without any roadbearers or decking. This new type was suggested by 11th Tank Battalion. Details were sent to you on 23.10.18 under my No. R.E. 5712. The work was done by 123rd Field Co., R.E., Lieut. Doyle being actually in charge of the job. It involved working breast deep in water for several hours under shell and M.G. fire, and the enemy's flares were falling within 20 yards of the site one night. The bulk of the work was done on the night 16th-17th October, improvements being carried out the two following nights. It was a complete success and enabled the Tanks to cross for the attack.

(*c*). *Two Artillery Bridges* were to be put over by 123rd Field Co., R.E. as soon after Zero as possible. One medium pontoon bridge was constructed, but the work was delayed as nearly 50 per cent. of the party became casualties. Two sections of 151st Field Co., R.E. were therefore placed under the orders of O.C., 123rd Field Co., R.E., and a second medium pontoon bridge was built. The tank crossing was also decked, etc., to take field guns.

(*d*). *Two heavy bridges* were built. The first was done by 212th Field Co., R.E. (Major Anderson, M.C., R.E.) of 33rd Division, which was placed under the orders of C.R.E., 38th Division for the work. The bridge was one 30-ft. span reinforced for tanks. The bridge stores were only handed over by XII. Corps (which was originally to have done the work on 19th October). On the morning of 20th the necessary measurements of the gap were made under heavy shell fire. Work was started 1245 hours and was completed next day (21.10.18) at 0845 hours, delay having been caused by shelling. The other heavy bridge was done by 124th Field Co., R.E. (Major Brazel, M.C., R.E.). It was a two-span bridge for Tanks supported in the centre on a sleeper crib pier, the roadbearers being 22-ft. R.S.Js. The stores having been delivered some days before 20th at a bridging dump, very careful and complete preparations were made. Measurement of the gap was done under very heavy shell fire on the morning of the 20th. Work was started at 1315 hours and was completed (except for improvements to the approaches) by 1630 hours next day (21.10.18). The improvements to the approaches were completed by 1750 hours 21.10.18. There was further very heavy shelling of the site during this period.

(3). The work was rendered very difficult and dangerous by the following conditions :—

(*a*). The approaches to the river were down long open slopes, subject to shell and M.G. fire. Even after the attack the road to Montay was under enemy observation.

(*b*). The nights prior to the attack were very light.

(*c*). The enemy was very close. On the night 16th-17th our posts were withdrawn behind the river on account of a gas projection.

(*d*). There was a good deal of gas in the valley.

(*e*). On the morning of the 20th and again in the evening, the valley and approaches were very heavily shelled.

That all the bridges were successfully constructed under these conditions reflects the greatest credit on all ranks of the Field Cos. concerned.

T. E. KELSALL, *Lieut.-Colonel, R.E.*
C.R.E., 38th Division.

28. 10. 18.

XIII. CORPS.

Report dated November 7th, 1918.

The following is a report on work done by the special parties detailed from No. 2 Section, 182nd (Tunnelling) Co., R.E., to save bridges over the canal from being destroyed by the enemy.

Main Road Bridge and Lock at Landrecies.—The party consisting of 2 N.C.Os. and 9 men advanced with the first wave of the infantry as far as the western outskirts of Landrecies. At this point they preceded the Infantry a distance of 400 yards. When reaching the bridge the superstructure was blown and immediately the débris had fallen the garrison which consisted of about 20 men, was rushed, killing two and taking 14 other ranks prisoners, thereby saving any further damage being done. All wires, etc., were then cut and charges removed. In addition, the party at the request of the Co. Commander of the Infantry, constructed a bridge over the Rivierette River to allow the men to cross.

One N.C.O. and 2 men advanced with the first wave of the infantry, and were successful in saving the wooden bridge. They removed the charges and rendered the bridge fit for traffic.

Three men advanced with the infantry and found that the footbridge had not been mined by the enemy.

NARRATIVE OF OPERATIONS BY 150TH FIELD COMPANY, R.E.

13th—21st October, 1918.

In the operations carried out by the II. Corps commencing on the 14th October, 1918, the 150th Field Co., R.E., was attached to the 109th Infantry Brigade, and the following special tasks were allotted to the unit :—

(1). To assist the assault waves to cross the Heulebeeke by placing light infantry bridges across.

(2). To carry out any necessary repairs on the roads in the area to be captured by the Brigade, with especial reference to the bridges over the Heulebeeke at Moorseele, Gulleghem, and Heule. Preparations were completed by the afternoon of the 13th October, the

Company being organized on the following basis :— No. 1 Section, under 2nd Lieut. C. L. Knox, V.C., R.E., and one wagon attached to the 1st Battalion, Royal Innis. Fusiliers, for the purpose of carrying forward infantry bridges; No. 2 Section, under 2nd Lieut. R. Charlesworth, R.E.; No. 4 Section, under Lieut. W. M. W. Brunyate, R.E., each with a specially loaded bridging wagon attached in readiness to repair any craters or other gaps in the Moorseele-Heule Road.

Fighting transport, consisting of above-mentioned wagons, a trestle wagon loaded with 15 ft. of superstructure and spare timber, and a double tool cart were all under the general control of Lieut. J. B. Stapylton-Smith, M.C., R.E. At 1900 hours on the 13th, 2nd Lieut. C. L. Knox, and No. 1 Section, moved off into battle position with the 1st Royal Innis. Fusiliers at Jago Farm. At 0330 on the 14th, Nos. 2 and 4 Sections, and fighting transport moved into a reserve position at Arkmoelen, arriving about 0500. Capt. A. Ferrier, R.E., and 2nd Lieut. R. Charlesworth, then went forward to 109th Brigade Headquarters at Bass Farm. 2nd Lieut. C. L. Knox, and No. 1 Section successfully bridged the Heulebeeke with the first wave, but the infantry bridges proving somewhat short, other crossings were constructed with local materials. Casualties were one killed, one died of wounds, four wounded. As the enemy carried out no demolitions to roads in the area captured by the 109th Brigade, the remainder of the unit was not called on to go into action. The whole Company, less horse lines, was concentrated on the night of the 14th, at Cohen House, and fighting transport at Oram Farm. On the 15th, the Company stood by for orders. Two pontoons, with wagons and teams complete, were attached to the 122nd Field Co., R.E., taking subsequent part in the bridging operations carried out by that unit on the 16th October, at Courtrai. On the 16th October, the Company moved to Ledeghem, and remained there until 1330 on the 18th, when it moved to Absul, with horse lines at Winkle St. Eloi. During the afternoon of the 18th, Capt. Ferrier and 2nd Lieut. Charlesworth visited the Headquarters of the 11th Belgian Infantry Regiment, from whence 2nd Lieut. Charlesworth went forward with a guide to gain information about the approaches to the Lys near Oyghem. Capt. Ferrier returned to Vlugery Farm and remained there all night in close touch with 109th Brigade. At 2220 on the 18th October, Lieut. Stapylton-Smith, and 2nd Lieut. Charlesworth with No. 2 Section went forward with two pontoons and placed them in concealment in Oyghem, in case an attack should be ordered at dawn of the 19th. At 0730 on the 19th, Lieut. Brunyate, went up to Oyghem and made a most valuable daylight reconnaissance of the Lys and its approaches. The information he gained, decided without a doubt, the site at which a bridge was subsequently placed. Just before dusk on the 19th, Lieut. Stapylton-Smith,

and 2nd Lieut. Charlesworth, with two teams of horses and No. 2 Section went to Oyghem and collected the pontoons, and took them to a reserve position in a farm. In the meanwhile, Nos. 1 and 4 Sections, 2nd Lieut. Knox, and Lieut. Brunyate, with two trestle wagons, followed later by two pontoons belonging to No. 7 Pontoon Park, under Capt. Ferrier, moved into position at a farm. Having arrived at this position, Capt. Ferrier and 2nd Lieut. Knox went forward to gain touch with No. 2 Section and the pontoons, and also the 121st Field Co., R.E. on the river bank. Touch having been gained, 2nd Lieut. Knox returned to his Section. Capt. Ferrier remained.

During the night, O.C., 121st Field Company, R.E., asked for another pontoon, and Lieut. Stapylton-Smith, and 2nd Lieut. Charlesworth, with No. 2 Section brought the wagon down to the bridge under heavy shell fire and unloaded the boat. At this stage, one driver and five horses were killed in the farm. Word was received from O.C., 121st Field Co., R.E. at 0250 on the morning of the 20th, that the 107th Infantry Brigade had completely passed over the Lys. Instructions were accordingly sent to Lieut. Brunyate and 2nd Lieut. Knox, with Nos. 1 and 4 sections, to investigate the river bank and start bridging, if possible. The material was all brought down to the site, when these two sections came under shell fire, and were forced to scatter, one man being killed. At this time, owing to the situation on the left flank not being clear, orders were issued to stop bridging until later. Shortly after 0800 on the 20th, the situation on the left was reported clear, and bridging operations were again ordered to start. Capt. Ferrier and Lieut. Stapylton-Smith, having previously made a rough reconnaissance of approaches to the bank, a medium bridge was constructed, the first transport passing over at 1415. A certain delay was caused in the construction of the bridge, owing to the shortage of pontoons. During the 21st October, the Company was employed on maintenance of the pontoon bridge, construction of roadways, and a light footbridge.

NARRATIVE OF OPERATIONS ON 19TH AND 20TH OCTOBER, 1918.

Bridging of River Lys by 121st Field Co., R.E.

Three bridging wagons with complete bridging equipment, were moved up at 0300 hours and equipment unloaded and placed amongst farm buildings.

At 1900 hours Capt. Knox and 2nd Lieut. Delahey with Nos. 2 and 4 Sections launched the two pontoons and tied ropes on for towing. At 1925 hours the infantry arrived and three N.C.Os. and three sappers rowed the first two boat loads across the river and then stayed on the east bank to tow the boats across during subsequent

trips. After two trips had been made, the enemy sent up flares and turned machine guns on the site of the operations. The remainder of the two Cos. of Infantry and the Machine Gun Sections were safely ferried across, in spite of heavy M.G. fire, and no casualties were sustained, all the men being ferried across by 2000 hours.

The building of the bridge was then commenced, Nos. 1 and 3 Sections being held in reserve. About 2100 hours the enemy put down a heavy barrage of H.E. and gas shells right along the river. A light bridge was constructed, using half pontoons, but it was found that the width of the river was 83 ft., which was 8 ft. more than was estimated beforehand. I decided to try and launch a trestle, and had the parts carried down and assembled on the river bank. The shells were falling very close and making work difficult. Before the assembling of the trestle was completed, a gas shell fell amongst the party, and killed four men and wounded several others. No. 1 Section was called on to get the wounded away, and No. 3 to take the place of the wounded men, as the 4 Sections altogether only mustered 73 men to commence with. Several men on the bridge head were also hit, and it was only the magnificent example set by Capt. Knox, 2nd Lieut. Delahey, and some others that the work went on whilst the wounded were still lying there. The shelling caused further delay, and as the infantry were nearly due, it was decided to draw on the reserve pontoons of 150th Co., instead of launching the trestle and so save time. Word was sent to Lieut. Stapylton-Smith, 150th Co., and he brought the pontoons down at the gallop, and the bridge was then completed. Three minutes later, the first platoon of the 1st Inniskillings arrived. The 109th Brigade crossed without casualties. At 0430, 20. 10. 18, the shelling again increased, and the bridge got a direct hit, which destroyed the superstructure of part of it, and damaged one pontoon. Magnificent work was again done, and the bridge repaired before the next Battalion was due to cross, viz., 0600 hours. At daybreak material was collected for the construction of a permanent footbridge, which was completed during the day, and has been very much used.

122ND FIELD COMPANY, R.E.

Report dated October 18th, 1918.

On the morning of the 16th October, 1918, it was arranged to bridge the River Lys at Courtrai. The 122nd Field Co., R.E. was detailed to throw the bridge across the river, while the Commanding Officer of the 9th Royal Irish Fusiliers made all arrangements for loading and covering parties, also for a smoke screen and trench mortar fire on selected targets. The artillery were also to co-operate by putting down a barrage on a high bank about 200 yards on the right front, but failed to do so.

The smoke screen on the right was poor, but might have been sufficient, if the artillery barrage had been provided as promised. By 1230 hours, the pontoons were brought forward to within 30 yards of the river bank behind houses. The pontoons were unloaded, and all stores laid out in readiness under the shelter of a wood pile, by 1300 hours. At 1400 hours the smoke screen was put down, and the T.M. Batteries and Lewis guns opened fire on selected targets. By 1405 hours it was considered that the smoke screen was thick enough and bridging could commence. 2nd Lieut. J. J. A. Fagan, R.E. took the first party down to the river with a half pontoon, and launched it successfully. A Lewis gun team and three riflemen were ferried across in this, and a sapper party landed, who put in a rope anchorage. 2nd Lieut. Fagan superintended the further ferrying of Infantry until he was wounded. Meanwhile, 2nd Lieut. A. J. Towlson, R.E. had launched the next boat, and started bridging. All available infantry having been ferried across, the boat thus employed was brought into position to complete the bridge. It was now about 1415 hours. The shore baulks and last bay were got across from this boat, but the chessing was never completed, as No. 3 boat was by this time in a sinking conditon owing to M.G. fire. The infantry, who were on the far side, had dealt successfully with the M.G.'s. on the left, but the smoke screen was insufficient to mask the bridge from the M.G.'s. on a high bank 200 yards away on the right front. About one rifle section got across the bridge, but the far shore bay, which was not completed, opened up and owing to the sinking condition of one of the pontoons the bridge broke up. At 1410 hours 2nd Lieut. A. J. Towlson, R.E. had been killed, and 2nd Lieut. J. J. A. Fagan, R.E. wounded. Capt. E. A. Wheatley, R.E. then took charge of the whole situation, and carried on all parties until he was wounded about 1440 hours. At 1445 hours the M.G. fire was very intense, and 3 officers and 24 other ranks, including most of the senior N.C.Os. were casualties, so the bridging party was ordered to withdraw.

THE ROYAL ENGINEERS OF THE IRISH DIVISION.

21ST MARCH—4TH APRIL, 1918.

By LT.-COLONEL R. F. A. BUTTERWORTH, C.M.G., D.S.O., R.E.

THE fighting troops of a Division are the Infantry, Artillery and Field Companies R.E. *vide* F.S. Regulations, Part I. (Operations).

In trench warfare this fact is often lost sight of, as from the nature of things, the Field Company sapper is looked upon as the builder of dug-outs, provider of trench-boards and revetting material, and the handy man of all trades in and out of the line. In the retreat, however, he comes into his own, and both works and fights, laying down shovel to pick up a rifle, and defending a bridgehead until it is his job to drop the bridge prior to retirement. In all phases of war it is his honourable task to assist the infantry and artillery in gaining and maintaining the advantage over the enemy, using, for this purpose, his technical skill and training as an engineer. But when chance offers, as in a withdrawal, he is happy to fight alongside the infantry, and great is his reward if he gains some meed of praise for his stout resistance in a village street, or for timely support at a critical moment.

The withdrawal of the Allied Armies under the concentrated and well-prepared attacks of the German forces delivered on 21st March, 1918, may well be said to mark the turning point of the great European War. Then it was that the German General Staff —calculating on our big losses in the Ypres and Cambrai battles of 1917—hoped to break the allied front, sever the British and French along the line of the Somme, and win the War before the Americans could effectively intervene.

Trench warfare was converted into open fighting and the change of tactics was destined to put into the hands of one or other of the opposing forces the opportunity of strategical combination hitherto impracticable.

The dogged retirement of the Third and Fifth Armies, the fine defence of the First Army at Bethune, and the gallant stand of the Second Army on the Scherpenberg-Mont des Cats position, though yielding a few miles of territory, laid the foundation of a victorious counter-thrust.

Following close upon this the magnificent leading and fighting of the French about Rheims and Chateau Thierry, enabled Marshal Foch to set in motion a strategical combination which was to have far-reaching and decisive results.

The share taken by the 16th Irish Division in the March battles, (its early and desperate defence of Ronssoy village, and its subsequent fighting withdrawal, and recovery on the Hamel-Marcel-cave line), find its place in the official records and war diaries. It is the hope of the writer to place on record the work and action of the Royal Engineers of this Division during this period, both in appreciation of the work done, and gallantry shown, and also as a possible help to future students of Engineer work in a retreat.

The order of battle of the 16th Division on 21st March, 1918, was as follows :—

Division Commander.—Major-General Sir C. P. A. Hull, K.C.B.

R.F.A.—G.O.C. R.A.—Brig.-General C. E. C. G. Charlton, D.S.O. 177th, 180th, 189th, 277th Brigades R.F.A.

R.E.—C.R.E.—Bt. Lieut.-Colonel R. F. A. Butterworth, D.S.O., R.E. 155th, 156th, 157th Field Companies, R.E.

49th Brigade.—Brig.-General P. Leveson-Gower, C.M.G., D.S.O. 2nd Royal Irish Regiment, 7th Royal Irish (South Irish Horse), 7/8th Royal Iniskilling Fusiliers.

48th Brigade.—Brig.-General F. W. Ramsay, C.M.G., D.S.O. 1st Royal Dublin Fusiliers, 2nd Royal Dublin Fusiliers, 2nd Royal Munster Fusiliers.

47th Brigade.—Brig.-General H. G. Gregorie, D.S.O. 6th Connaught Rangers, 2nd Leinster Regiment, 1st Royal Munster Fusiliers.

16th Machine-Gun Battalion.—Lieut.-Colonel R. Le Butt, D.S.O.

11th Hants Pioneers.—Lieut.-Colonel B. E. Crockett, D.S.O.

DETAIL AND DISPOSITION OF THE DIVISIONAL ENGINEERS, 21ST MARCH.

155th Field Co.—O.C., Major E. I. Scott, R.E., T.F. H.Q. and 3 Sections—Villers Faucon. 1 Section—Ronssoy.

Left Brigade Sector.—157th Field Co.—O.C., Major P. F. Whittall, D.S.O, R.E. H.Q. and 3 Sections—Villers Faucon. 1 Section—Ronssoy.

Right Brigade Sector.—156th Field Co.—O.C., Major T. L. Holbrow, M.C., R.E. H.Q. and 2 Sections—St. Emilie. 2 Sections—Villers Faucon. In reserve.

Orders in case of attack.—O.'s C. Field Cos. were instructed to collect their units as far as the actual situation allowed, and man

the village defences under the orders of the commander designated in the Divisional Defence Scheme.

155th Field Co. } Villers Faucon.
157th Field Co. }
156th Field Co. St. Emilie.

Horse transport, with technical wagons and stores, were to be parked clear of the village, pending further orders.

The Opening of the Attack.—The attack in the early hours of the 21st March came in the nature of a surprise; it had been long anticipated, but there were no special signs or final warning on the night of 20–21 March that the blow would fall next day.

