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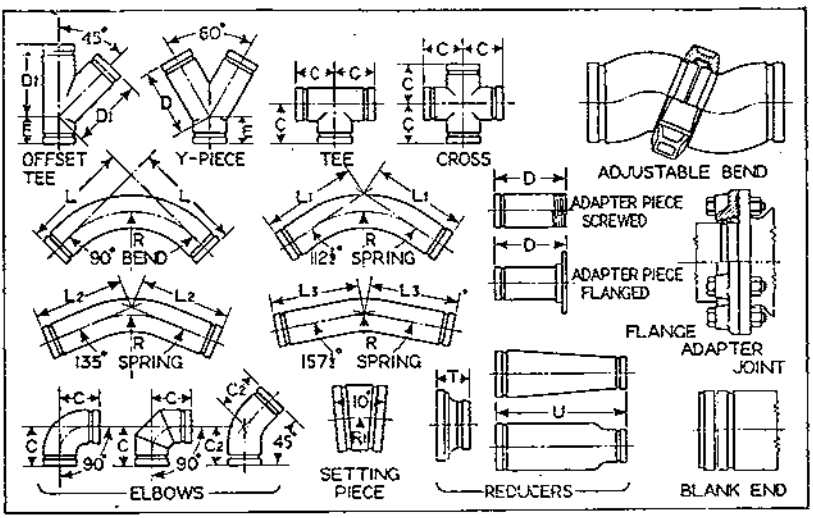

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THE DIARY OF AN R.E. SUBALTERN WITH THE B.E.F. IN 1914.

(Continued.)

By MAJOR B. K. YOUNG, M.C., R.E.

PART III.

THE MOVE FROM THE AISNE.

BY 11 p.m. on 6th October, the French had sufficiently taken over from the 4th Division to allow of our lifting and packing all the pontoons and bridging equipment.

The traffic over the bridges that evening was terrific, but the traffic control was adequate for the situation, and the relieving French and relieved 4th Division all crossed without any particular incident—the relief was evidently kept from the enemy, who fortunately indulged in no extra " hate " outside his usual programme.

As we had to load the Bridging Train as well as our Company equipment, it can well be appreciated that we left the Aisne fully up to establishment in this equipment ! But there were recriminations at the time. In the meantime, the Company had packed up. When we came to pack up, it was amazing how much gear we had collected, and most heartbreaking to have to leave the majority of it behind ; though even then we left the Aisne more heavily-loaded than when we arrived.

As soon as the bridging equipment was clear and loaded, we joined the column on the road and marched to Rozières, bivouacking in a field about 4 a.m. Winter was starting and there was a frost that night which we did not welcome.

We marched again at 1 p.m. on the 8th, reaching Largny at 2.30 a.m. on the 9th—a good long march which the men stood well. Here we were rejoined by Martel and his party from Soissons. They had finished their wooden box-girder bridge there, and made a most successful job of it.

We moved on again at 3.30, reaching Néry at 10.30 p.m.; we stayed here till 1.30 p.m. next day, the 10th, when we moved to Verberie. The locals of Néry were most interested when they found out we had been so near on September 1st, and we were able to reconstruct some of the scenes of that engagement. The Bays' horse lines had been just south-west of the village and their horses had evidently been caught in enfilade from across the valley; the long, straight, lime-covered mounds where the horse lines had been, bore only too eloquent testimony to the accuracy of the fire. We had apparently been in a field near La Fay farm, only about a mile away!

We left the locality fully impressed with the odd chances of war; nothing but that mist had saved us, personally, from extreme unpleasantness.

We left Verberie at 7 p.m. and marched to Longueil, where we commenced entraining at 9.30 p.m. The Company were all aboard by midnight, but it had been a hard job—all done by side-loading from a short platform, the difficulties accentuated by the fact that the trucks had low sides (about 12 to 14 in.) that would not drop or take out. The pontoon wagons with their full lock were not so bad, but the G.S. wagons were most obstinate and awkward.

So we once more renewed our acquaintance with the *Hommes* 40, *Chevaux* 8. The train journey, beyond being long and tedious, was at least a rest. We reached St. Omer *via* Boulogne and Calais, arriving about 4.30 p.m., and detraining at once.

The fact that the enemy appreciated our move was emphasized by the fact that he bombed St. Omer station and town. It was our first experience of this form of frightfulness, which fortunately being in its extreme infancy was not accurate or very impressive—but it certainly gave one to think, and I for one, felt glad that the enemy had not practised on our Aisne bridges.