The enemy barrage came down with almost perfect synchronism at 4.15 a.m., the battle lines, battery positions, and villages of Lempire, Ronssoy, St. Emilie and Villers Faucon being heavily shelled with H.E. and gas. All telephonic communication forward of Brigade Headquarters was at once destroyed.

A thick fog enveloped the whole area, a grey white darkness of the consistency of steam. Advancing under its cover the enemy early reached the southern edge of the Lempire-Ronssoy defences, where hot fighting took place. The two forward sections of 155th and 157th could not for the moment be extricated and fought under the orders of the O.C. Lempire defences. Later on they were withdrawn to Villers Faucon by Lieut. F. H. King (Royal Irish Regt., attached R.E.), Lieut. G. H. Baxter, R.E., having been mortally wounded while engaged at close quarters in the defence of the citadel.

After a severe struggle in which the gallant battalion of South Irish Horse was practically annihilated, and in which the 7/8 Inniskillings suffered very heavy casualites, the villages of Ronssoy and Lempire fell into the enemy's hands. This happened at approximately 11 a.m. and had the effect of turning our battle line from the south. A withdrawal to the Switch Line Epeny—St. Emilie became imperative.

Meanwhile the Left Brigade put up a fine fight, and held on tenaciously to the Malassise Farm position, where the gallant defence of the Dublin Fusiliers continued until late in the afternoon.

The 155th and 157th Field Cos., under the command of Major Whittall, who became O.C. Village Defences, manned the defences of Villers Faucon. They suffered some casualties through shell-fire, including 2nd Lieut. N.C. Gornall who was killed while taking a message from the O.C. to one of his groups.

The 157th successfully evacuated its transport during a lull in the shelling, to the neighbourhood of Marquaix. Unluckily a big shell struck the harness room of 155th and a great part of the transport was consequently immobilized. However, by making several trips the greater number of the wagons were got clear of the village.

156th Field Co., not being immediately required for the defence of St. Emilie, the O.C. reported to the Brigadier 49th Brigade, and was instructed to extend our line to the right and head off small parties of German scouts who were advancing with light machine guns in order to work round the flank of the St. Emilie position from the south. This was a task dear to Major Holbrow's heart, and he fought his company till late in the afternoon on the right, and did most useful service. He was ably backed up by his senior subaltern, Lieut. W. B.G. Whitehouse, and his C.S.M., H. Gates, until the former was unluckily killed by a machine-gun bullet.

156th Co. was relieved at 3 p.m. by the Munster Fusiliers and withdrew to a support position in rear of St. Emilie. Major Holbrow sent off an excellent sketch and tactical report timed at 5.5 p.m. which was the first reliable information of the situation on our extreme right to reach Division Headquarters.

The situation at nightfall of 21st March was:—16th Division Brown Line (Corps Line) just east of St. Emilie—touch on the right with the 66th Division who had fallen back behind Templeux-Gerrard. 21st Division still holding out in Epehy.

As regards the R.E., 155th and 157th had been withdrawn to the Green Line just east of Tincourt, having been relieved in Villers Faucon by the 2nd Leinsters—156th remained in support at St. Emilie.

After dark, Capt. J. Shelly, of 156th Field Co. ran some transport into St. Emilie, the outskirts of which were occupied by the Germans, and succeeded in removing all the officers' and men's kits and mess gear. Major Holbrow turned out his company again to assist the infantry to dig in, and succeeded in strengthening the railway cutting midway between St. Emilie and Villers Faucon.

During the night 21–22 March orders were issued for the withdrawal of the Division on the Green Line (Tincourt—Templeux—La-Fosse). The C.R.E. was instructed to improve the defences of the Green Line, using 155th and 157th Field Cos., and any infantry that were available.

The 7th Corps Cyclist Co. were sent up to strengthen the right flank of the line which rested on the Cologne river just south of Tincourt.

At daylight, work was started on deepening the Green Line which, in our sector was a spit-locked trench protected by three belts of good wire. The Cyclist Co. was employed in wiring the marsh from the Tincourt-Roiselle high road up to the river. Meanwhile the infantry withdrew from the St. Emilie position and came into line by noon on the Green Line. This line had a fine field of fire, and the further advance of the enemy was held up during the day. 155th and 157th remained in line and assisted in the defensive action.

Earlier in the day 156th had a difficult retreat through Villers Faucon and were withdrawn to Doingt.

Divisional Headquarters moved that afternoon to Doingt, and during the night 155th was withdrawn from the line and joined 156th.

22nd March.—Divisional Headquarters moved at 7 a.m., *viâ* Peronne to Biaches, where Divisional Headquarters were established.

155th and 156th Field Cos. marched to Biaches and remained during the day in Div. Reserve. The infantry fell back, stubbornly resisting, from Tincourt *viâ* Doingt to Peronne, reaching the latter town in the late afternoon. Fighting took place throughout the day, and many tactical points were resolutely held, while the general retrograde movement conformed to the movement of the Division on the left flank.

Here 157th Field Co. distinguished itself in acting as part of the rearguard for the 49th Brigade. On approaching Doingt, which is a small village in the main road about three miles from Peronne, the enemy pressed the 49th Brigade very hard with the intention of making the passage of the Somme at Peronne a difficult operation.

157th Field Co., under Major Whittall, and two companies of 11th Hants Pioneers, under Major Hazard, fought a valuable delaying action in the village. It was realized that, by taking cover in the houses and enclosures, a stout fight could be put up against the enemy, whose principal weapons at the moment were rifles and machine-guns.

A house-to-house fight took place, and valuable time was gained for the extrication of the infantry. Major Whittall received a bar to his D.S.O. for this action, and there is little doubt that Major Hazard would have been similarly rewarded if he had had the luck to survive the retreat.

Capt. G. Howson, of the Pioneers, showed great initiative in the same action, but, holding too long on to a building, was surrounded and captured. However, he eluded his captors and rejoined his company later in Peronne.

The infantry crossed the Somme just before dusk, and took up a position covering the river approaches in and about Biaches. The Bristol Bridge on the Peronne-Amiens Road was blown at 6 p.m.

The road between Biaches and Herbecourt was now much congested with horse traffic and transport, and three enemy aeroplanes came over and machine-gunned it. It was, however, a timorous effort from a great height, and three or four men only were wounded.

During the night the infantry were withdrawn on relief by the 39th Division, and marched into bivouac between Herbecourt and Cappy, and Divisional Headquarters moved to Cappy.

157th was ordered to rejoin 155th and 156th Field Cos. west of Cappy, and reached that village at 3 a.m. on the 23rd. The men

were in splendid spirits, and were singing as they went through, in spite of having continuously marched and fought since 7 a.m. on the 22nd.

23rd March.—A day of most brilliant sunshine which the Division spent in support. The Field Cos. were ordered to fill up with S.A.A. and be ready to move at half-an-hour's notice. News was very scarce, but the general impression was that the Fifth Army were standing on the line of the Somme, and that the Division would soon be on its way again into line east or north-east.

Towards the afternoon, however, it was evident that the enemy was pressing forward on the north bank of the Somme, as the artillery fire was increasing momentarily in that direction.

At about 3 p.m. the Divisional Commander issued orders that bridgeheads were to be prepared at Froissy, Cerisy, and Mericourt, each of which would be held by a brigade. The C.R.E. was instructed to arrange for the necessary work at each bridgehead, in co-operation with the Brigadier concerned, and to prepare the bridges at those places for demolition. For this purpose 155th Field Co. was told off for Froissy—156th for Cerisy—and 157th for Mericourt.

Lieut. Webster was sent off with two lorries to fetch picks and shovels from the Army Dump at Chaulnes; he got there at 8 p.m. to find the place in flames. He then went on to La Flaque which was deserted and picked up the necessary tools. These he delivered at each of the bridgeheads, and reached H.Q., R.E., at 7 a.m. on the 25th, having covered a distance of nearly 70 miles in the dark over absolutely strange roads, and been within an ace of being captured near Chaulnes.

Divisional Headquarters moved that evening to Morlancourt. The C.R.E. arranged work and demolition at the three bridgeheads, and reached D.H.Q. *viâ* Bray at midnight. The latter town was seriously blocked with transport, and was bombed by the enemy though luckily no hit was obtained in the main traffic thoroughfare.

25th March.—The Division was transferred from the VII. to the XIX. Corps H.Q. Harbonnieres. D.H.Q. moved to Warfusee-Lamotte about three miles from Villers-Bretonneux.

The Field Cos. worked all day in preparing bridges at Froissy, Mericourt, and Cerisy for demolition, and in fortifying bridgeheads at these places. Ten bridges in all were got ready, including the railway bridge at Froissy, which carried a line of rail and double width railway on a 4ft. brick-arch span. Capt. Jennings, acting adjutant, scoured the country for gun-cotton and fuse, and sufficient was obtained to supplement that carried to make up the necessary charges.

The enemy was now developing a strong attack on the North of the Somme on the line Curlu-Montauban-Longueval.

The Brigades were moved up to a preparatory position west of

Proyart with a view to holding up an advance on the south of the river. The Field Cos. were instructed to move into the village of Proyart, leaving a small detail at each group of bridges to carry out the demolition when ordered.

At 8 p.m. that evening information was received that the Fifth Army was falling back on the line Chaulnes-Bray-Albert, and the 16th Division was ordered to prepare and occupy the section of this general line between Proyart and the River Somme at Froissy, connecting on the right with the 39th Division.

The C.R.E. visited Brigade H.Q. at Moncourt and Mericourt, and the Field Cos. at Proyart, and made arrangements to start work at daybreak next morning.

26th March.—Soon after daylight the C.R.E. met the three Brigadiers at Proyart, and arranged the siting of the line, and details of work to be done. The defences of Proyart and line joining up with the 39th Division was given to the 11th Hants Pioneers—the remainder, a distance of about 6,000 yards, was sub-divided among the three Field Cos., each working on a Brigade Sector, with infantry parties provided by the Brigade.

A supply of wire was found at La Flaque and Froissy Dumps and there were plenty of picks and shovels at the former.

The line selected had a good field of fire into, and across, the small valley running from Proyart *viâ* Chignolles to the Somme at Froissy and was not under observation from the high ground further east, except on the left where it was overlooked from the north bank of the river. The line passed just in rear of Chignolles, which was at the bottom of the valley, and it was intended to deny the occupation of this to the enemy by rifle and Stokes mortar fire.

At about 1 p.m. Germans appeared on the south of the Somme, pushing in the advanced line of infantry scouts. Our half-completed line was soon under erratic but fairly brisk machine and field-gun fire. The R.E. and Pioneers, with the infantry working parties, stood to arms and lined the trenches and banks. The attack was not driven home, and at 3 p.m. the R.E. were relieved, and went back into support in Morcourt wood just west of Proyart.

In the meantime the ten bridges had been blown up by the R.E. detachments—a good job was made of the big Froissy bridge in which the crown was attacked, making a wide gap up to the abutment on each side.

At 4 p.m. the C.R.E. was ordered to reconnoitre a position covering Morcourt, to be garrisoned by the Field Cos. in the event of the Proyart line being forced back, and to dispose of the three Field Cos. for its defence.

The Field Cos. were accordingly moved back to a preparatory position close to Morcourt village. They had, however, very little rest that night, for at 2 p.m. on the 27th they were called upon to

extend the left flank of the Divisional front, and guard the crossings of the Somme on the flank of the 49th Brigade. They marched off under the command of Major P. F. Whittall towards Froissy, and, based in the Froissy-Mericourt Road, pushed out an outpost line on the river bank from Froissy to Etinehem and Cerisy.

27th March.—The enemy attacked the Proyart Line at 9 a.m., and, after severe fighting captured the village of Proyart, forcing the 47th Brigade south-west, thus leaving the 48th and 49th Brigades in a precarious position. The 11th Hants Pioneers formed a defensive flank on the right of the 48th Brigade, and, being well handled by Lieut.-Colonel Crockett, facilitated the withdrawal of the 48th Brigade to the Morcourt Line. The 49th Brigade held on to the left flank, and commenced to withdraw at about 2 p.m. It was then reported that the Germans had crossed the Somme at Chipilly about one and half-miles in rear of the Morcourt Line.

The three Field Cos., who were on the extreme left guarding the crossings of the Somme, retired slowly, and protected the left flank of the 49th Brigade in their withdrawal. The Morcourt Line was, by this time, turned by the enemy crossing at Chipilly south-west on Lamotte. The position was extremely critical, as a rapid advance by the enemy on the Cerisy-Lamotte Road would have endangered the retreat of the 48th and 49th Brigades on Lamotte.

The R.E. and Pioneers did useful work at this juncture, for, advancing towards Cerisy, they opened heavy rifle fire on the advancing infantry, and gained valuable time for our Brigades. The 155th Field Co., under Major Scott, especially distinguished itself. The Co. was led forward to gain touch with the advancing infantry, and Lieut. A. G. Atock bravely charged and destroyed a machine-gun detachment.

This counter-attack had, undoubtedly, great effect on the hostile troops who had forced the Chipilly crossing, and took the pressure temporarily off the flanks of our retreating Brigades who successfully passed through Lamotte to the Marcelcave-Hamel Line.

In their left flank action the Pioneers fought splendidly, and Major Hazard, who did so well at Doingt on the 23rd, and Capts. Thyne and Maconochie, were all missing.

155th Field Co. were the last British troops to pass through the village of Lamotte, and they fought wonderfully for men who had had so little infantry training. Each section supported the other in its retirement, and the value of the left side of the street was fully realized and made use of. Lieuts. J. P. Haugh and C. V. Brook, and C.S.M. W. Argyle especially distinguished themselves.

For their brave and excellent work on this afternoon, Major Scott and Lieut. Atock were awarded the M.C.

At nightfall the 48th and 49th Brigades were holding the old French line running in rear of Lamotte village—as far as the village

of Hamel—the Field Cos. and Pioneers holding the extreme right on the main Peronne-Amiens high road.

Divisional Headquarters remained at Hamel throughout this critical day. Meanwhile the Employment Co. and all batmen and spare clerks were organized for its immediate defence by the A.Q.M.G., Lieut.-Colonel G. A. C. Webb. The village was heavily shelled, but not attacked, and towards the evening Headquarters was moved to the Convent at Fouilloy, just clear of the town of Corbie.

28th March.—Advanced Divisional Headquarters was formed on the west edge of the Bois de Varie. The Division was relieved in the Marcelcave-Hamel Line by a mixed force of Tunnellers, A.T. Cos., Instruction Staffs, etc., raised and organized by Major-General P. G. Grant, Chief Engineer, Fifth Army. This Unit afterwards came under the command of Major-General Carey, R.A., and became known as Carey's force.

156th Field Co., R.E., had suffered heavily during the retreat, and its O.C., Major Holbrow was only able to muster twenty sappers. The Company was reinforced by the addition of some twenty infantry and a few sappers (the original Dump Party) from H.Q., R.E., under 2nd Lieut. S. A. Hall.

All three Field Companies were placed in close support at Hamel, and dug themselves into the side of a hollow road at the Southern exit of the village. The men looked, and were very tired, but their spirits and moral remained unimpaired. Major Whittall, who was a splendid example of cheerfulness to everyone, told me that afternoon that the men were fit and willing for any job of work or fighting, but it was useless to expect any rapid movement out of them.

I found Major Holbrow in a cottage at the edge of the village, helping his company cook to make stew. His first thought, at all times, was the care and comfort of his men, and it was only a little later in the same afternoon that, in leaving his billet during a bombardment to look after three of his men, he was killed by a shell, and so passed away a fine young officer "sans peur et sans reproche." Capt. Jennings, who accompanied the C.R.E. that afternoon, was wounded in the leg by a shell splinter, but remained at duty.

The 48th and 49th Brigades, together with the R.E. and Pioneers, were now formed into a mixed Brigade under Brig.-General F. W. Ramsay.

Total Strength	700 rifles.
Infantry—as 2 battalions ...	... 380
Pioneers—as 1 battalion ...	... 200
R.E.—as 1 battalion	... 120
	700

Capt. Tilly was in command of the Pioneer Battalion, and Major Whittall of the R.E. Battalion.

29th March.—The fine spell of weather now broke, and during the night there was a very heavy fall of rain which continued off and on all day.

The British line covering Corbie and Villers-Bretonneux was strengthened by the arrival of the 1st Cavalry Division at Fouilly, and two Australian Divisions on the west bank of the Somme.

The C.R.E. went up to Hamel and selected sites for an advanced dump at north-west edge of Hamelet. Meanwhile Lieut. Webster went off to XIX. Corps Headquarters and obtained a supply of wire and pickets and some tools, which were taken forward by him after dark to the Hamel Dump.

30th March.—The weather cleared somewhat, and there was much enemy aerial activity. Two big flights of Fokkers were operating for an hour over our lines, until engaged in a heavy air battle by our scouts, and chased away. A very heavy barrage was put down at 11 a.m. by the enemy on the front line (held by Carey's force) and Hamel, followed up by an infantry attack. The enemy succeeded in entering the front line just east of Hamel, and the R.E. and Pioneers were called upon by the Brigadier, 48th Brigade, to counter-attack. The R.E. counter-attack was delivered in three lines—157th leading under Lieuts. J. R. Osmond and E. H. Barcroft, supported by the 156th in two lines, led by Capt. J. Shelly, with Lieuts. S. A. Hall and E. H. Norman. It was a gallant little effort and was completely successful in driving the enemy out of the part of the front line and support lines occupied. Various infantry officers told me that it was an inspiring sight to see those three thin lines going ahead at a steady double over the open. Three out of the four officers became casualties—Lieuts. Hall and Norman being killed, and Lieut. Osmond wounded. Also Sergt. Hughes and 2nd Corpl. Fryer, D.C.M., M.M., a brilliant young N.C.O., were killed.

The Sappers remained in the line until relieved next morning, and excellent work was done by Lieut. Atock, 155th Company, R.E., who worked backwards and forwards with a small party of Sappers, carrying up rations, water, and ammunition. One of the party, Sapper Finlayson, afterwards received the D.C.M.

During the night a squad of infantry were taken up by Lieut. Webster, and some useful wiring done.

31st March.—A day of brilliant sunshine. Orders were issued that Carey's force was to be relieved by the 1st Cavalry Division, and that the 16th Division would take over the portion of the line between Hamel and the Somme. The C.R.E. reconnoitred the front line with Lieut. Webster, with a view to improving the defences in the 16th Divisional Sector. The German dead were lying about in heaps, showing how heavily the 228th Bavarian Division had suffered in their attempt to wrest Hamel from our possession on the previous day.

The line held by our troops was an old French defence trench, much fallen in and shallow, but with very fair wire in front. With a little work it seemed easily capable of strengthening and improvement.

The opportunity was taken by the C.R.E. of inspecting the bridge across the Somme at Bouzencourt. This was partially blown but quite passable for infantry. It had been apparently struck by a shell which caused one charge to detonate, cutting the girder on one side only. As the bridge was just in rear of our front line it was a bit of luck that the demolition had not been more complete. Capt. Hughes, 155th Field Co., took a limber with explosives up to Bouzencourt after dark, and prepared this bridge for demolition in case of further retirement.