THE ADVANCE INTO FLANDERS.

We had detrained by 6.30 p.m. but did not move off until 8 p.m. It is worth mentioning here that this day, September 12th, we met for the first time our own Territorials, the London Scottish—and a fine lot they looked, too; they were at that time doing duty on the L.-of-C. and very disgusted they were with it.

I should like again to emphasize the Field Company's position in the Divisional picture; we were amongst the last units away from

the Aisne on account of the bridges and therefore arrived in the new area behind the Division. We were as yet not in contact with the enemy, though the Division gained touch within less than 24 hours. As soon as they did so, Sappers were called for—and there were we, well behind all the Brigade and a lot of the Divisional transport. The result was that, as on the way up to the Aisne, we had to push up quickly through much transport, and for a greater length of march than the infantry had had to do, and do it all in time to get forward when we were wanted. No light task.

We left St. Omer at 8 p.m., October 12th, a cold, frosty night. The first incident occurred at Arques, the Company were going over a level-crossing quite peacefully when a railway engine appeared from nowhere and caught the rear half of No. 2 Section tool-cart well and properly. The tool-cart man was walking between the two half-limbers—fortunately on the " windward " side—and was untouched. The team bolted and scattered the Sappers, but was pulled up ; in all, only one man was hurt and he rejoined in about ten days or so. More remarkable still was that detonators, etc., in the tool-cart never protested at this rough treatment. The engine, which was running alone fortunately, never stopped—perhaps the driver was blissfully unconscious.

" Cart, local pattern, two-wheel, shaft-draught, one," was acquired and loaded up, adjustments made to the harness, and left to follow the Company up—it remained to decorate our Company on column of route for some time. Very soon after, I am not sure on which day, this cart miraculously became two carts, and we found we had a very handy little buggy for the Officers' Mess—most useful it was.

The remainder of that night was one long nightmare ; it took us until 5 a.m. to reach Hondeghem. At least four times our column was crossed and re-crossed by a motor-bus column that had obviously lost itself—the buses were French, I think single-deckers, and my impression is that they were bringing up the infantry of the last Brigade of our Division to leave the Aisne. I am not quite certain, though, on this point—they were certainly British infantry ; I don't think they were enjoying their excursion much more than we appreciated their incursion into our column—how we all cursed !

We were not to get much rest and moved on again in the mist and rain at 7.30 a.m. to Caestre, after a delay here we moved on to Fletre, arriving 5.30 p.m. At Fletre we were split up for the attack on Meteren. I took my section on to find the 12th Brigade and followed the infantry into the village at about 8 p.m. The countryside round Meteren was largely hopfields, and we had little or no field of view at any time. The enemy, on the other hand, used the tower of Meteren church as an observation post ; and as this tower stood out all round as a landmark, they were in a strong position and able to conduct a most adequate delaying action.

Work was started at once in putting the village into a state of defence, and finding one's way from one post to another round the perimeter was neither an easy nor pleasant task in the dark.

Dawn the 14th. I was at a machine-gun post we had made on the side of the long, straight road leading on to Bailleul. Suddenly we saw considerable movement from Bailleul towards us and expected an attack. However, the infantry officer at the post said it was a mob of women! Sure enough, it was, too, and they were chasing a miserable German Hussar down the road to us—he was quite glad to reach us. Our sympathies were not with him—Meteren had not been a lovely sight when we got in.

For some, to us inexplicable, reason the Division made little or no move forward during the day, though to us, in front of Meteren, there seemed little or no opposition and we all wanted to get on into Bailleul.

Next day we were left behind at Meteren and were joined by the Company H.Q. and transport; early on the 16th we moved into Bailleul. As far as I can remember, the weather was pretty constant, mist in the early morning and rain the rest of the twenty-four hours; we were all beginning to look pretty dirty and ragged.

On the 16th at 6 p.m., I went off to join the 11th Brigade and helped on some defended posts near Erquinghem on the River Lys. On the way there, along the first part of the main road between Bailleul and Armentières, we halted where the French–Belgium frontier runs along the road—our first step into that distressed country. However, as the Section wag said, we had now all qualified for the Belgian War Medal!

The enemy had been driven off the bridge without blowing it, so consequently my original task of bridge reconnaissance was not needed and my work was confined to the bridgehead posts.

The advance was continued next day by the 10th Brigade, whom I followed up through Armentières to Houplines; Westland with his section was ahead of me. The march through Armentières was in the nature of a triumphal procession and we were loaded up with gifts of eats and smokes by the excited populace—poor devils, they little knew how soon Armentières would have to suffer a regular, steady, daily shelling.