During the night 31st March—1st April, the Field Cos. were withdrawn from the line to Aubigny and the Hants Pioneers to Vaire.

1st April.—Work was organized for improving our front line, and for preparing a switch line from the village of Vaire to meet the mail road near Villers-Bretonneux. The latter was sited in conjunction with the 1st Cavalry Division, and work was started by our R.E. the same evening.

The 11th Hants, under Capt. Howson, commenced deepening and revetting the shallow parts of the front line, and in strengthening the wire.

2nd April.—Very heavy German bombardment to the south of Villers-Bretonneux, but quiet on our front. The weather was fine, and some useful work was done on our defensive system and the switch line.

3rd April.—16th Division was relieved by the 14th Division, and the Field Cos. were moved by 'bus to Salleux late that afternoon.

This brings to a conclusion these few notes on the work and fighting of the Royal Engineers 16th Division during the critical period, 21st March to 4th April.

It is an interesting fact that each Field Co. learnt the use of Lewis machine guns on the retreat, and, finally, between 30 and 40 of these weapons were handed over to the infantry, after having done excellent service.

In the form of an appendix are added a Special Order of the Day, issued by General Sir H. P. Gough, commanding the Fifth Army, and three letters received from the Divisional Commander and Brigadiers of the 16th Division, in kind appreciation of the efforts of the R.E.

I think it can be fairly said that the Sappers, under difficult and unusual conditions, did their best to worthily uphold the traditions of the Corps, and that they have, perchance, also earned the right to say with their brothers of the infantry

"Et militavi non sine gloria."

APPENDIX.

SPECIAL ORDER OF THE DAY.

By GENERAL SIR H. DE LA P. GOUGH, K.C.B., K.C.V.O., Commanding Fifth Army, dated 26th March, 1918.

I wish to express to all Officers and men of the Fifth Army my immense admiration for the truly magnificent way all ranks have fought in this desperate struggle against immense odds. The very grandest traditions of British soldiers and of the British race have been maintained. We are fighting for our lives, our existence, our honour, and in your hands all these are safe. It is a matter now only for few days before reinforcements arrive to alter the situation.

(Sd.) H. P. GOUGH, *General.*

2nd September, 1918.

MY DEAR BUTTERWORTH,

Your letter reached me just as we were starting the fighting in these parts, hence the delay in answering.

I am very glad to hear that the deeds of the Field Cos. of the 16th Division during last March and April are to be brought to light. Their fighting qualities were beyond praise, and they helped the remains of the infantry in many a tight corner by their dash and grasp of the situation.

Notably the 156th Co., on March 21st, at St. Emilie, where the fighting was hard and the situation at the moment decidedly mixed. On March 23rd the 157th Co. attached to the 49th Infantry Brigade put up a stout resistance on the extreme right of our line, and when the order to withdraw was sent, gave material assistance to the Brigade when passing through Doingt.

I think one of their best actions was when the three companies were ordered to move from Morcourt to Mericourt during the night of 26th-27th March, in order to guard the crossings at the latter place, and probably the left of the 49th Infantry Brigade. Owing to the enemy pressure forward on the north of the river, and eventually crossing at Chipilly on the 27th, our left was under heavy fire from its flank and rear, the way the Engineers held their ground and eventually fought their way back was splendid.

The 155th Co. I remember especially did good work there. I have no doubt there are other instances, but these showed what stuff they were made of, and how they proved themselves first-class fighters

in a first-class fighting division. You, yourself, deserve every credit for this, and I am glad to have the opportunity of again thanking you for all you did during those strenuous times.

Yours very sincerely,

AMYATT HULL,

G.O.C. 16th (Irish) Division.

1st September, 1918.

MY DEAR BUTTERWORTH,

I am very glad to hear that you are putting on record the extraordinarily fine work performed by the R.E. Cos. of the 16th Division during the operations of the 21st March to 3rd April.

It was towards the evening of the 21st, and during the following days when the whole of the infantry of the Division were engaged, and losses had been very heavy, that the fighting and steadiness of the R.E. Cos. were of invaluable assistance. Especially noticeable was the gallantry displayed by the 156th Co. at St. Emilie on the 21st, by the 157th Co. at Doingt on the 23rd, and by the 155th Co. who covered the retirement on the 27th. On the morning of the 30th, when the Divisional Front was attacked and partially penetrated, the bravery of all three companies in the counter-attack was worthy of the highest traditions of the Army.

The R.E. Cos. of the 16th Division have at all times been held in high esteem by the Infantry for their personal fearlessness and the high standard of their technical work in the line, but during these operations they demonstrated that, in addition their *morale* and fighting qualities as a formed body, acting as Infantry, left nothing to be desired.

Yours ever,

P. LEVESON-GOWER.

Commanding 49th Infantry Brigade,

HEADQUARTERS,

58TH DIVISION,

6th April, 1918.

DEAR BUTTERWORTH,

I am anxious that my appreciation of the good work of the R.E. Cos. during the operations 21st March to April 3rd, when attached to my Brigade, should be conveyed to all ranks.

I may especially mention the fighting work of the 156th Co. on the right flank at St. Emilie on the 21st March, of the 157th Co. in passing through Doingt on the 23rd, and in the withdrawal from

Morcourt on 27th, on which day the 155th also did good work in holding up the enemy's advance at Warfusee-Lamotte; and of all these companies in the counter-attack against the Bavarians on the morning of the 30th March.

They worked well and in good formation under shell-fire, and though not trained as infantry, they were equal to the best, and showed great determination and pluck throughout the operations.

Yours sincerely,

FRANK RAMSAY,

Commanding 48th Infantry Brigade.

A FIELD COMPANY ON PACK TRANSPORT.

METHODS EMPLOYED BY THE 2ND WESSEX FIELD CO., R.E. (T.F.).

Described by CAPTAIN G. C. SANFORD, R.E.

IN certain of the Expeditionary Forces where most of the roads to be negotiated are unsuitable for wheeled transport, it has been found advisable to adopt Pack Transport for all 1st Line Units including, of course, the Divisional R.E. Field Companies. It is obviously impossible to carry pontoons on pack mules, and it was found advisable to slightly reduce the tools, etc., normally carried by the H.Q. and sections with their wheeled transport. A Divisional R.E. train was therefore formed consisting of the pontoons and trestle wagons of all three Field Companies, and each company supplied two limbers to this train. The tool carts, forage carts, water cart, cook's cart, and H.Q. vehicles were withdrawn from the companies and pack mules and saddlery were issued in lieu. Appendix 1 gives the mounted establishment of a Field Company on Pack Establishment as adopted by the Salonica Army, and Appendix 2 gives a detailed list of the pack saddlery. While the companies were in the line they temporally retained their pontoon and trestle wagons, and the two limbers belonging to the Divisional R.E. train; 16 drivers and 32 mules belonging to Divisional R.E. H.Q. being temporally attached to each company. Appendix 3 gives general description of the loads carried by each of the H.Q. mules, and Appendix 4 shows the general loading of the section pack mules. The total weight of the pack saddlery is about 70 lbs., including feeds and saddle cover. The average load including pannier or other carrying contrivance is 90 lbs. a side, and the driver's kit will scale, say 20 lbs., so that the total load carried by the mule is about 270 lbs. One of the common causes of trouble with pack work are the loading ropes. These ropes are made up in pairs with loops to hook out the pack saddle hooks and leather distance pieces about 12 in. long between the two ropes. When skilfully handled loading ropes can be made to sling all sorts of seemingly unweildy loads, but wherever a load is of a uniform pattern, it is better to arrange for permanent rings on the load or carrier so that the loads cannot slip in the ropes, and the risk of a badly-roped load getting loose or shifting is obviated. Referring to Appendices 3 and 4, it will be noticed that only 12 out of the 32 loads in the H.Q. list are loaded with pack ropes, and only 12 out of the 34 in the section lists. To

illustrate the method of making up the loads, we will go through those shown on Appendices 3 and 4. The first load in Appendix 3 (Company H.Q. loads) is the anvil, this is carried as a top load, the wooden anvil block being sawn vertically in half and each half fitted with an iron bar and two rings in such a manner that when the two half blocks are slung on the saddle they form supports for the anvil; the latter being lifted out and across them, and then lashed to the saddle. A field company anvil should weigh 140 lbs., but if a rather lighter one can be obtained for pack purposes it is an advantage, as it is an awkward load, and in lifting it on and off an accident can easily occur. No. 2 load forge and bag of coal on the near side are carried by fitting two carrying rings to the forge body and lashing the bag of coal inside it. The grindstone case on the off-side, with the forge legs lashed to it, being also fitted with carrying rings. It is important when fitting up pack loads to keep the weights well up on the pack saddle, and of course great care must be exercised to ensure that the loads do not project so as to gall the shoulder or flanks of the mules when turning. No. 3 load Clarkson chests containing small tools and instruments are already fitted with loading rings when issued; the same applies to the entrenching bags used for Nos. 4 and 5 loads. No. 6 load shoemaker's valise on the near side is secured by loading ropes; the leg vice and bag of coal on the off side are lashed together and carried by loading ropes. No. 7.—These loads, the veterinary chest and plane table on the near, and the stretcher and veterinary wallet on the off, are also lashed and carried by loading ropes, the stretcher being slung at an angle of about 30 degrees, so as to clear the shoulder and flank of the pack mule. The pieces of round bar iron and flat iron and steel carried as No. 8 load are best cut into lengths of about 3 ft. 6 in., and made up into bundles, the end of the bundles being fitted into two light metal or leather buckets, with a strap connecting them together. The bundles can then be carried horizontally, though possibly with a slight lift in front, by loading ropes or by short chains secured to the buckets. No. 9 load stationary boxes can be carried by loading ropes or short chains can be rivetted to the boxes. It will be noticed that Nos. 10, 11, 12 and 13 mules carry respectively entrenching bags and panniers, but these are empty, so that practically speaking, the mules are spare. The panniers are strong wicker baskets fitted with short loading chains and rings, the lids are covered, and the insides of the baskets lined with oil cloth to keep out rain. These pannier baskets are very much like a small theatrical hamper, and being light but strongly made, are very useful for carrying small tools. No. 14 load is a pair of panniers with officer's mess gear. No. 15, the major's and captain's valises carried with loading ropes. No. 16 is a packhal (*i.e.*, a galvanised iron water tank 2 ft. × 1 ft. × 8 in. in size, and of a capacity of approximately

8½ gallons). It is carried by loading ropes on the near side, the cook's dixies packed in a sack and carried by loading ropes being carried on the off side. Referring to Appendix 4 (Section Loads), Nos. 1 and 2 loads are picks and shovels carried in wooden frames called "Kajawahs," *Fig.* 1. Each kajawah is constructed to

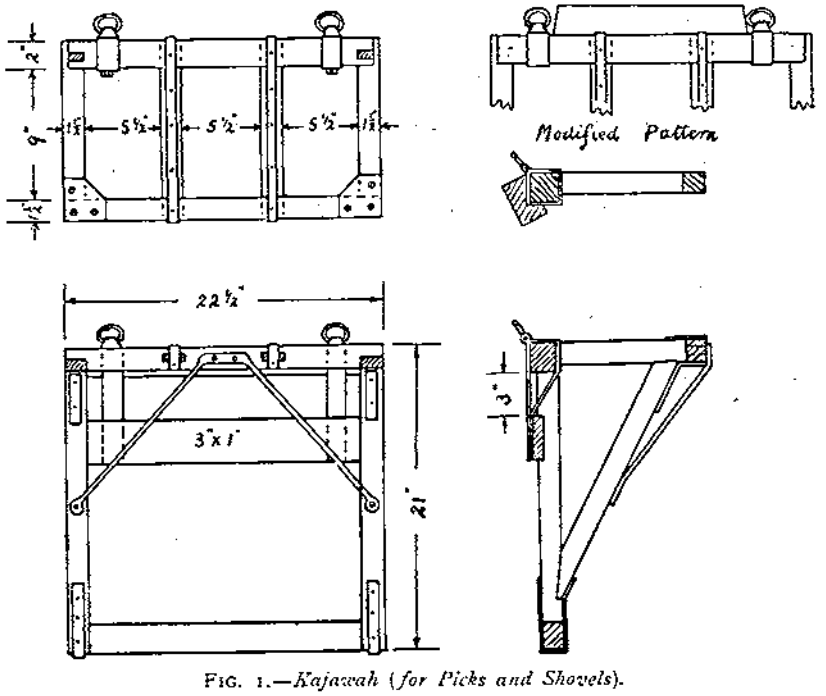


FIG. 1.—*Kajawah (for Picks and Shovels).*

carry 13 or 14 picks and shovels; it is a wooden frame-work about 22 in. square, against the pack saddle pad, with a 22 in. × 12 in. carrying frame divided into three compartments standing out at right angles to the saddle pad frame, and braced off it with angle struts. The kajawah is fitted with loading rings, and is metal bound at the corners, the weight being about 16 lbs. The tools are carried in the frame heads upwards, the helves and handles being snake-lashed to the lower part of the frame, so that the complete load can be lifted off without any trouble. A short surcingle connecting the near and off kajawahs is an advisable adjunct. No. 3 load consists of sandbags made up into bales and carried with loading ropes. Nos. 4, 5, and 6 are various tools carried in entrenching bags, *i.e.*, leather bags about 2 ft. × 1 ft. × 8 ins., fitted with heavy straps and loading rings. No. 7 load, carpenter's leather hold-all on the near and smith's ditto on the off side, are carried with loading ropes. The section's measuring rods reduced from 6 ft. to 5 ft. are carried on the outside of the near load. No. 8 load comprises the section grindstone fitted with loading rings (as in No. 2 H.Q. load), with

picket line and farrier's bag lashed to it, and various heavy ropes and lashings coiled and carried with loading ropes forming the off load. No. 9 load consists of a coil of 2½ in. rope and a small quantity of plain wire on the near, and a pair of 2½ in. blocks lashed into a coil of 1½ in. rope on the off side, both loads being secured with loading ropes. No. 10 load, panniers containing demolition gear. No. 11, tins of amonal carried in a pair of boxes, Noble pattern,* (*Fig.* 2). These boxes are made of light gauge iron, and are

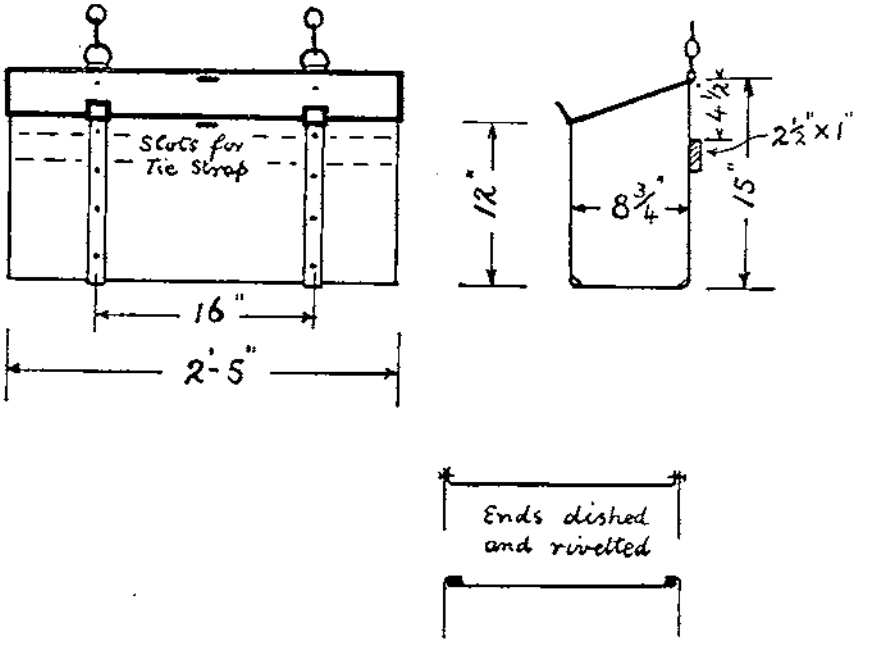


FIG. 2.—*Box "Noble" Pattern.*

almost identical in shape with the entrenching leather bag; they are fitted with short chains and loading rings, over all dimensions being 2 ft. 5 in.×12 in.×8¾ in. They are specially designed to take eight tins of amonal and a tin of detonators and safety fuze each. No. 12 load, panniers containing gun cotton and primers. No. 13 load, two boxes of S.A.A.; these boxes are rather small for securing with loading ropes, the total length of the box being only 16 in., while the pitch of the pack saddle loading hooks is 15½ in.; it is therefore advisable to fit the ends of the S.A.A. boxes with a pair of light iron strips about ¾ in.×¼ in., carried down the back along the bottom, and an inch or two up the front of the box, and secured to it with a few short wood screws, the top of the strips being fitted with loading rings. No. 14 load, pump on near and hose for same on off side. The pump of the ordinary service pattern

* Invented by Major N. D. Noble, D.S.O., R.E.

having a new base fitted to it. This base is formed by two 4 in. × 2½ in. timbers, 2 ft. 8 in. long, bolted to the pump lugs, through the 2½ in. section, the two timbers being spaced out with 2 in. blocks, just under the ends of the pump cylinder. Long bolts with loading rings in the heads are carried through both longitudinal timbers and distance pieces, the rings being on the delivery side of the pump (*Fig.* 3). The strainer is carried screwed on to the suction

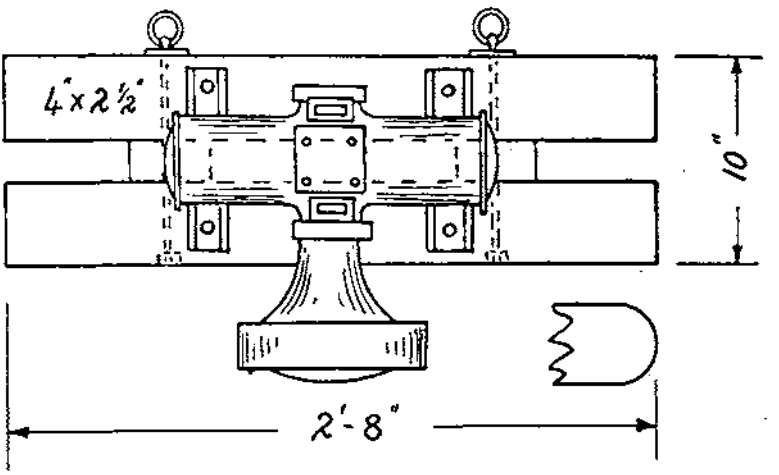


FIG. 3.—*L. and F. Pump (Off Load).*

orifice of the pump. The off-load (*Fig.* 4) is made by forming a

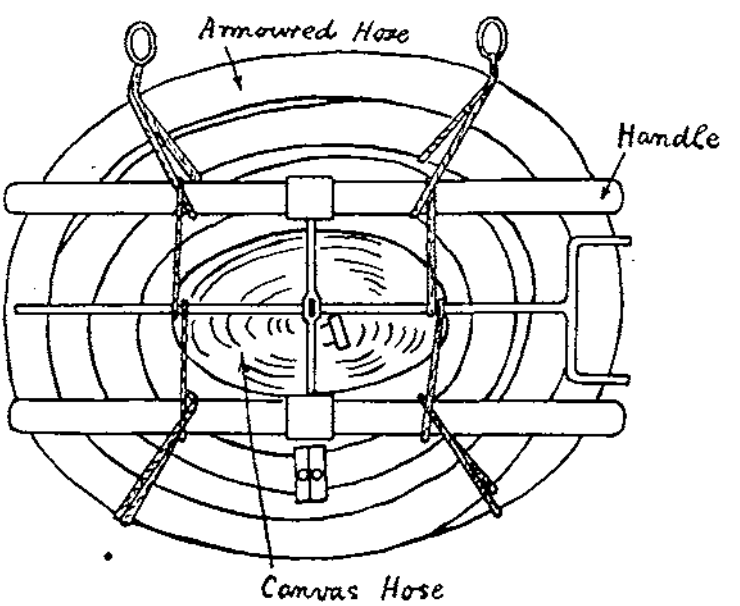


FIG. 4.—*Hose and Handle (Near Load).*

continuous coil of two lengths of suction hose with one length of delivery hose rolled in the centre, the handle and lever of the pump being lashed to these coils and the whole load secured with loading ropes, the pump handles being slung against the pack saddle pad. No. 15 load packhals is carried as described in No. 16 H.Q. load. No. 16 load section officer's valise on near and cook's dixies on off are carried with loading ropes. No. 17 load two empty kajawahs these kajawahs being spares may be rather a modification of the pattern described for Nos. 1 and 2 loads, the top frame only with a shaped block at the back and loading rings being sufficient (*Fig.* 1), but of course this type of kajawah cannot be lifted on and off complete with load as in the more elaborate type. Appendix 5 gives complete table for all H.Q. and sectional pack loads and list of stores carried by Divisional H.Q. wheeled transport for each field Company. On perusal of these tables it will be noticed that the various loads are as far as possible arranged so that certain mules can be sent off with the tools or gear required for certain jobs. This feature of the pack transport has been very carefully considered, especially in the case of the sectional equipment. For instance, if the section is suddenly called upon for any digging or entrenching work, Nos. 1, 2, and 3 mules are loaded with the necessary tools and sand bags. If the section is required to do any temporary wiring, which in a rough country would probably necessitate felling and sharpening the pickets on or near the site, then Nos. 4 and 5 mules will be found to be carrying all the necessary tools. No. 6 mule carrying principally supplementary tools of the same class as Nos. 4 and 5. If any carpenter's or joiner's work is required, then the near load of No. 7 mule will be required, and smith's iron and tin and mason's tools will be found in No. 7 off load. If it is necessary to carry out any work necessitating the use of ropes and tackle, then Nos. 8 and 9 mules will be wanted. Materials for demolitions or blasting will be found loaded on Nos. 10, 11, 12, and 13 mules; and if water has to be pumped from a well or river, the pump and hose pipes, etc., will be found complete on No. 14 mule. The water supply for the section while on the march is carried by No. 15 mule, and everything necessary for a temporary camp, *i.e.*, cook's gear, a shovel, pick and axe, etc., will be found on No. 16 mule. When on the march, each section of sappers should be sub-divided, roughly according to trades, the N.C.O. or senior sapper of each sub-section being made responsible for the loads of certain mules, he and his men loading and unloading their allotted mules for the drivers, and re-roping their loads if any of them slip or get loose. If this system is adopted it becomes automatic for certain sappers to fall out with any driver who is in difficulties with his load, and it is not necessary for the section officer or serjeant to select and fall out men specially for the job. The mounted N.C.O. simply informing the sapper

N.C.O. in charge of, let us say, No. 7 mule's load, that this load requires attention. The N.C.O. in charge of each sub-section should carry a detailed list of the tools in each of the loads under his charge, and the officer and serjeant complete lists of the distribution of all tools. Roughly the sub-sections should be made up as follows :—

(*a*).	Digging Party	1 N.C.O. and 6 men.
	Trades	5 bricklayers, 1 surveyor and 1 blacksmith.
	Mules	Nos. 1, 2, and 3.
(*b*).	Cutting Party	1 N.C.O. and 6 men.
	Trades	6 carpenters and sawyers, and 1 wheelwright.
	Mules	Nos. 4, 5, and 6.
(*c*).	Carpenters' Party	1 N.C.O. and 6 men.
	Trades	4 carpenters, 1 blacksmith, 1 tinsmith, 1 mason.
	Mules	Nos. 7, 8, and 9.
(*d*).	Demolition Party	1 N.C.O. and 6 men.
	Trades	2 masons, 2 painters, 1 engine driver, 1 pioneer, 1 cooper.
	Mules	Nos. 10, 11, 12, and 13.
(*e*).	Water and Cooks' Party	1 N.C.O. and 6 men.
	Trades	2 fitters, 2 plumbers, 1 plasterer, 1 tailor, 1 clerk.
	Mules	Nos. 14, 15, and 16.

NOTE.—Section officer and serjeant are responsible for general supervision. The detailed trades are, of course, only given as a guide to the general idea of the scheme. In loading and unloading a pack mule it is generally necessary to have two men for each load. The driver should stand facing, but not looking into the eyes of his mule, with the reins held in both hands. If his mule is nervous he will, of course, endeavour to soothe the animal. The four sappers detailed to load the mule must lift both loads together, slipping the loading rings on to the fore hooks of the pack saddle first, and then on to the hind hooks. It is important to load in this manner, as the weight coming on the shoulders of the mule first is less likely to upset the animal if it is at all nervous than if the weight is first felt on the hind quarters. The sappers should try to support the loads until both are properly hooked on and then release them gently. Having fixed the loads the driver's kit must be placed in position between them, and the pack saddle cover slipped over the lot. The pack saddle cover is secured by a long surcingle. This surcingle should always be passed over the load from the near to the off side, the buckle being kept well up on the near side about level with the animal's shoulder blade. The pull when tightening the surcingle will thus be downwards, which is easier for getting it properly tightened up. The loose end of the surcingle must, of course, be tucked up out of the way. Drivers leading mules should march on the near side of their animals with their rifles slung from the

left shoulder. When acting as pack mule men they should not, of course, parade in spurs. When leading a mule the driver must hold the reins with his right hand fairly near the bit, and his left hand at the end of the reins, but over very rough country, he should lead at the full length of the reins. When about to negotiate a stretch of stiff uphill track the breast collar straps should be slightly tightened. When negotiating a bad down grade track the breeching straps should be tightened. When pack mules are first saddled up in the morning, it is a good plan to lead them round for a few minutes before actually loading. After leading them round, the girths should again be tested, and probably most of them can be slightly tightened up. With the new pattern pack saddlery, the girths should be crossed, one girth passing from the near fore to the off hind, and being secured first, while the other passes over it from the off fore to the near hind. When a driver is leading two mules, the second one should be secured by its head chain to the near hind hook of the leading mule's pack saddle.

After a long march, the pack saddles should be left on the mules backs for half-an-hour or so, to allow the animals to cool off, the girths, of course, being eased. After they are taken off, the pack saddles should be placed in such a way that as much air and sun as possible is able to get on the inside of the saddle pads. After a long march with heavy loads, a pack mule will often be found to have developed a swelling, varying in size from an egg to a man's fist under the belly. This is nothing serious, and is simply caused from unavoidably tight girths. The swelling will usually have gone down by the morning. Galling under the tail from the crupper is a common trouble with pack mules. If a mule shows a tendency to develope such galls, the crupper can be removed, as it is really of very little use. On the march, and in fact at all times, pack mules should be watered as often as possible. It will not hurt them to take a little water with their loads on, but wherever possible the packs should be off-loaded, and the girths eased and bits removed. When a section is halted and the mules are to be off loaded they should be lined up about five yards in front of the place to be occupied by their loads, so that the four men unloading can lift the packs off and carry them back to the place allotted. If the weather is cold, spare blankets for the men of the section can be carried folded square between the mules' blanket and the pack saddle. If this is done, however, care must be exercized to so arrange the blankets that there is an air space along the back bone of the animal. It is sometimes not practicable to head and heel picket the mules, because many mules are liable to gall from the heel straps. A good method of fixing up a temporary mule line is to head picket all the animals in a line with head chains and iron pickets, and then pass a light 66 ft. picketing rope through the rings of all the iron pickets, securing

it with a wooden picket at each end. By this means if one mule should pull its head picket out it is still held by the picket rope to the head pickets of the animals on either side of it. If the country allows, the pack mules should march parallel to the sappers, otherwise the column becomes very long and unwieldy. In passing through enemy country it may sometimes be necessary to divide the pack transport of a field company into 1st and 2nd line, the 1st line marching with the sections, and the 2nd line being attached to the 2nd line transport of the main body of troops on the march. In this case all the H.Q. pack mules would probably become 2nd line transport, and the sections' transport would be divided up according to local requirements. Probably mules Nos. 1, 2, 4, 10, 11, and 15 and the spare animal No. 17 of each section would be 1st line, and the other animals of the sections would become 2nd line, but, of course, the actual arrangement on any particular days march would depend entirely on local conditions, and any special work which it was anticipated that the company might have to negotiate. It is very important before taking pack mules on a long march that each animal should be individually fitted with a full set of spare shoes, these being carried in the shoe case with a sufficiency of nails. In soft country, it is not an uncommon practice to only shoe mules on the fore hoofs.

Transporting R.E. Stores on Pack Mules.

When wiring materials have to be transported by pack mules, the following loads can be carried :—

(*a*). Four coils of barbed wire, two on each side, carried with loading ropes.

(*b*). Sixteen angle iron 6-ft. pickets, eight on each side; carried with loading ropes (the ropes should be longer from the hind than the fore, back saddle hooks to allow the load to ride free of the mules shoulders).

(*c*). Eight lengths of French concertina wire, four on each side; each length should be twisted into the form of a figure 8 lashed in this shape and carried with loading ropes so fixed that the figure 8 rides at an angle of about 30 degrees.

(*d*). Wooden pickets 6 ft. long (number according to weight) carried in the same way as iron pickets.

(*e*). Short 3 ft. pickets carried either in entrenching bags or in sacks lashed up and secured with loading ropes.

(*f*). Sand bags. A strong mule will carry two bales of 250 bags each for a medium distance. The bales are secured with loading ropes.

For carrying small quantities of CG1 sheets, heavy timbers, etc., mule-drawn skids (see *Fig.* 5) are very useful, two or more mules

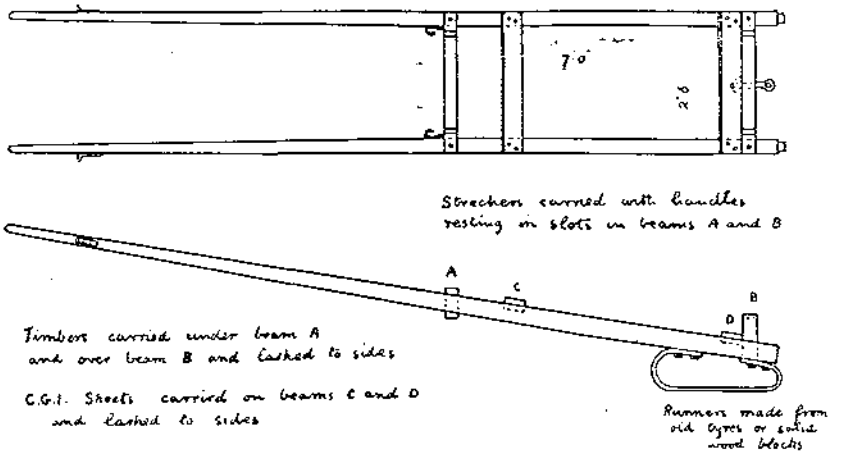


FIG. 5.—*Skid for Hill Tracks.*

being harnessed tandem fashion to them. The skids should be equipped with a tail rope so that a man can guide them from the rear. These skids fitted with stretchers are very useful for transporting wounded. The shafts should be as springy as possible, and if thus constructed the jars to the stretcher case are surprisingly light. Palaquins with shafts at each end slung between mules are not very satisfactory, as they are too long and cumbersome, especially in negotiating corners.

APPENDIX I.

MOUNTED ESTABLISHMENT OF A FIELD COMPANY ON PACK.

Headquarters of Company.

2 Officers	4 Riding Horses.
1 C.Q.M.S.	1 ,, Horse.
2 Mounted Sergeants	2 ,, Horses.
1 Farrier-Sergeant	1 ,, Horse.
1 Farrier-Corporal	1 ,, ,,
1 Shoeing and Carriage Smith	1 ,, ,,
2 Lance-Corporals	2 ,, Horses.
1 Horseholder	1 ,, Horse.
1 Lance-Corporal (as Driver), 20 Drivers, 4 Batmen ...	16 Pack Mules.

EACH SECTION.

1 Officer	1 Riding Horse.
1 Corporal or 2nd Corporal	1 ,, ,,
1 Lance-Corporal (as Driver), 7 Drivers, 1 Batman ...	17 Pack Mules.

TOTAL.—21 riding horses (1 extra horse is allowed if the Company has an interpreter attached), and 84 pack mules. Subsequently some of the mounted N.C.O.'s. were issued with riding mules in lieu of horses. Each driver is responsible for 2 mules, so that 13 of the Company H.Q. drivers can be called spare, and can be attached to the section as required. It will be noticed that the actual sectional establishment necessitated the officer's batman leading the spare mule. The extra establishment of drivers was allowed in the Salonica Army to cover sickness, malaria being very prevalent, and it was also realized that it was not always practicable for one man to lead two mules under certain conditions.

APPENDIX II.

PACK SADDLERY FOR MULES.

Pack Saddle.
Breechings, breast piece and girths.
Head stall, bridle and bit.
Head chain.
Wood picket and heel strap and rope.
Iron picket for head chain.
Horse blanket folded under saddle.
Shoe case (containing 4 shoes and nails).
Body brush (hung by wire loop from saddle).
Feed bag (10 lbs. of forage).
Feed bag (unexpended forage).
Drivers' kit (packed in ground sheet and carried lenghtwise on top of saddle).
Two loading ropes (hung from saddle if not required for load being carried).
Pack saddle cover and surcingle (carried over entire load).
Total weight including feeds, but not drivers' kit, about 70 lbs.
Canvas Water Buckets.—Company H.Q. pack mules 21 buckets, and 9 for pack mules of each section.

APPENDIX III.

PACK TRANSPORT, COMPANY HEADQUARTERS MULES.—TOTAL, 16 MULES.

(Loads marked * secured by loading ropes.)

Mule.	Near Load.	Off Load.
	Anvil	(Top load).
No. 1 ...	½ Block	½ Block.
No. 2 ...	Forge and coal.	Grindstone and forge legs.
No. 3 ...	Clarkson chest, carpenter's tools, etc.	Clarkson chest, instruments, etc.
No. 4 ...	Bag, intrenching, saddler's outfit	Bag, intrenching, soap, lanterns, etc.
No. 5 ...	Bag, intrenching, reaping, and bill hooks, etc.	Bag, intrenching, smith's tools, etc.
No. 6** ...	Shoe maker's valise.	Leg vice and coal.
No. 7** ...	Vet. chest and plane table.	Stretcher and vet. wallet.
No. 8** ...	Bar, iron	Flat iron
No. 9** ...	Box, stationery	Box, stationery, wire rope.
No. 10 ...	Bag, intrenching (empty).	Bag, intrenching (empty).
No. 11 ...	Pannier, " A " (empty).	Pannier, " A " (empty).
No. 12 ...	Pannier, " B " (empty).	Pannier, " B " (empty).
No. 13 ...	Pannier, " C " (empty).	Pannier, " C " (empty).
No. 14 ...	Pannier, mess gear.	Pannier, mess gear.
No. 15** ...	O.C.'s kit.	Capt's kit.
No. 16** ...	Packhal.	Cook's gear.

APPENDIX IV.

PACK TRANSPORT, SECTION MULES.—TOTAL, 17 MULES.

(Loads marked * secured by loading ropes.)

Mule.	Near Load.	Off Load.
No. 1 ...	Kajawah picks and shovels.	Kajawah picks and shovels.
No. 2 ...	Kajawah picks and shovels.	Kajawah picks and shovels.
No. 3** ...	150 sandbags, etc.	150 sandbags, etc.
No. 4 ...	Bag, intrenching, axes, crowbar, etc.	Bag, intrenching, axes, wire cutters, etc.
No. 5 ...	Bag, intrenching, axes, heavy hammer, etc.	Bag, intrenching, axes, boring bar, etc.
No. 6 ...	Bag, intrenching, adzes, tracing tapes, etc.	Bag, intrenching, hooks, reaping, lamps, etc.
No. 7** ...	Holdall, R.E., carpenter's tools.	Holdall, R.E., smith's tools, etc.
No. 8* ...	Grindstone, picket line, and farrier's bag.	2-in. rope, and lashings, etc.
No. 9** ...	2½-in. rope and wire.	Blocks and 1½-in. rope, etc.
No. 10 ...	Pannier, "A" exploder and cable, etc.	Pannier, "A," guncotton and auger, etc.
No. 11 ...	Box, Noble pattern, ammonal, etc.	Box, Noble pattern, ammonal, etc.
No. 12 ...	Pannier, "B," guncotton primers, etc.	Pannier "B," guncotton.
No. 13 ...	S.A.A. box	S.A.A. box.
No. 14* ...	Pump.	Hose, etc.
No. 15** ...	Packhal.	Packhal.
No. 16** ...	Officer's kit.	Cook's gear.
No. 17 ...	Kajawah (empty) (small type).	Kajawah (empty) (small type).

APPENDIX V.

PACK TRANSPORT LOAD TABLES FOR A FIELD COMPANY, R.E.

HEADQUARTERS.

No. 1 MULE.

Near.	lbs.	Off.	lbs.
½ Anvil	70	½ Anvil	70
½ „ block	25	½ „ block	25
	95		95

Anvil resting on 2 pick heads passed through hooks of saddle arches and secured with loading ropes.
Block cut in half and hung by rings and wire from arch hooks.

No. 2 MULE.

Forge (Careless pattern) fitted with rings and 2 wood chocks to prevent rocking when hung from arch hooks	70	Forge legs	28
Coal (auxiliary sack)	20	Grindstone	62
	90		90

No. 3 MULE.