The front line had overrun Houplines to the outskirts of Frelinghien; between these two villages, on the road there was one of the usual farms of the country with all its buildings encircling a rectangular smell. In this farm were lodged a small party of the enemy, who had roused the extreme ire of the Irish by shooting up our wounded and refusing to surrender. The farm had been fired and the enemy were in the cellar alongside the roadway—still holding out and shooting through ventilators. The aid of Divisional Engineer and Divisional Artillery was sought and Westland defeated

a howitzer, which the gunners brought up to fire at point-blank range, by a short head. Westland rigged up a G.C. charge on a plank, got it up against the top of the cellar wall alongside the road, and blew the whole lot in. Brig.-General Milne (C.R.A.) arrived just in time to find that " Eng " had beaten " Arty."

My section joined the Right Battalion (2nd Dublin Fus.) of the 10th Brigade after dark, to take part in the further advance on the 18th, and I had orders to put some farm, whose name I think was properly Fme. des 4 Hallots, in a state of defence.

The Company had come up to Houplines and found a billet—also mending a bridge across the River Lys ; the bridge was of the Pont-Levis type.

The opposition in front of us had now greatly increased and the Division was not able to make much progress. Frelinghien, on my left, where Martel was, proved the stumbling-block, and Martel had a very unpleasant time there in house-to-house fighting ; the Sappers blowing in a wall and so fighting and blowing-in from house to house.

Actually we never reached my farm at all and in this area our advance was stayed, and we were once more in for trench warfare —though none would admit it at the time.

My farm easily and naturally acquired a very obvious nickname, by which it soon became well known, being developed as a strong point by the enemy just behind their front line.

Approaching Stalemate.

On the 19th October, we did not make much advance and the fighting in Frelinghien continued to be pretty unpleasant ; I did a certain amount of work helping the right of that Brigade dig-in that night and then rejoined the Company in Houplines.

The 20th proved a most unpleasant day—spy fever was again at its height. Shelling was supposed to follow signals given from chimneys. It certainly was a fact that the unfortunate 10th Brigade H.Q. were chased out of three or four houses in this one day, and we also were chivied out of the excellent *château* we had appropriated. Some spies there undoubtedly were, a few were caught and dealt with, but I never saw any.

However, we were sent right back into Armentières and at 9 p.m. my section and another, I think Fishbourne's, built a pontoon bridge over the River Lys at La Targette, the north-west suburb of Armentières ; this was required for lateral communication, the road bridge having been blown. We had a lot of approach road to make and the job wasn't finished until dawn. The other two sections were still up at Frelinghien. My section had a bit of a rest on the 21st until 11 p.m., when we were hurriedly sent off to the 12th Brigade in front of Le Touquet, north-west of the River Lys (*i.e.*, the opposite bank to

Frelinghien). Here we had a particularly sticky night of it, helping construct two machine-gun posts in the line. By now fighting had become pretty desperate and we were heavily out-numbered. I am not quite certain, but this must have been about the first night that the enemy produced the forerunner of the Very pistol—one felt peculiarly helpless and naked at first when a light went up and disclosed one standing in the open in full view—but we all soon got used to the idea and generally met it by just remaining wherever we were, absolutely still—movement, more than position, seemed to betray one.

We were recalled from the 12th Brigade at dawn, and that night, the 22nd, went up to Frelinghien for a 48-hour spell. Martel had done a tremendous lot there; the work was not only "house-breaking," but sapping across *pavé* roads and under the tramlines.

We came out at dawn the 25th; I think Martel came up again. That day the enemy seemed much more aggressive and furnished with more and heavier artillery.

It was, I think, on this day that the enemy produced the first trench-mortar, or *Minenwerfer*, soon called "Minnie," which lobbed real nasty big stuff on our line at Frelinghien, and the Seaforths were forced out of that part of Frelinghien nearby a brewery which we had won and held at much cost.

That night my section went off to the 12th Brigade, who had been moved across the River Lys and taken over on the right from the 6th Division, who were having a bad time. Our extreme right was on the Armentières–La Bassée railway line and Ploegsteert Wood was the Division left; about eight miles, and only two Field Companies for all the trench and wiring work we were wanted for.

The countryside on this, the right flank, was dead flat, and all day long, and more so at night, the overs and spents used to travel two to two and a half miles behind the line and often, too, unfortunately, took their daily toll.