Near.	lbs.	Off.	lbs.
Clarkson chest, containing carpenter's tools, viz. :—	24	Clarkson chest, containing instruments, viz. :—	24
2 Augers (⅜-in. and ½-in.) and handles	66	1 Compass, magnetic plane table	66
2 Chisels, brick, 18-in.		1 Box, instruments, drawing, filled...	
1 ,, coachmaker's		Pins, drawing	
1 Diamond, glazier's		Pens, mapping	
1 Gauge, carpenter's		1 Cloth, tracing, roll	
4 Gimlets (Nos. 1, 2, 3 and 6) ...		Paper, drawing	
3 Gouges (⅜-in., ½-in. and ¾-in.) ...		,, plane, table	
1 Knife, carpenter's		2 Protractors	
1 ,, putty		2 Rules, rolling, 15-in.	
1 Mallet, carpenter's		1 ,, sight, plane table, 16-in....	
4 ,, tinman's		1 Scales, Marquois, sets	
1 Oilstone		1 ,, mathematical, boxwood, sets	
Oil, in bottle, for same		1 Set-squares, 6-in., 45°	
8 Doz. pencils, carpenter's ...		1 ,, ,, 60°	
6 Pincers, carpenter's (pairs) ...		1 Clinometers, pendant	
2 Glue pots (glue for same) ...		1 Level, pocket	
1 Rasp, half-round, 12-in. ...		1 Sextant, in case	
1 Rule, G.S., 4-fold		1 Plane table, legs	
1 Saw, compass		2 Screw-cutting sets	
1 ,, frame, 15-in.		8 Compasses, prismatic	
1 ,, tenon, 14-in.			
2 Screwdrivers (9-in. and 6-in.) ...			
1 Set saw, hand			
1 Spokeshave, carpenter's, 3¼-in. ...			
1 Square, carpenter's			
Screws, brass and iron, 3-lb. ...			
1 Plane, jack			
1 ,, plough			
1 ,, trying			
1 ,, smoothing			
1 ,, skew, rabbet			
	90		90

No. 4 MULE.

Near.	lbs.	Off.	lbs.
1 Bag, intrenching tool	18	1 Bag, intrenching tool	18
Saddler's outfit with holdall, 2 hides, 2 clams	59	1 Stone bottle acid, hydrochloric ...	60
Dubbin in tin	1	12 Bars soap (yellow)	
Can oil, lubricating, armourers ...	3 oz.	4 Boxes candles, filled	
(This mule carries one water bucket)		12 Boxes matches, safety ...	
		2 Funnels, tin, ¼-pt.	
		2 Pairs handcuffs, common ...	
		Balance, butchers	
		Flannelette, 88-yds.	
		72 Cartridges, Webley Pistol ...	
		2 Ropes, picketing	
		4 Lanterns, tent, folding	
	78		78

No. 5 MULE.

Near.	lbs.	Off.	lbs.
1 Bag, intrenching tool	18	1 Bag, intrenching tool	18
4 Hooks, bill		1 Pair farrier's pincers, horn cutting	
1 Reaping hook		Smith's tools :—	
Zinc, 1-lb.		1 Apron, basil	
200-lb. spring balance	18	2 Cutter's anvil, flat, 2-in. ...	
Files, handles and holders ...	7	2 Fuller's small top	
Last, shoemaker's	11	2 ,, F.S. bottom ...	
1 Cutter, wire, small pair ...		1 Punch, centre	
1 Hammer, sledge	10	3 Punches, hot (⅝-in., ½-in., and ¾-in.)	
1 ,, tinman's creasing, 12-oz.	1	1 Punch, cold	
Oil, lubricating, G.S. 7 pints ...	10	1 Smith's rule	39
(This mule carries one water bucket)		1 Saw, hack	
		6 Blades	
		1 Square	
		2 Spanners, adjustable, 11-in. and 15-in.	
		Chalk, 2-lbs.	
		Tongs :—	
		1 Forebit	
		1 Hollow bit	
		1 Plier	
		Oil, lubricating, G.S. 6-pints ...	8
		Hammers :—	
		1 Claw, 16-oz.	
		1 Rivetting, 24-oz.	11
		1 ,, 12-oz.	
		1 Smith's, hand	
		1 Setting	
	75		76

No. 6 MULE.

Bags, tool, shoemakers, filled ...	47	Vice, standing	36
Materials	43	Coal in sack	54
	90		90

No. 7 MULE.

Chest, veterinary, filled	82	Stretcher, with slings	32
Plane, table, top (on outside) ...	8	Wallet, veterinary	7
		Nails, 50-lbs.	50
	90		89

No. 8 MULE.

Bar, iron, round, ¼-in.	56	Flat iron, 1-in. by ¼-in.	14
,, ⅜-in.	14	Steel, mild hoop, 2-in.	4
,, ½-in.	6	,, 1¼-in. No. 14 ...	4
,, flat, 1½-in. by ⅜-in. ...	14	tool, 1½-in. by 1½-in. ...	28
(Cut to suitable lengths and packed up from saddle by rolled sandbags hung from arch hooks)		,, ¾-in. square	28
		2 Axes, felling (in sacking) ...	12
	90		90

No 9 MULE.

Box stationery, filled, maximum weight	70	2 Boxes guncotton	50
(Mule carries 1 water bucket) ...		Galvanized wire rope	21
	70		71

No. 10 MULE.—Spare, carrying 2 bags, intrenching tool.

No. 11 MULE.—Ditto.

No. 12 MULE.—Ditto.

No. 13 MULE.—Ditto.

No. 14 MULE.—Mess Gear.

No. 15 MULE.—Officers' Kit.

No. 16 MULE.

Near.	lbs.	Off.	lbs.
Water pack	80	Cookery gear, kettles, camp etc., 3	80
	80		80

Equipment of One Section Field Company, R.E.

No. 1 MULE.

Near.	lbs.	Off.	lbs.
1 Kajawah	16	1 Kajawah	16
6 Shovels, R.E.	31	6 Shovels, R.E.	31
1 Spade	6	1 Spade	6
6 Picks	43	6 Picks	43
	96		96

No. 2 MULE.

1 Kajawah	16	1 Kajawah	16
7 Shovels, R.E.	35	7 Shovels, R.E.	35
1 Spade	6	1 Spade	6
6 Picks	43	6 Picks	43
	100		100

No. 3 MULE.

150 Sandbags	63	150 Sandbags	63
3 Pick helves	9	2 Shovel helves ...	4
		1 Axle helve	1
		1 Pick helve	3
	72		71

No. 4 MULE.

1 Bag, intrenching tool ...	18	1 Bag, intrenching tool	18
3 Axes, felling	18	2 Axes, felling	12
2 ,, hammer headed ...	4	3 ,, hammer headed ...	6
2 ,, hand	4	2 ,, hand	4
1 Crowbar, 4-ft. 6-in.	20	4 Billhooks	8
1 Maul	13	1 Hammer, spalling	12
		1 Scoop and scraper	3
		1 Axe helve	1½
		1 Maul	2
		1 Wire cutters, large ... (prs.)	3
		5 Pliers, side-cutting small ,,	5
		2 Gloves, hedging ... ,,	1½
		1 Saw, hand	2
	77		78

No. 5 MULE.

Near.	lbs.	Off.	lbs.
1 Bag, intrenching tool ...	18	1 Bag, intrenching tool	18
3 Axes, felling	18	2 Axes, felling	12
2 ,, hammer headed ...	4	3 ,, hammer headed... ...	6
2 ,, hand	4	2 ,, hand	4
2 Billhooks	4	2 Billhooks	4
1 Hammer, miner's, boring ...	8	1 Bar, boring, 4-ft.	17
1 Maul, ...	13	1 Wire cutters, large (prs.)	3
1 ,, helve	2	5 ,, small ,,	5
1 Axe ,, ...	1½	3 Gloves, hedging ,,	1½
		1 Saw, hand	2
	72½		72½

No. 6 MULE.

	lbs.	ozs.		lbs.	ozs.
1 Bag, intrenching tool ...	18		1 Bag, intrenching tool ...	18	
2 Adzes and handles ...	9		1 Hook, reaping	3	
1 Bar, boring 2-ft. 6-in. ...	9		1 Bar, boring 2-ft. 6-in. ...	9	
1 Saw, hand	2		Soap	8	
1 Case, saw, hand	2		1 Box tape	2	
3 Tapes, tracing	5		2 Boxes dubbin	2	8
1 Pick	7		1 Board, sketching } ...	2	
3 Flags, distinguishing ...	1		1 Protractor }		
3 ,, poles ...	9		1 Tube, paper drawing ...	1	
2 Flags and pole, signalling ...	1	8	2 Lamps, folding	14	
Nails	10		2 Boxes, candles	2	
1 Hammer, mason's mash ...	4	8	1 Doz. matches		8
Spare parts, pump ...	3		6 Railway dogs	13	
			2 Hammers, claw	3	
			Spare parts, pump ...	3	
	81	0		81	0

No. 7 MULE.

	lbs	ozs.		lbs.	ozs.
1 Holdall, R.E.	7		1 Holdall, R.E.	7	
2 Hammers, claw	3		2 Sawyer's wedges	6	
2 ,, fitters	5		2 Chisels, brick	6	8
1 Bradawl		4	1 Smith's brace and 3 bits ...	3	8
1 Oilstone	2		2 Mason's trowels	1	8
1 Doz. pencils		4	2 ,, mash hammers ...	9	
2 Pincers	2		1 ,, point	1	8
2 Rules, G.S.		4	1 Compass, wing		8
2 Saws, hand 26-in. ...	4		2 Spanners, adjustable ...	7	8
1 ,, ,, rip	2	4	1 Tinman's snips		12
2 ,, folding	3	8	1 ,, iron	2	8
2 Screw drivers, 9-in. ...	2		Solder	2	
1 Saw, set (hand)		4	Resin		8
1 Square		12	Sal ammoniac		4
1 Adze and handle	4	8	Zinc		8
4 Augers, 29-in.—1-in., ¾-in., ½-in. and ¼-in.	5		Hydrochloric acid		4
			1 Smith's hard chisel ...	2	8
4 Auger handles	2		3 Cold chisels	3	
1 Steel bevel		8	2 Rivetting hammers ...	4	
1 Brace and bits (24) ...	5		1 Wrench, 9-in.	1	4
9 Firmer chisels, 2 1½-in., 2 1¼-in., 2 1-in., ½-in., ¼-in., ⅜-in.	6		1 Bar, boring 2-ft. 6-in. ...	9	
			6 Railway dogs	13	
1 Socket chisel and handle ...	1		3 Files and handles	3	
2 Files, saw		8	1 Set coloured chalks ...		4
4 Gimlets (spike, Nos. 1, 2 and 3)		8	3 Bags, line, gear	2	
1 Hammer handle		8	1 Wire breaker		4
1 Spokeshave		8	Twine, whipping		12

No. 7 MULE—*Cont.*

Near.	lbs.	ozs.	Off.	lbs.	ozs.
1 Level (spirit) rule		8	1 Clinometer		8
1 Draw knife	1		1 Level, F.S.	3	8
2 Paint brushes		8			
1 Plane, Screws, 3-lb. ...	9				
Nails, assorted	10				
1 Cross-cut saw with handles and set in case	10				
5 Measuring rods, 5-ft. ...	1				
	90	8		92	4

No. 8 MULE.

	lbs.		lbs.
1 Grindstone	60	6 Hambro lines	18
1 Farrier's bag (complete) ...	15	56 fms. 2-in. rope	45
1 66-ft. picketing line	7	Lashings (48-ft., 2-in.; 150-ft., 1½-in.; 60-ft., 1-in.)	20
	82		83

No. 9 MULE.

40 fms., 2½-in. rope	60	2 Blocks for 2½-in. rope	31
Iron wire soft	10	70 fms. 1½-in. rope	35
		Iron Wire, galvanized	1
	70		67

No. 10 MULE.

1 Box, iron	12	1 Box, iron	12
1 Exploder	30	Guncotton, 1 tin	25
220 yds. Cable	16	Auger and case	5
8 Tins, primers (10 in each) ...	8	220 yds. Cable	16
		1 Tin, Detonator No. 8 ...	1
		1 ,, No. 13 ...	1
		2 Tins, safety fuse	3
		2 ,, rubber tape	1
		2 Tubes, rubber solution ...	½
		1 Brush, 3 boxes matches ...	½
	65		65

No. 11 MULE.

1 Box, iron	12	1 Box, iron	12
8 Tins, ammonal	56	8 Tins, ammonal	56
1 Tin (25) No. 13 Detonator ...	1	1 Tin No. 8 Detonator	1
1 Tin safety fuse	1½	1 ,, Safety fuse	1½
5 Boxes matches	1		
	71½		70½

No. 12 MULE.

1 Box, iron	12	1 Box, iron	12
2 Tins, guncotton	50	2 Tins guncotton	50
4 Tubes, rubber solution ...	1	Box, testing and jointing ...	18
12 Friction tubes	2		
3 Tin safety fuse	4		
2 ,, No. 8 Detonator ...	2		
4 Guncotton bags	4		
2½ Tins, primers(25)	2		
	77		80

No. 13 MULE.

Near.	lbs.	Off.	lbs.
1 Box, ammunition	77	1 Box, ammunition	77

No. 14 MULE.

1 Pump	85	2 Suction hose	68
1 Strainer	12	1 Delivery hose	15
		Handles and spanners	15
	97		98

No. 15 MULE.

1 Packhal (water)	90	1 Packhal (water)	90

No. 16 MULE.

Officer's kit	63	4 Dixies	35
Spare blankets		1 Shovel	5
Spare pack cover		1 Felling axe	6
		1 Pick	7
		1 Axe, hammer headed	2
		1 Set butcher's implements, 1 Tin opener	8
	63		63

No. 17 MULE.

Spare Mule to carry spare Kajawahs.

STORES CARRIED BY HEADQUARTERS DIVISIONAL ENGINEERS (2 LIMBERS) FOR EACH FIELD COMPANY, R.E.

Stores.	lbs.
5 Hooks, reaping, large ...	7
16 Axe helves, 36-in.	47
4 Shovel helves, curved, 32-in....	8
1 Adze, carpenter's, handle ...	1
1 ,, head ...	3½
20 Augers, assorted :— 5 1½-in., 5 1¼-in., 1 1⅛-in., 5 ⅞-in., 4 ⅝-in.	49
7 Auger handles, 5 18-in., 2 16-in.	3
8 Awls, blades, brad, 1 ,, handles, large ...	¼
1 Bevel steel blade ...	¾
1 Brace, carpenter's, ratchet ...	5
4 Brushes, sable, writing, large, 4 ,, ,, small, 4 Bars, boring, 4-ft. ...	68
4 Crowbars	80
10 Boxes, guncotton	250
38 Chisels, brick, 11 18-in. firmer, 1 1½-in., 1 1¼-in., 1 1-in., 4 ⅞-in., 1 ¾-in., 5 ⅝-in., 1 ½-in., 5 ⅜-in., 1 ¼-in., 1 ⅛-in. hand, cold, 6 ¾-in. by 8-in. ...	45
12 Files, assorted	37
8 Hammers, mason's, mash ...	34
8 ,, miner's, boring ...	64
4 ,, spalling ...	48
1 Saw, hand, 26-in.	2
1 ,, pit, 7-in.	15
1 ,, tenon, 14-in.	1½
6 Spanners, adjustable, 15-in. ...	25
4 Mikometer, G.S. (sets) ...	36
Ratchet brace and drills ...	28
Carried forward	857½

Stores.	lbs.
Brought forward ...	857½
1 Lines, white, 1 skein ...	1
1 Vice, hand, 16-oz.	1
1 Wrench pipe, ¼-in. by 2½-in. ...	10
11 Borax	1
4 Marine glue	4
2 Pints, oil, linseed	1
½ Gallon, oil, sperm	½
7 Lbs., Paint, black, ivory ...	8
7 Lbs., lead, white	8
7 Lbs., tallow	8
4 Pints, turpentine	4
2 Tins, oil, screw, top, 2 qts. ... 1 ,, ,, 1 qt. ...	15
7 Boxes dubbin	7
1 Lb. tacks, copper, ½-in. ... 1 Jack, lifting, G.S.	31
Pump spares :—	
8 Lengths, suction hose ...	280
8 ,, delivery	120
8 ,, 2-in. diam., 15-ft. canvas hose...	64
4 Lengths 4-in. diam., 6-ft. canvas hose	24
1 Rope, picketing	6½
4 Hose, binder's	1
2 Clarkson chests to carry small gear	48
4 Tapes, measuring, linen, 100-ft.	4
1 Flat iron and stand ...	5
5 Yards, canvas, 30-in. ...	6½
	1516

JOINTED CHESSES.

By LIEUT. G. R. PERCY, M.C., R.E.

IT was decided many years ago that the only timber which combined the qualities of durability, hardness, freedom from knots, and closeness and evenness of grain, necessary in an article so heavily used as the chess, was Kauri pine.

As the finest quality of Kauri comes from New Zealand, shipping difficulties during the war caused a shortage, and as, in addition, it is estimated that approximately 30 per cent. of every shipload of Kauri received in this country is either too small in size to convert into chesses, or else is taken up by the waste pieces resulting from their cutting, it became necessary to devise methods of getting the utmost value out of such supplies as were available, in order to meet the constantly increasing demands for chesses from overseas. The most successful of these methods having proved to be the "Jointed Chess," it is thought that prominence might be given to it in the *Journal*.

The jointed chess (*Fig.* 1) is composed of either two or three narrow pieces of Kauri, glued together to make up the requisite

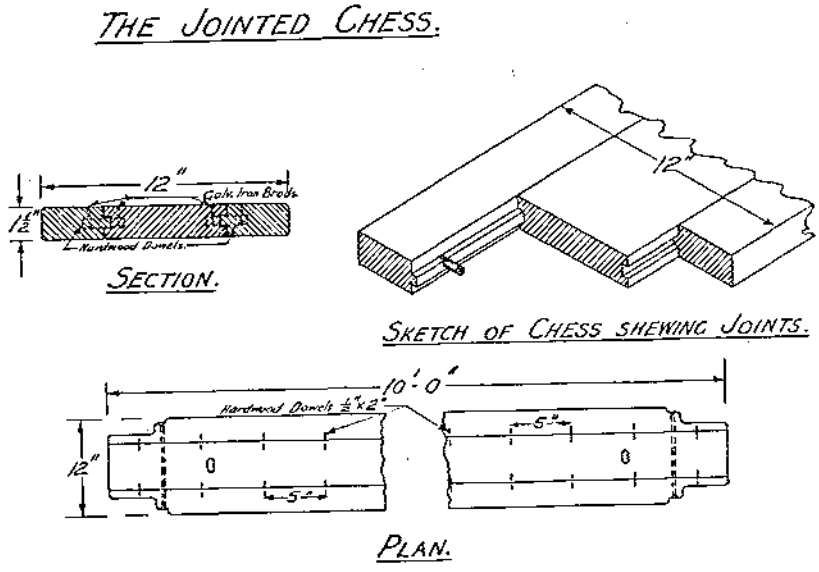


FIG. 1.

width of 12 in. In order to render them absolutely proof against a sudden shearing strain, the joints are also tongued and grooved together, with the addition of hardwood dowels inserted at intervals of 5 in. along the joints and pinned with galvanized iron brads, to minimize the likelihood of transverse warping, and to prevent any possibility of the joints opening. In addition, there are of course the usual tie rivets at the ends, as in the solid chess. By this method, a chess as strong, and very little heavier than the ordinary solid chess, is produced.