At night it was worse and the enemy used to traverse machine-guns over the area, which caught us coming up in file to do our night's wiring.

I worked with the 12th Brigade until the end of October—always night-wiring; first of all with wire laboriously collected and rolled up by day, and later with stuff obtained by local purchase in Armentières and elsewhere.

This night-wiring business in those days was not pleasant—it was impossible to get covering parties from the infantry, and carrying parties were non-existent. We had to hump it all up ourselves, and then erect it. For safety's sake, we generally managed to get some of the local infantry out in front with us and were all right until a "hate" started; then we literally were between two fires and could do nothing but lie "doggo" where we were and wait till it was all

over. I remember one night in particular, bright moonlight and no rain for a change; we had just got well out, wiring, when the enemy attacked—he was driven back all right, but from our point of view it was not a good night for work.

Meanwhile, on the 26th, the O.C. and Evans organized local labour and started on a reserve line; a truly thankless task.

By now, I suppose, we had all realized that the most our Division could hope to do was to hold on to where it was; we seemed to be far outweighted in men and artillery and we had now to face the fact that any further advance without much reinforcement was quite hopelessly impossible.

PART IV.

The Situation, October 31st–November 2nd.

Before going on any farther with the narrative, it is, I think, necessary to explain the divisional situation as we saw and felt it at the end of October, '14.

We had been fighting and working night and day now in the wet and mud since October 13th, without any form of rest or relief whatsoever; both clothing and tools were in a bad way—boots in particular. For the last week, the Divisional line had been some eight miles in extent with no reserves anywhere; we had held our line against all attacks and were now subjected to daily "hates" with heavy stuff up to 8-in.; we had nothing heavier than one battery of 6-in. howitzers and the whole of our artillery was cut down apparently to about twelve rounds per gun per day. In addition, the enemy had already developed sniping to a considerable art. The result was a very steady and considerable strain on everyone and an absolutely ceaseless daily and nightly toll of casualties. The second half of October showed the enemy pressure greatest south of the Lys, hence our taking over part of the 6th Division line, but from now onwards we are concerned with the left flank of the Division, which now ran to the River Douve just below Messines. Here we were really the opposition to the enemy's left flank of his attack on Ypres, in that Messines vitally affected us to the south and Ypres to the north.

Our left flank was a heterogeneous collection of battalions. Originally 11th Brigade, it had had to expand farther and farther north to help the hard-pressed Cavalry who held Messines. For a time it was known as "Butler's Commando," after Lieut.-Colonel R. H. K. Butler of the Lancashire Fusiliers, the Senior C.O. present, and consisted of battalions of the 12th and 11th Brigades, with

Divisional Cavalry and Cyclists and also a battalion, I think the Dorsets, of the 5th Division. This "Commando" had its H.Q. in a little house on the Ploegsteert–Messines road, just west of Ploegsteert Wood, and for long the house was known as "Butler's House."

Our line then ran from Le Gheer along the east front of Ploegsteert Wood *via* St. Yves to the Douve Farm on the River Douve, thence to Messines.

The word "line" is misleading—in no sense was there a continuous line; there was some wire and there were some trenches, but all in odd, disconnected parcels. Communication trenches, of course, were quite unheard of then.

On the 31st, Messines was entered by the enemy, and on the 1st the Cavalry had to withdraw their line.

Wytschaete was lost on the 1st or 2nd, and despite gallant attacks by the Cavalry and French remained lost to us. The line on our left therefore was bent back towards Wytschaete behind the River Douve and we had to conform.

The Divisional line was bent back almost at right-angles from St. Yves, across the Ploegsteert–Messines road south of the River Douve. and so more or less parallel to the River Douve.

St. Yves was, therefore, a very pronounced and unpleasant salient —the Division only lost it once and then only for a few hours. The enemy retained the Wytschaete–Messines Ridge and so dominated, not only us, but also the Ypres salient.

This rather prosaic description of the gallant defence by our Cavalry and Infantry must suffice to explain the anxiety of the situation as we felt it and as it affected us.

TORRES VEDRAS, NOVEMBER, '14.

On the 30th our Company started on a series of strong points on a line behind Armentières running north *via* Neuve Eglise towards Mt. Kemmel. Civilians organized in *équipés* were produced and the work was pushed on at feverish speed—we worked from the Nieppe–Armentières road to Neuve Eglise.