One great difficulty however, was that the ordinary bone or fish glue employed became more or less solvent when exposed for any length of time to the effects of water, a common enough occurrence under Active Service conditions. To overcome this difficulty, various experiments were tried, culminating in the adoption of "Casein waterproof glue." The following description of this glue, and of tests carried out on it at Woolwich, may be of interest to engineers generally.

The glue, which is obtained in powder form, consists of a mixture of casein and alkalies, the proportion of casein being about 10 per cent. The powder is mixed with 1½ times its own *weight* of *cold* water, and stirred until a smooth paste results. It is then ready for use, and should be applied to the surfaces of the wood (which must be quite dry), with a broad spatula or similar tool, as its caustic properties destroy the hairs of a bristle brush. After the application of the glue, the joint is cramped up in the ordinary way.

For testing purposes, four plain *butt* joints were made up in Kauri pine, as follows :—

Sample No. 1.—Joint made with *ordinary glue.*

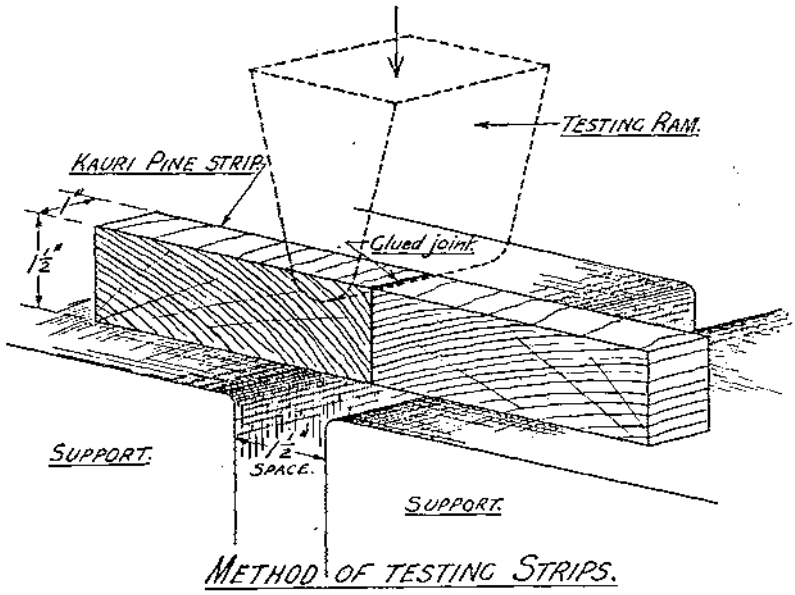
Sample No. 2.—Joint made with *casein waterproof* glue, mixed with 1½ *times* its own *weight* of water.

Sample No. 3.—Similar joint to No. 2.

Sample No. 4.—Joint made with *casein waterproof* glue mixed with an *equal weight* of water.

After sufficient time had been allowed for the setting of the glue, sample No. 2 was soaked in water at a temperature of 100° F. for 150 hours. The four samples were then cut, transversely across the joints, into strips 1 in. wide (in the direction of the grain), and 1½ in. thick, *i.e.*, the thickness of a chess.

Twenty-eight days after the joints were made, several of the strips cut from samples 2, 3, and 4 were immersed in water for 30 minutes, after which the whole of the strips were tested by placing them with the glued joint midway between two supports, which latter were 1½ in. apart, and applying a gradually increasing pressure to the upper side of the joint (*Fig.* 2). The result of these tests are tabulated in *Fig.* 3.



METHOD OF TESTING STRIPS.

FIG. 2.

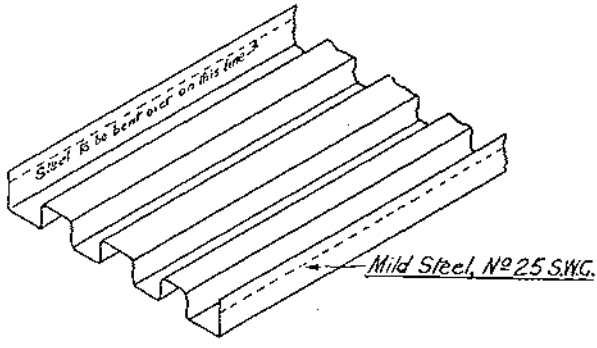
TESTS OF SAMPLE GLUE JOINTS IN KAURI PINE.
STRIPS OF 1 Sq. INS. SECTIONAL AREA.

SAMPLES.	No. of Strip	ACTUAL BREAKING STRAIN IN LBS.	BREAKING STRAIN IN LBS. PER Sq. IN.	NATURE OF FAILURE (WHETHER IN WOOD OR GLUE.)	REMARKS.	No. of Strip
	1	784	523	Glue.	Not immersed in water.	1
Sample No 1. (Joint made with ordinary Glue.)	2	761	507	Wood.	Do do.	2
	3	716	477	Glue	Do do.	3
	4	604	403	Glue	Do do.	4
		Avge. 716	477			
	1	604	403	Wood.		1
Sample No 2. Joint made with Casein Glue (1 part) Water (1½ parts) by weight	2	515	343	do.	Immersed in water at a temperature of 100°F. for 150 hours. — No further immersion.	2
	3	582	388	do.	Immersed again before testing for 30 minutes.	3
	4	437	291	do.	Do do.	4
	5	515	343	do.	Do do.	5
	6	604	403	do.	No further immersion.	6
	7	618	412	do.	Do do.	7
		Avge. 554	369			
	1	1164	776	½ Wood, ½ Glue.	Not immersed in water.	1
Sample No 3. Joint made with Casein Glue, mixed as in No 2.	2	1187	791	Wood.	Do do.	2
	3	1097	731	do.	Immersed before testing for 30 minutes.	3
	4	985	657	do.	Do do. do.	4
	5	963	642	do.	Do do. do.	5
	6	1142	761	do.	Not immersed in water.	6
	7	1120	747	½ Wood, ½ Glue.	Do do.	7
		Avge 1094	729			
	1	403	269	Wood.	Not immersed in water.	1
Sample No 4. Joint made with Casein Glue, - 1 part, Water - 1 part. (by weight)	2	492	328	½ Wood, ½ Glue.	Do do.	2
	3	627	418	Wood.	Immersed before testing, for 30 minutes.	3
	4	492	328	Glue.	Do do. do.	4
	5	649	433	Wood.	Do do. do.	5
	6	515	343	Glue.	Not immersed in water.	6
	7	403	269	Glue.	Do do.	7
		Avge. 512	341			

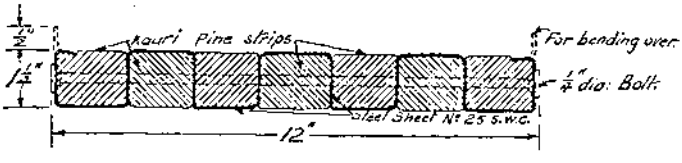
NOTE:- Strips 3, 4 & 5, from Samples 2, 3 & 4, were 2 inches wide when immersed for the 30 minutes, but before testing, 1 inch was cut off from each side, thus bringing their width down to 1 inch (the same as all the other Strips.) This was done to minimise the effect of the extra percolation of the water on the end grain.

FIG. 3.

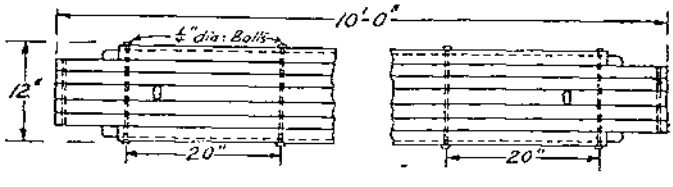
THE CORRUGATED CHESS.



CORRUGATED STEEL SHEET.



SECTION THRO' CHESS.



PLAN.

FIG. 4.

It will be seen that the soaking in hot water of sample No. 2 had no apparent effect on the casein glue, as in the case of every strip from this sample, failure occurred in the *solid wood* adjoining the joint, the glue successfully withstanding the strain. The 30-minutes immersion in water just prior to testing, had likewise, no effect on the glue. In sample No. 3, no failures occurred entirely in the glue, but two strips failed—half in the glue, and half in the adjoining wood. The remaining strips from this sample failed entirely in the solid wood. The mixing of the casein glue with a lesser proportion of water than advocated above, was not a success in sample No. 4. It may be noted, however, that the glue in the strips from this sample which were immersed before testing, appears to have been strengthened, rather than otherwise, by so doing. The tests of the ordinary glue in sample No. 1 resulted in three of the four failures occurring in the glue itself.

In conclusion, it may be stated that the jointed chess, when put together with casein glue, is undoubtedly a very valuable means of supplementing the supply of chesses, and of using to the best advantage the smaller sizes of Kauri pine.

Finally, a brief reference must be made to another war substitute—the "Corrugated chess" (*Fig.* 4) which utilizes even smaller strips of Kauri than the jointed chess. The corrugated chess is a composition of steel and wood. A sheet of mild steel, No. 25 S.W.G. is rolled to the corrugated form shown in *Fig.* 4, its finished sizes being the same as those of an ordinary chess, except that it is 1¼ in. instead of 1½ in. thick, in order to keep down the weight as much as possible. Strips of Kauri pine of the same length as the steel are then inserted into the corrugations, and the whole stiffened by bolts of ¼-in. diameter, spaced 20 in. apart. Several disadvantages, however, which up to the present have prevented its general adoption, are attached to this form of chess. Chief among these are its somewhat heavy cost (special rolling mills are necessary for the steel), the difficulty of fitting the steel down to the outside strips of Kauri, and the difficulty of making the bolt holes in steel and wood exactly co-incident. It is also from 8 to 10 lbs heavier than the ordinary chess.

FUTURE TACTICS.

By BRIG.-GENERAL A. L. SCHREIBER, C.B., C.M.G., D.S.O., A.D.C.

IT may seem somewhat premature so soon to consider what the future conditions of modern fighting will be, but any ideas, however crude, on the subject may be of some utility. It must be understood that the following is put forward to give an indication of the lines on which thought and discussion are now needed, rather than as an attempt to formulate a conclusion.

After our great successful advance in France the trend of war training has turned naturally almost entirely, as it was before the War, to the attack; and there is little doubt that we have arrived at the right conclusions (copied from the Germans) of pressing home the attack wherever "soft spots" in the enemy's defence are found.

The training of troops must of necessity be for the attack but the danger is that as before the War, the principles of defence may be neglected, and this in spite of our having had to act for four years on the defensive. There is no doubt that we suffered greatly, and might have suffered more, from the fact that the necessary conditions of defence had been ignored.

I remember well how immediately after our arrival near Mons, we had to prepare at once to act on the defensive and took up a position, in a half-formulated system, of *points d'appuis* or small defended localities. These were so weakly held, and were so far apart for such an enclosed country, that there is little doubt they would have been over-run in a very short time; fortunately we had to retreat before being attacked in that position.

The principles of defence had only been studied by few; practically every thought in training had been devoted to the attack. We must beware of this again occurring.

Is it not possible that after the preliminary fighting two opposing forces may not again remain for a long time practically equal in *morale*, numbers, and armament till such time as some deciding factor gives sufficient preponderance to one side or the other, in fact may not the conditions of this War be again repeated? If there is the chance, the principles of defence require very earnest study, and a very difficult problem is presented.

In any case with large armies in order to take the offensive with the largest possible strength in the required portion in the war area, the best possible system of defence must be established to hold the other parts with minimum forces. It cannot be too strongly emphasized that it is the side which is able to build up the strongest, the best trained, and the most mobile reserve which is

going to win, and the stronger and the better the defensive system, the greater the facilities for carrying this out.

For three years at least we played a game of bluff—so did the French—so did the Bosch. Both sides held far greater fronts than by all the rules of war were conceivedly practicable. The chief axiom for the offensive—defensive, which all this time both sides were attempting, was that there should be a general reserve equal at least to the total number of troops in the defensive zone. Ours was practically *nil*, the French and the Bosch were more or less in the same state till the latter had accumulated troops from Russia in March, 1918. After that the stable defences on the whole ceased, but even then whenever the fury of fighting had died down for a time in any part, the old conditions began to reassert themselves.

At the present time it is hard to concentrate the imagination on what future conditions may be, as certain important factors of change have developed which will be mentioned later. One has a feeling of groping along well-known and well-remembered streets in a fog.

If fighting began to-morrow and we had to act on the defensive, what system should we try to establish?

First let us study the evolution of defence in this War.

As stated above we started with a half-formed system of *points d'appuis*. We then had open warfare, first in retreat and then in advance, till we were stopped on the Aisne. What happened then? We were stopped in our attack and had to dig in—either on the line we had reached, or behind it in places where our infantry was swept off the crest of the ridge by enemy's shrapnel. We dug in, gradually joining up the trenches till they formed a continuous line. The reasons for this were:—

First—every rifle possible was required in the front line to prevent the enemy crossing what soon became the "No Man's Land" 100 yards in width.

Secondly—the Bosch penetrated the intervals, and, incidentally, as a minor item, snipers crept through and were a nuisance, and

Thirdly—to allow of lateral communication.

We dug in, we deepened the trenches, we improved them, we increased the traverses where they were enfiladed, we put what wire we could in front, we dug support trenches and connected them to the front, and we dug holes in every available nook and corner we could find for the men to rest in. We had a desperate time, and then handed over to the French. That defensive line remained, I believe in exactly the same place for over three years, till the Bosches carried out their big "push" in 1918.

This is what happened on the Aisne and subsequently on the whole original British front from north of Ypres to Quinchy on the La Bassé Canal.

All our defences were begun on the field of battle. We always started attacking on what by all the rules of war, were ridiculously

wide fronts. I don't say for a moment we were wrong—no doubt desperate conditions necessitated desperate measures. I only speak of the result, We attacked, we dug in where we could, and there we remained, if we were able.

If driven back we kept digging in, till we finally reached the low water mark, and that became the permanent line. The Bosch came up as close as he could and there he dug in. In places these lines remained the same for years.

I remember so well a senior officer of a New Army Division that had just come out and into a quiet part of the line, declaiming against the scandalous system on which our front line trenches had been laid out! Ye gods and small fishes! If he had only known the conditions under which those trenches had been made!

To resume; always the same ending, a continuous line—even though it entailed in the mud of Flanders the excessive labour of nightly connecting up "grouse butts" by breastworks.

Then gradually the whole defence systems developed, support reserve and communication trenches and all that.

There was one variation—"strong points" instead of being in front, were placed behind the front line, perhaps in front of support trenches if they existed, or perhaps behind; small, it is true but there they were, *points d'appuis* to hold out and retain lodgments till the counter-attack could be made. These were of great use at Ypres, when the Prussian Guard attacked, and in Givenchy Village and in the Quinchy brickfields in January, 1915.

The establishment of strong points when attacking, became later the order of the day; but as the defences were consolidated they became subsidiary only, and always the continuous front line was established. The reasons I have given above. Defended localities were established intermittently in reserve and on rear defensive systems throughout the whole period.

The *morale*, and strength and armament of both sides were normally equal.

The continuous line system lasted with us up to March 21st, 1918, almost without variation, except where there was very severe fighting and the occupation of shell-holes became the only forward means of defence, and except on a small front south of Cambrai where there was a system of small strong points in front, through which the enemy penetrated with comparative ease in the Cambrai counter-offensive of November 30th, 1917.

The French had more or less the same system except as a rule they did not occupy their front line strongly and had forward "elements" with their main line of resistance a short distance behind. With the French however, the normal conditions were somewhat different, except when they were engaged in active operations, they lived in comparatively peaceful conditions without the continuous "straafing" and "bickering" which was almost universal on the British Front.

Recently a new system with us has been evolved, with an outpost or observation system in front and the main line of resistance well in rear. It is believed the same system has been formulated by the French. Incidentally the real line of observation, chiefly for the artillery, must be in rear of the main infantry line of resistance and the actual siting of the latter with its outpost system for local observation in front is a minor consideration compared with the former.

The point of chief importance is that the observation positions should be retained, so that if any portions of the front defences are lost, the operations will not then have to be continued by fighting blindly in ignorance of the enemy's movements.

The chief factors in such alterations to systems of defence are believed to be :—

(*a*). Increased proportion of machine guns.
(*b*). Increased amount of artillery.
(*c*). Tanks.

As regards (*a*) there is no doubt that the immense increase of machine guns has removed one of the chief reasons for the holding of the continuous front line in strength, *i.e.*, the number of rifles required. In addition the large number of machine guns now give far greater facilities, for what may be termed the passive defence in depth.

As regards (*b*) the enormous increase of heavy artillery in the field and the use of heavy trench mortars have rendered the practical blotting out of trenches an easy matter—with directly observed fire.

As regards (*c*) the employment of tanks has made the offensive possible against well-constructed defences, protected by many machine guns and heavy belts of wire which even an enormous preponderence of artillery was unable to counterbalance. It is thought however that tanks will not affect materially the actual systems of defence to be established.

The first two items, machine guns and heavy artillery, appear the chief factors in inspiring the new system. The first making this possible and the latter rendering it necessary. The question which presents itself is how long will such a system last? It will doubtless be effective in the initial stages of a force deliberately acting on the defensive.

What is going to happen if and when the outpost system forms the enemy's first objective and he successfully occupies it, approaches the main position, is not able to capture it, digs in and establishes himself as close as possible? Are not we going to have the old situation over again—however wrong we may say this system may be in theory and practice? This is one of the main problems that has to be considered and makes further study of defence of vital importance.

ROADS.

By LIEUT.-COL. A. G. T. CUSINS, R.E.

IN view of the vast demands on transportation generally which an army of modern times is enabled to make by reason of the capabilities of mechanical transport, and of the wear and tear of roads involved, it may be of interest to record the methods adopted on the Serres Road running from Salonika to the river Struma.

It may be taken for granted that transport will be expected to work up to the limit of its capabilities, and roads must be constructed accordingly. Before the war very little was known in the service, and experience was limited out of it, on the subject of the action of heavy rubber-tyred vehicles in the disintegration of road surface. To this subject these notes are devoted.

The Serres Road, running north-east from Salonika, was before the war doubtless considered a good road, that is to say it was fairly well located, but like all roads in hilly country somewhat tortuous, and sufficiently metalled to stand the light traffic of the country and to present to the casual observer the appearance of solidity. So it remained until the commencement of the winter of 1916–17, but steadily deteriorating all the time and giving increasing trouble, especially across the Langaza Plain, and on the foothills beyond, from about the 13th kilometer post (General's Corner) where it passed through the old "Birdcage" Lines, the Torres Vedras of the campaign, up to about the 27th kilo. post. This portion was on a treacherous alluvial clay, comparable in places to anything Flanders can offer, and at the best a highly viscous fluid. No clay, however apparently hard, can ever be treated as a solid, as I think Robert Stevenson remarked; if it cannot move in any other direction, it will move upwards. For the rest up to the 43rd kilo. post, which was the limit of my area, the bottom was sound and ranged from gravel to actual cutting in quartz. So much for the bottom.

Metalling was fairly plentiful and accessible. There were two good quarries of hard limestone, practically unlaminated and non-absorbent, about one kilo. from the road near Lembet at about the 6th kilo.; a very good quarry of hard but somewhat brittle limestone very non-absorbent and resembling a hard marble at Deve Kran (Gibraltar Hill), three and a-half kilos. from the road at about the

18th kilo.; a patchy and not at all easily worked quarry at kilo. 34, a somewhat similar quarry at kilo. 37, giving a hard but somewhat laminated limestone; and a small quarry of good granite at kilo. 41. These last three quarries were fairly close to the road. There was no difficulty about soling stone, which was plentiful.

The main difficulty in connection with stone supply was that the transport requirements were hard to drive home to the Transport Staff, and it took time and bitter experience to establish the axiom that for any road to be maintained under heavy transport there is a definite proportion of that transport which must be devoted to maintenance.

I do not write this in any carping spirit. The long continued dry weather of 1916, and the consequently fair condition in which the road remained on the whole, produced a sense of false security and was a very bad preparation for the state of affairs which followed immediately on the setting in of the winter rains. The gloomy prophet met with about the success of his local predecessor, Cassandra, and had the same gloomy satisfaction.

Previous to this however, the first four kilos. of the road, having not only to serve one complete British Corps at the front but also to deal with heavy French and British traffic from the docks to the large base camps and dumps, had given ample opportunity for observation and experience. Part of this portion also had an unsound bottom, being in places on clay, as near the Allied Cemetery, a portion of it on a made embankment, and in one place, a very narrow strip into the bargain, actually running through an old Turkish cemetery over badly filled graves. Over this portion of the road traffic was counted, and amounted to 30 vehicles per minute for three hours in the forenoon, a large proportion consisting of heavy mechanical transport.

Observations.

It was on this that observations were taken, and from those observations certain theories were evolved and checked. It must be borne in mind that the road was entirely water-bound, as no tar was to be had, and that no other method of surface treatment was possible except the application of oil to keep down dust in the vicinity of hospitals. But this did not materially affect the construction. It was observed:—

(1). That the wear of metal was very much less on the surface of the road than just below it. This is to be expected. The action of a heavy rubber-tyred vehicle is not to abrade the surface but to cause local compression and consequent grinding together of the upper three or four inches of the metal.

(2). That where the surface metal was small, *i.e.* 2 in. and under, the movement and flow of the metal was more marked, key was sooner lost, and mud and dust formed more rapidly in consequence, than when the metal was large, *i.e.* $3\frac{1}{2}$ to $4\frac{1}{2}$ in. Moreover, that the smaller metal favoured the production of potholes and the formation of regular corrugation and was more easily picked out by fast cars.

(3). That potholes and corrugation both appeared much sooner on a clay formation, even when apparently hard and dry, than on gravel or other sound formation.

(4). That a more or less complete break up of the metalling followed close upon the appearance of anything like numerous potholes or of regular corrugation, and that the metalling so broken up was almost invariably rounded at the edges and generally deficient in key.

(5). That, as is generally known, more damage was caused in wet weather than in dry, and most of all on the break up of frost, but that in any case the damage was considerably less in the case of the large metal.

(6). That there is very little rocking of individual surface stones under heavy rubber-tyred traffic.

(7). That too much camber causes drivers to keep almost entirely in the middle of the road. Lorry convoys always tried to "track," *i.e.* to follow the same wheelmarks. The effect of this is if anything more marked in the middle of the road than towards one side, as the tracking is more regular.

(8). That drainage of the formation is as necessary as that of road surface, and that the surface of the formation requires protection against indentation. This is particularly the case where clay occurs, as irregularities retain water and cause local softening.

(9). That mechanical stone crushers, when used on any but very hard homogeneous stones quite devoid of lamination, produce flake-shaped metal unsuitable for surfacing. Moreover, that the stone in addition to being broken is structurally crippled and rendered prone to subsequent disintegration.

Much of the above may be ancient history, but it constituted the data on which what proved in the result a successful system was built.

From (3), (4), (5), and (8) we see at once that stability is required and that it must begin from the bottom upwards. The first thing to do is to produce a well-drained formation, and on that formation to distribute the weight as widely, evenly, and steadily as possible. In the worst cases therefore, the existing road surface itself, scarified and rolled if necessary to produce a good drainage surface, was used as the formation, and on this a soling of block stone as cubical in shape and as even in size as possible, was hand-packed, always using

the largest surface downwards. Where it was exceptionally desirable to protect the drainage surface, a blanketing of 1 to 2 in. of small quarry rubbish was used for bedding the soling. The heaviest soling of this type put in was 10 in. deep in one thickness. It was found to be best to employ the local mason, who is skilled in dry stone walling and of superior intelligence to the ordinary "Idey Bross" or labourer. This soling was contained laterally by a continuous kerb of long stones placed on end in a narrow trench, the tops of the stones coming to the level of the finished road. This system is of course only possible where there is a plentiful supply of stone over 2 ft. in length. Still longer stones may be used at intervals to mark the edge of the metalled portion. The kerb trench itself must be drained to the side ditches. Before metalling, but after inspection, the soling was hand-spalled up to rough level, lightly blanketed with small stone rubbish and rolled to consolidate it. Hand-broken metal was then laid and rolled in two thicknesses, the first being rolled to consolidation, the second to surface. The finished thickness of metal after rolling was about 8in.

A good many objections were raised to the use of large-sized metal:—It would not roll; it left too many voids; stones would rock and work loose; the final result could not be more than a cobbled surface; and so on. Experience showed that it could be rolled even as large as 5 in. If of a good solid shape and not flaky it filled in well in the rolling, and if voids exist I do not know that they matter much. They certainly aid in keeping the surface clean. Owing to the length of side of each stone, its moment of resistance to turning is considerable and rocking is prevented. Consolidation is good, kneading is absent, and corrugation does not occur. The importance of this last is incalculable in terms of upkeep of both road and vehicles. The surface tended to become slightly cobbled in places, particularly on steep hills, but lorries rather liked it as it reduced the chance of skidding, and fast cars did not complain of it. Small metal, moreover, is pulled out by fast car traffic. The sole of a rubber driving tyre is strained forward where it is in contact with the road, and is released backwards as it leaves it, rolling out small stones and actually throwing them back as from a catapult. On a sharp curve this action takes place sideways as well.

In one place, on a steep hill where during the worst period of the road's history its condition very nearly resulted in complete breakdown, the worst of the mud was dug out and large stone, the smallest 4 to 6 in., was just shot in to find its own bed. This consolidated so well under traffic—there were then no rollers—that it was left until almost the last for permanent repair, and though rough and untidy to look at never developed either potholes or corrugation. Water was only used with the surface binding material which was

not applied until the surface itself had begun to consolidate dry. The binding was then watered to a slurry whilst rolling was in progress. The binding material itself should vary with the nature of the fracture of the stone. River gravel should only be used with the rougher kinds of crystalline stone, such as granite, while with stones having a smooth fracture a more cohesive binding such as decomposed granite or bed gravel is preferable. A little thought will make this obvious; a hill wind shows it at once. Unsuitable binding may be blown right out.

DRAINAGE.

There are three main rules for drainage :—

(1). Start with your road as dry as possible.

(2). Keep it so.

(3). Get the water from the road as far away as possible.

Side ditches should be not less than 6 ft. from the edge of the metalling and their bottoms not less than 1 ft. below formation. They should be V shaped, and not more than 1 ft. wide at the bottom. The saving of labour in clearing silt when a V-shaped ditch is adopted is surprising.

On sloping ground, the road must be located if possible so that the cross section gives a fall of natural clearance, *i.e.*, that no silt accumulates in culverts or in the drains leading away from the road. Considerable trouble was experienced from the fact that the existing road, where crossing a plain at the foot of the hills, was at such a level that the cross section was insufficiently inclined to carry away silt.

Springs and oozing seepage are serious difficulties. They can be dealt with however by lowering the bottoms of side ditches, and tapping the formation by means of perforated pipes driven with a pipe pusher.

As regards the road surface, it was found best to allow water a clear run from the crown of the road to the side ditches. Banking the sides "to support the road," nearly always results in supporting two continuous quagmires to destroy it. The muddy ruts formed by vehicles passing each other constitute a series of parallel dams and prevent drainage. The ruts, moreover, are always worst at the water-cuts through the bank. Any ruts which form at the edge of the road should be flattened out at once, and especially those made by occasional wanderings off the metalled portion. This is often neglected, as the intimate connection between tidiness and efficiency is not always realized.

Camber must be kept to a minimum to prevent "tracking." Especially is this the case with inferior limestones which produce a mud on which one can hardly walk safely. I remember a lorry

on the Monastir Road, which was level but rather overcambered, skidding slowly round as it tried to regain the middle and finally sliding right off the road backwards. The driver's only comment was "I now know why this —— country is called Greece." Camber must not be allowed to degenerate into barrel, but the road should if possible consist of two slopes of not more than 1 in 30. More than this leads at once to tracking, and the deterioration due to this and to lorries continuously making a steady amount of leeway is apt to be serious. The effect of barreling is to accentuate the evil at the edges of the road, the worst possible place. Unfortunately many men with road experience seem to have been brought up on barrel as opposed to even camber. The rounding off of the crown of the road need not be more than about 6 ft. wide.

Throwing open New Road.

The first month of a new road's life is the most critical. Nothing can consolidate roads so well as traffic, and on the other hand nothing can do it more harm. The main thing is to try and prevent "tracking" and to distribute the traffic as much as possible. This was affected by "groining" with trestles, sandbags, etc., the groins being moved along the road at intervals, the effect being to cause traffic to undulate from side to side and distribute its consolidating effect to the utmost. It is greatly to the credit of the Motor Transport that they tolerated this imposition without a murmur.

Transport of Stone, Water, etc.

Owing to the strictly limited amount of transport available every effort was made to utilize it to the utmost. Having since observed the handling of stone in France I am of opinion that the motor vehicle used, a design borrowed from the French, was out and away the best. It was made by building a W-shaped iron body on a 3-ton lorry chassis. Each side was hinged at the top, and the two hoppers, each holding 1 cubic metre or 1½ tons, could be emptied in about half a minute. The space between the hoppers is useful for the lorry gear.

At the quarries, stone was loaded from staithes and platforms downwards, not upwards as I have seen in some other areas, and the loading took rather under 2 minutes. Assuming that lorries were running one hour per trip, this means that they were standing still, or doing nothing but block traffic, for only about 4 per cent. of their time.

Four-mule double limbers, the vehicles lined with sheet iron, carry one ton. The utmost that could be got out of one double limber was 14 kilo. tons per diem, 28 kilos. in all, and this only by rapid loading from platforms, and by resting the men and animals well at

mid-day. If possible, a space was kraaled near water and trees, and the mules were turned loose, stripped of harness and allowed to graze and roll. More work than the above tended to reduce conditions.

Men should have shelter, and cooked meals be sent to them.

Native carts, ox and pony, are best kept to soling stone, the former on account of their construction, and both because less is lost on the way. In any case, contract drawn stone must be measured at site of delivery. Use was also made of empty supply lorries; these are slow to load, but times was saved by backing them to platforms and loading the stone in sandbags. On the average a sandbag does about two trips. Decauville railway, 60 cm., was also employed in places, but rolling stock was very scarce and got badly knocked about. The Macedonian loves joy-riding and has no discretion.

Brass bearings are useless. A good makeshift roller bearing was improvised by driving short lengths of 3-in. pipe through hard wood blocks, with two cover plates, the inner one pierced for the axle. The space between the axle and the pipe was packed with short rollers, cut from ordinary mild steel of suitable thickness, which lasted far better than might be expected.

A few motor water carts were available. These were used for carrying water, ordinary horse water carts for sprinkling. Distance from water was at times considerable.

LABOUR.

The native of modern Macedonia is the survival of the idlest. The slightest industry on that soil with that climate produces wealth, and the national pastime of throat-cutting applies the corrective. But given security, cupidity triumphs. The ideal of course is day work, or pay for working only while you are carefully watched. But piece work achieved the miraculous. The first week of it at rates calculated at half-day work bade fair to ruin the British Empire. But when rates were more scientifically fixed it was found advisable to reduce everything to this system. Men and boys were employed on all but breaking metal, which was done by women and girls.

Every process, ditching, forming, soling, spreading, spalling, etc., was treated separately, and the hands were paid individually or in small gangs as suited best. Details must vary accordingly to circumstances, but I would strongly advise R.E. officers, in the near East at all events, to adopt this method when working against time.

ROLLING.

Rolling went on night and day. New work by day, recently completed work open to traffic by night. It does much good to continue

rolling new work while still green, as it gets rid of incipient rutting and the uneveness inseparable from having to make the road one side at a time. The roller drivers worked in three reliefs.

The 43 kilos. of road so rebuilt were commenced in February, 1917, and completed in June, 1917. A letter dated November, 1918, from an officer well qualified to speak, tells me that "the Serres Road has been used right through. The British Salonika Force has never been able to get away from it. It now lasts without any repairs." As it was for many months the sole line of communication for one British Corps, it seems to have met requirements.

CORRESPONDENCE.

FUTURE OF PERMANENT FORTIFICATION.

TO THE EDITOR OF THE *R.E. Journal.*

SIR,

Lieut.-Colonel Clayton has raised a large question in the heading of his article. It is this, except for coast defence does Permanent Fortification exist? Lieut.-Colonel Clayton's article was written to raise discussion, and I venture to start the discussion with this question.

2. After my experience in the present war I am of opinion that permanent fortification as we understood it formerly is as dead as the Pharoahs. I do not mean its principles but its methods. The principles upon which men start out to kill each other are much as they were, but our methods of application change and must continue to do so.

3. The office of fortification is to first facilitate the destruction of the enemy and second to protect the troops from destruction.

To facilitate the destruction of the enemy mobility is essential and permanent fortifications are immobile. During this war it has been often found that even field defences, carefully prepared and sited to meet possible eventualities, were useless when the time came, as the enemy did not come the way he was expected. Permanent shelters and stores, *et hoc genus omne* must follow the distribution of the troops, and if that is not permanent it is waste of time and money to make the shelters, etc., so either.

4. Generally speaking I think the defences of a Territorial area should before war be dealt with under the following headings:—

(*a*). *Communications.*—Rail and road to be strategic in arrangement, and also be arranged with commercial objects. No modern army can operate without railways and good roads.

(*b*). *Distribution of Forces.*—To meet various situations. These with the defensive works should be on paper. As regards works—Alternative schemes should be designed and planned, and these should include works of defence gun positions, roads, light rail and extension of heavy rail, shelters, dumps, etc., etc. Stores should be accumulated at suitable points so that the army may put the selected scheme in operation at short notice.

5. Engineer officers must remember that all military action will commence with open fighting as a general rule, and that the decisive battle in the end will be an open one. Fortifications will only be used for special purposes, *e.g.*, to enable a small force necessarily immobile, to secure some definite point, or to enable an army to gather strength to assume the offensive in the open, as was the case with the Allies in the war. Even in the former case it is most likely that field works are the best form to use.

6. As regards Anti-Aircraft Defences it seems likely that in the future it will be largely if not entirely in the air. Fixed defences may be used, but even they will not be of a definitely permanent nature.

They will have to be fairly mobile and the construction of bomb-proof shelters and stores in time of peace is, I believe, a mistake as is likely to be the defence to positions which when the time comes may not be the most suitable.

Fixed defences, hutments and stores have been constructed during this war to meet a definite set of circumstances, but that is no guarantee that they will be suitable the next time.

7. I do not touch on coast defence, but even here the mobility of the larger natures of ordnance has increased so much lately that it seems very doubtful if our old ideas of a coast battery are not quite out of date, except in very special cases, such as in batteries sited actually in the sea.

Yours faithfully,

G. WALKER, *Brigadier-General.*

SIR,

1. With reference to the article on "The Future of Permanent Fortification" published in the February issue of the *R.E Journal*, it is suggested that a discussion on this subject might be based on consideration of the principal changes and developments in the methods of war recently introduced. At the same time it should be remembered that the principles of war as generally accepted in 1914 remain unchanged.

2. It would appear possible to group these changes, as far as *Land* fortification is concerned, under three general headings:—

(1). *Influence of Aviation*:—
  (*a*) Extended powers of reconnaissance;
  (*b*) Offensive action.

(2). *Development of Armaments*:—
  (*a*) Increased power of artillery;
  (*b*) Tanks.

(3). *Changes in the Time Factor*:—
  (*a*) Rapidity of action of aircraft;
  (*b*) Improved communications.

3. The question for the military engineer now resolves itself into "How are these new factors in the offensive to be met?"

(1). *Influence of Aviation*:

(*a*). Extended powers of reconnaissance—necessity for greater concealment. Camouflage to be studied in connection with aerial observation and photography; dummy works; many works hitherto constructed on the surface will be driven underground.

(*b*). Offensive action—consequent necessity for protection of
  (i.). Aviation units and grounds.
  (ii.). Centres of communication of all natures and delicate points in these, such as bridges.
  (iii.). Headquarters.
  (iv.). Depôts and factories of munitions and food.
  (v.). Accommodation for troops.
  (vi.). Centres of population, etc. (in order of importance).

The protection necessary will involve A.A. gun positions, range-finding and searchlight stations, in addition to the forms of material shelter which may be necessary in each case.

(2). *Development of Armaments* :—

(*a*). Increased power of artillery—a large question, which is possibly better considered under subheads :—

(i.). Increase in range—any permanent works must be further from the object they are designed to cover than has hitherto been the case—greater depth of all positions.

(ii.). Increase in shell power—more material cover required—deep dugouts—reinforced concrete.

[Before condemning the masses of steel and concrete of the forts of Liege and Namur, it would appear of interest to consider the effect of the large concrete works of Verdun, the capture and recapture of which were undoubtedly expensive undertakings for the assailants in each case.]

(iii.). Increased accuracy and development of the means of range finding, notably by sound ranging, necessitating adequate cover and alternative positions for gun positions hitherto termed "concealed"; small works presenting a difficult target.

(iv.). Increase in volume of shell-fire—to be considered with (ii.) as regards destructive effect; limitation of movement. The development of short range weapons for the destruction of obstacles will also considerably affect the design of the latter—sunken wire.

(*b*). Tanks will necessitate "anti-tank" defences of all sorts—ditches, traps, mines, and gun positions.

(3). *Changes in the Time Factor* :—

(*a*). Rapidity with which an attack by aircraft may be made after a declaration of war will necessitate considerable preparations being made in peacetime to meet such attacks.

(*b*). Perfected means of rail and road communication will shorten the period between the declaration of war and the time at which the enemy will be prepared to strike. The time therefore available for the organization of schemes of defence will be shorter than in the past, and work of a permanent nature may have to be undertaken on a larger scale than has hitherto been the case to guard against surprise.

4. The case of the offensive having been considered, it is necessary to ask the parallel question "How are future fortifications to be designed so as to obtain the maximum efficiency from the new powers of the defensive—the highly-organized artillery, machine guns, and communications at our disposal?"

5. The above outline is put forward as providing headings under which the large subject of the "Future of Permanent Fortification" might be discussed from the point of view of the military engineer.

The greater problems of expediency and the general nature of fortification are General Staff questions, which no doubt in the future will be severely limited by political and economic considerations.

It may, however, be permitted to draw the general conclusion that protection against aircraft, considerably more powerful than that we have hitherto had to contend with, will be the first problem to solve in connection with the reorganization of our Permanent Defences.

Yours faithfully,

K. J. MARTIN, *Major*.

REVIEW.

WATSON PASHA.

A Record of the Life-Work of Sir Charles Moore Watson, K.C.M.G., C.B., M.A., Colonel in the Royal Engineers. By Stanley Lane-Poole, Litt. D., assisted by Walter W. Skeat. London, John Murray, 1919.

Watson was very good company—full of information—full of humour—full of kindness. To say that he was "all things to all men" would be misleading, because that phrase generally implies a percentage of humbug, and Watson was not at all a humbug. Behind his pleasant talk, delivered in a delicate brogue, beat a heart as sound and true as in the most phlegmatic Englishman or the dourest Scot. All his friends, the few survivors of his early days, the many acquaintances of his "retired" but most active life—all will welcome this book. They will find probably some items new to them, and, throughout, will revive the recollections of a delightful personality. But, to those also who never knew the man, the book will be interesting. The Great War makes, it is true, all previous wars seem so small, and the changes in the world now under discussion seem so to dwarf all past history that the careers of even the greatest soldiers and statesmen of the past seem to shrink in importance as matter of study. But such feelings are illusions. Real history is always valuable. Biography is its most effective form, and the life of Watson is worth reading as the record of fifty years work—thirty-six on the active list as an exceptionally able and conscientious Royal Engineer Officer, and fourteen more engaged in public work of various kinds.

Early Life and Service (1844—1874).—Watson's family settled in Ireland early in the 18th Century. They were leading business men in Dublin, and several were distinguished graduates of Trinity College, so that Watson inherited a combined tradition of business and scholarship, giving him methodical habits and a wide outlook, two excellent qualities usually more wanted than found in those who follow the trade of war. He was born on July 10th, 1844, and educated at home, except for one year at a Dublin day school, and two years attending lectures at Trinity, under a good tutor preparing him for Woolwich. In July, 1863, he passed in first. Till joining at Woolwich he had never left home. He passed out also first, with prizes and distinctions. In 1866, in February, he took his B.A. degree at Trinity; his Commission was dated April 17th, and on May 17th, he joined as an officer at Chatham. Professionally he was, of course, a model young officer. His deficiencies were mainly in dancing and small talk. He dissociated himself from the Corps proverb by expressing his astonishment at "the mania for getting married." He matriculated in yachting under the superintendence of a brother officer (now Sir Elliott Wood), who describes an incident off the Nore deserving the careful attention of all who propose either to learn or to teach the sailing of boats. In 1868 he left Chatham. For six years he was employed on Home Service; 3 years on fortifications in Ireland, 2½ years at Woolwich and Sheerness on the experimental work of Submarine Mining.

In 1874 he was thirty years of age. His home life had been perfect. His education and early years of service satisfactory and promising, but he had still to come under the influences of the two men who most moulded his character, Sir Lintorn Simmons,

one of the ablest military administrators of his time, and General Gordon, one of the greatest genius's of his own and of a good many other times as well. From Simmons he was to learn what wonders can be worked by tact and firmness, by (in the words of Lane-Poole) "level-headed governance"; from Gordon, to "follow the gleam" of truth and duty wherever leading, to do with all his might the work in hand, whether congenial or uncongenial, recognized or unrecognized, and so to reach the best happiness life can give. Simmons was "just the right antidote to Gordon's enthusiastic impetuosity." Gordon was a hero of heroes, but difficult to serve and still more difficult as a subordinate. Simmons was a practical man. Watson had the great advantage of intimacy with both men.

With Gordon in the Soudan (1874–75).—In 1874 General Gordon was Governor (under the Khedive of Egypt) of the equatorial provinces of the Egyptian Soudan. He wanted two R.E. officers for survey work—Watson was chosen as one of them. He left England on July 29th, and, travelling, viâ Suakim, Berber and Khartoum, reached Gordon at Gondokoro on November 14th. He remained there till November 28th, when Gordon sent him on to Rejaf, where he got fever so badly that Gordon had to recall him. On the 31st January, 1875, he met Gordon again at Bor, and they travelled together down the Nile till February 9th. Watson then went on (with Colonel Burnaby as companion), reaching Khartoum February 16th. They rode on camels from Khartoum to Korosko, 600 miles in three weeks; then down the Nile by boat to Assiut; and on by train to Cairo, March 30th. Watson was back in London by May 1st, 1875.

The whole trip was only ten months, and of that time Watson was actually with Gordon only a little over three weeks. But the two men became the closest friends. Till Gordon's death, ten years later, they continually corresponded. Whenever Gordon was in England they continually met. Gordon, on his last journey to Khartoum, stopped in Cairo with the Watsons, who did everything they could for him. Gordon's last letter from Khartoum, December 14th, 1885, was written to Watson, and Gordon's memory became "part of his religion."

Gordon's peculiarities were, of course, just as obvious to Watson as to any one else. As an amusing instance of "Gordonese," Watson told how in 1880, Lord Ripon, on appointment as Governor-General of India, tried, in a weak moment, to get Gordon to go with him as Military Secretary. Gordon, in a moment equally weak, accepted the offer. When Watson met Gordon he expostulated with him, pointing out that he must know not only that the job would be uncongenial to him, but that he was himself totally unfit for it. Gordon agreed. So Watson made him sit down at once, and write to Lord Ripon that, on re-consideration, he must refuse. The letter went, because Watson himself posted it at once in case of further change. Lord Ripon, however, like the foxy old Khedive Ismail, knew Gordon's weak point and replied to the effect, "But you have promised. You, Gordon, cannot go back on your promise." And Gordon, veering, again consented. When next they met, Gordon's defence to Watson was (and here, said Watson, telling the story, came in a peculiar element in "Gordonese" psychology), "Well, I've promised to go and I'll go. But I shan't stop." And this programme Gordon put through without further change.

When, in 1880, Watson married, the banns were blest by Gordon in a rather pathetic note to Watson:—

> "A man who is not married cannot know his faults; a man's wife is his faithful looking-glass; she will tell him his faults. . . . Till a man is married he is a selfish fellow, however he may wish not to be so. . . . You say, 'Why do not you follow your own advice?' I reply, 'Because I know myself sufficiently to know I could make no woman happy.'"

Lady Watson (who has assisted in the compilation of this book) was a true helpmate to her husband during the 36 years of their married life. She was with him in Cairo

and Suakim, and accompanied him in his travels all about Europe and to Palestine, South Africa and America.

Home Service (1876—1882).—On his return from Egypt (after some months sick leave) Watson was employed in the office of the Inspector General of Fortifications, Sir Lintorn Simmons, for four years. For 18 months he was Simmons's personal A.D.C. It was partly at this time that he watched over the infancy of Submarine Mines (first called "Torpedoes"), and Aviation (then called "Ballooning"). Those engaged later in such pursuits will be interested in some of the details given in the book. Writing in 1905, Watson deprecated the change of policy by which the R.E. Submarine Mining Service was suppressed and harbour defence transferred to the Navy, the idea being to use submarine vessels instead of submarine mines. Such change was, however, inevitable. The Russo-Japanese War of 1904–05 so greatly increased the importance of mines, and, in the recent war, they have been so largely (even if reluctantly) used by the supreme Sea Power, that the Army Submarine Mining Service (though excellent at the time of its suppression) was already becoming an anachronism. And now, if the ideas of President Wilson and Lord Grey prevail, the world will soon outgrow all such warlike toys.

From March 1880 till August 1882, Watson was employed in the Stores Department of the India Office.

Egypt (1882—1886).—This period includes the two most exciting episodes in Watson's life—the capture of Cairo on the night of September 14th-15th, 1882, and the Governorship of the Red Sea Littoral at Suakim from May 3rd to August 24th, 1886. For the capture of Cairo Dr. Lane-Poole has reproduced Watson's own account (published in *Blackwood's Magazine*, March, 1911), together with notes by General Lawrence who was with him at the time. By sheer bloodless bluff, Watson, with only 150 cavalry and M.I., persuaded some 6,000 Egyptian troops to march quietly out of the Citadel at Cairo, and another force out of a fort near, and to hand him over the keys. The whole account of the capture is worth reading, but the following extract gives an idea of the effective methods pursued by Watson :—

"There was a strong guard on the gate of the Citadel. I ordered the officer in charge to go to the Commandant and tell him to come to me at once. This took a considerable time, and I am inclined to think that the good Commandant had gone to bed. He came out at last, however, accompanied by a number of officers, and asked what I wanted him to do. I said that he must parade the whole garrison without any delay, and send them down to the Kasr-en-Nil Barracks in the lower part of Cairo. I said that I had brought a British force to garrison the Citadel, and that the keys of all the gates were to be handed over to me at once. He seemed a little doubtful at first, but not having any idea how many men we had, he decided to comply, and sent for the keeper of the keys, who brought a number of very large keys in a beautiful bag and handed them over. Soon bugles were heard, the troops began to hurry out of their quarters . . . fell in by companies and marched off, as if they were quite accustomed to being roused up in the middle of the night, and turned out by foreign troops."

Cairo was occupied in the morning without any fighting or riot, and the whole business was so peaceful that Watson's name was not mentioned in Sir Garnet Wolseley's despatch of the following day.

The Suakim episode is not so simple. Dr. Lane-Poole gives some data but offers no solution. The story in outline is as follows. In January, 1885, with the death of Gordon, the Khartoum relief expedition collapsed, and there was a period of confusion both in Cabinet Councils and in military plans. The scare of war with Russia (though lasting only six weeks, from March 15th to the end of April), was the conjurer's cap enabling the Government to drop the Soudan. In military matters, Wolseley's failure on the Nile naturally revived the alternative scheme of a Suakim Berber railway. This gave special importance to Suakim, which became

the residence of four successive Governors of the Red Sea Littoral—Chermside, Warren, Watson, Kitchener. Owing to unemployed riots in London, and the demand for a "strong man" as Chief Commissioner of Police, Sir Charles Warren was removed from Suakim in the middle of March, 1886. Watson was offered the post and consented, on the understanding that he should be given military as well as civil authority. That understanding became in some way modified, and Watson had to resign, leaving Suakim on the 24th of August, 1886. During his few months rule he seems to have done a good deal, by diplomacy rather than by arms, towards pacifying the wild tribes round Suakim and reducing the influence of their chief, Osman Digna. Watson complained of the way in which he had been treated but could get no redress or even explanation. In England he was given sympathy and the C.M.G., but told not to bother. Kitchener, his successor, was at any rate not concerned in the intrigue, if intrigue there was. In the 10th August, 1886, he wrote from London to Watson, explaining that he would never have accepted had his refusal been of any use to Watson, but that he had found out that, if he refused, an R.A. officer would be appointed.

In 1889 there was an echo of the controversy, owing to a despatch from Sir F. Grenfell to Sir E. Baring, in which it was said that Major Watson had been recalled "not from political, but from military reasons." Watson (in a natural, but rather un-Gordon-like spirit) condescended to notice this remark, and was finally silenced with the formula, "that nothing has occurred in Major Watson's military career which will injuriously affect his prospects of future advancement in the service."

The personal aspects of the episode are, of course, transient, but the account in the book gives the idea that the treatment of Watson was part of a policy disapproving the conciliatory attitude towards the natives pursued by both Warren and Watson. Twelve years elapsed before the Soudan had peace. Would not that time have been shortened if the Warren-Watson policy had been continued? This point has historic interest, and, when all personal feelings have passed away, when portfolios and pigeon-holes reveal their secrets, some future historian may perhaps unravel the tangle.

Home Service (1887—1902).—On returning home, Watson was employed at Chatham for three years. For the rest of his active service (over twelve years) he was employed at the War Office, in charge of the construction of Barracks. On the 20th March, 1902, he was placed on the retired list, and in the same year was made a C.B. Imaginative gifts (perhaps unfortunately) are not usually associated with Barrack work, but one suggestion of Watson's is an exception. It was that "Barracks should be made of indiarubber and mounted on wheels, so that they could be enlarged or reduced and shifted from place to place in accordance with the changes of Army Policy."

Retired Work (1902—1916).—In 1903–05, Watson was British Commissioner for the International Exhibition at St. Louis. This meant three trips to America and residence there for over a year. His work was very successful, and he was made a K.C.M.G. He was British representative at three International Navigation Congresses, 1902 Düsseldorf, 1905 Milan, and 1908 Petrograd. He attended the British Association meetings 1909 at Winnipeg as Vice-President of the Engineering Section, and 1912 at Dundee as President of the Geographical Section. He wrote the *Life of Sir Charles Wilson*, 1909, the *Story of Jerusalem*, 1912, *Fifty Years Work in the Holy Land*, and Volume III., *History of the Corps*, both in 1915. In 1909 he wrote two pamphlets, one in favour of Universal Service, the other against the Decimal System.

But his largest and most important work after his retirement was as Chairman of the Palestine Exploration Fund for over ten years, from 1905 till his death. He lectured continually for the Fund (and he was a perfect lecturer). He contributed scholarly articles to the *Quarterly Statement*. He wrote the books above mentioned on Jerusalem, and on the work of the Fund. The book on Jerusalem is a masterpiece

of condensed history, and should be carried in the wallet of every English-reading pilgrim to the Holy Land. He visited Palestine several times, and was Chairman of the British Opthalmic Hospital at Jerusalem. He gave much time and attention to the financial and other business of the Fund. In one of his last articles, written during the dark days of the war, he made the interesting prediction that, judging from past history, Palestine would remain under the influence of the rulers of Egypt.

Looking back over Watson's career, any one might wonder that his high character and great natural abilities did not attain wider distinction, and might be inclined to blame providence for the chapters of accidents which interrupted the continuity of his efforts. Might he not, as a student, have become one of the world's leading Orientalists? Had he not gifts for the highest rank in diplomacy? He chose to be a soldier, and his capture of Cairo certainly justified his choice, but no further opportunity came, and the rest of his military service was mainly administrative. His work for the Palestine Fund was very good, but in a different line from any of his previous energies.

Such questions are often asked about distinguished men whose friends think their distinction should have been greater. The best answer is to study the lives of the great men in history. How rarely arises a man like Nelson, really great and really loved, radiating both power and affection over his "band of brothers." Wellington, on the other hand, though his military genius shines more brightly than ever, seems to have been most unattractive, almost disagreeable, as an individual. Among the 19th Century statesmen there are Gladstone, without humour, and Disraeli, without principle (both defects most serious); among Churchmen, Newman, full of subtlety, Manning, of ambition, and so on.

After inquiring into the characteristics of great men, the student will not be too critical but only too thankful, whenever providence gives us such a thoroughly lovable, first-class, good-all-round man as Watson Pasha.

PUBLISHED WORKS BY THE LATE SIR CHARLES WATSON.

Date	Description.	Publication.
1877	White Nile Survey in 1874	Royal Geographical Society.
1878	Vocabulary—English Arabic	War Office
1880	Gordon and Abyssinia	R.E. Journal.
1886	Mosque of Sultan Nasir at Cairo	Royal Asiatic Society.
1887	Sudan—Trade Prospects	Manchester Geographical Society.
1888	Vocabulary—Suakim languages	S.P.C.K.
,,	Campaign of Gordon's Steamers	R.E. Journal.
1890	Balloons—Tables for Calculations	R.E. Institute, Chatham.
,,	Berlin—Artillery and Engineer School	R.E. Journal.
1892	How Gordon was lost	R.E. Journal.
1893	Captain Jopp, R.E., Memoir	R.E. Journal.
1894	Sudan—Suakim-Berber Route	Manchester Geographical Society.
1895	River Jordan—Stoppage, A.D. 1267	Palestine Fund.
1896	Jerusalem—Site of Temple	Palestine Fund.
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1900	Coffer of the Great Pyramid	Palestine Fund.
1901	Second Rotation of the Earth	R.E. Journal.
1902	Construction of Great Pyramid	Palestine Fund.
1903	Great Pyramid and British land measures	R.E. Journal.
,,	Sir Lintorn Simmons, Memoir	R.E. Journal.
,,	Jerusalem—Basilica of St. Mary	Palestine Fund.
1906	Metric System	Society of Arts.
,,	Jerusalem—The Akra	Palestine Fund.
,,	Date of the Crucifixion	Palestine Fund.
1907	Jerusalem—The Akra	Palestine Fund.
,,	Sir John Ardagh, Memoir	R.E. Journal.
,,	Barrack Policy	R.E. Journal.
1908	Decimal Money	Society of Arts.
,,	Lord Cromer and Sir Charles Wilson	R.E. Journal.
,,	Division of the Circle	British Weights and Measures Assoc. Journal.
,,	Justice to Gordon	National Review.
1909	Life of Sir Charles Wilson	Murray.
,,	Universal Service	Rees.
1910	British Weights and Measures	Murray.
,,	Jerusalem—Altar of Burnt Sacrifice	Palestine Fund.
,,	Jerusalem—Traditional Sites on Sion	Palestine Fund.
,,	Colonel Conder, R.E., Memoir	Palestine Fund.

PUBLISHED WORKS BY THE LATE SIR CHARLES WATSON—(*continued*).

Date.	Description.	Publication.
1910	Colonel Conder, R.E., Memoir	R.E. Journal.
,,	Gordon, Memoir	Encyclopædia Britannica.
,,	Jerusalem	Encyclopædia Britannica.
,,	The Holy Sepulchre	Encyclopædia Britannica.
1911	Weights and Measures	Whittaker's Almanac.
,,	Cavalry March to Cairo	Blackwood.
1912	Jerusalem, The Story of	Dent.
,,	British Weights and Measures historically considered.	British Weights and Measures Assoc. Journal.
,,	Commematorium de Casis Dei	Palestine Fund.
1913	Colonel Archer, R.E., Memoir	R.E. Journal.
1914	The Desert of the Wanderings	Palestine Fund.
1915	Sir H. Prendergast, Review of Life	R.E. Journal.
,,	Babylonian Measures of Length	Biblical Archæology Society.
,,	Egypt and Palestine	Cornhill.
,,	History of Royal Engineers, Vol. III.	R.E. Institute, Chatham.
,,	Fifty Years Work in the Holy Land	Palestine Fund.

NOTE.—Dr. Lane-Poole (who was an old friend of Watson) explains in the preface that owing to ill-health he was unable to complete the book himself. His assistant, Mr. Skeat, is a son of the late Professor Skeat, and was for many years in the Civil Service of the Malay Federated States. By a misprint on the title page of the book he is described as of the Indian Civil Service.

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