Generally speaking, this "line" consisted of defended keeps, wired and sited so that they could be (and much later were) joined up. They were sited by Division H.Q. and we were given *carte blanche* to remove all buildings, etc., in the way. We worked on this to November 9th—except for shelling, a peaceful though arduous job. The civilians were a nuisance and caused trouble by producing drink for any weak-minded Sapper! Payment for labour and stores by local purchase was all done through the Company imprest account, which meant a good deal of work.

On November 2nd, we moved out of Armentières to the Fme. Du Don, behind Ploegsteert village—the usual type of farm, built round

a rectangular yard. We got a lot of experience on demolitions during this period—we blew down several rows of cottages alongside the Nieppe–Armentières road, a few isolated houses or villas and several small farms. This was not a pleasant task, involving as it did the eviction of the inmates, which we were left to arrange, and many very pathetic scenes were our lot.

The peasantry had a habit of trying to take away doors and window-shutters with them; this made demolition much more difficult. The usual practice was to put a box of G.C. in each of the main "rooms," the boxes only opened sufficiently to allow of a primer and detonator to be put in; connect up electrically and touch off.

We got quite expert and worked it up to about a maximum of 14 charges in series, at one time, off one exploder. Leads began to run short, and in the end we used to have to place the exploder only about 50 yards from the victim, press the handle and then run hard. I remember on one occasion doing this and seeing the whole of the "front door" coming straight at me. I mentioned the question of doors and shutters; one of the other sections had to deal with a red-brick villa that had been so gutted. The usual method of boxes of G.C. in the ground-floor rooms merely blew the roof off, and the subsequent demolition of the shell had to be tackled, a much more difficult and protracted job involving the proper laying of charges against the external walls.

Ploegsteert Wood.

On the 7th and 8th, the 11th Brigade, who held from Le Touquet to St. Yves, were heavily attacked, and Le Gheer was lost actually by a battalion of Worcesters lent to the Brigade by Third Division. Despite counter-attacks, Le Gheer remained lost to us—an ugly salient into our line just at the south-east corner of Ploegsteert Wood. This was actually the only bit of ground the Division lost during all this trying period.

As a result of this encounter, the Company were taken off Torres Vedras—which was a fairly strong line now, as defences were considered in those days—and we went up to help our infantry. For the next week, I think, I was on night-wiring in front of Ploegsteert and St. Yves. Once more the trouble was to get the stores up. Winter had really set in and the mud was awful.

Ploegsteert Wood was still held by "Butler's Commando," and our work was made much more difficult by the number of different battalions there; as a result of the heavy fighting, battalions were at company strength and so holding comparatively small bits of line, and it was not easy to find who was in command of any particular locality to which we were sent to work. In this "Commando" I remember meeting the Lancashire Fusiliers and Inniskilling Fusiliers

of the 12th Brigade ; an odd company of the Seaforths' 10th Brigade ; Somerset Light Infantry and Rifle Brigade of the 11th Brigade ; Dorsets of 5th Division ; Worcesters of 3rd Division ; Argyll and Sutherland Highlanders of 19th Brigade ; and Royal Scots Fusiliers from the 21st Brigade. Surely a complicated mixture —there may have been others as well, but these units I can remember, particularly the Scottish regiments. They had even greater difficulties to contend with in the awful and all-pervading mud —many of them were still wearing the pre-war pattern shoe and spat ; the mud just sucked these off at every step. As stores came up the Scottish regiments were given boots and short puttees.

Two things happened about now : firstly, the Somersets at St. Yves obtained one of our early Very pistols—it really was a pitiful comic compared to the enemy article and always drew a laugh from across No Man's Land when anyone was foolish enough to let it off ; secondly, the mix-up of battalions and brigades began to get sorted out and " Butler's Commando " ceased to exist as such.

As far as I know, the 12th Brigade held from the Armentières–La Bassée railway to the Armentières–Lille railway, and the 10th Brigade from the latter to the Lys at Frelinghien. The 11th Brigade from Le Touquet, north of the Lys opposite Frelinghien, to St. Yves and round north-west along the River Douve. Between the 11th and 15th, the 6th Division relieved the 12th Brigade, and the 12th Brigade the 10th Brigade. I remember Martel had to go back to Frelinghien during this hand-over. The 10th Brigade took over from St. Yves (inclusive) round to the north-west from the 11th Brigade. All these moves, of course, took time.

On the 16th November, Fishbourne and I started work on communications and a second line in Ploegsteert Wood—our movements through Ploegsteert village had to be timed exactly to avoid the monotonously regulated cross-roads *strafe* by the enemy. On this day we actually started making corduroy paths in Ploegsteert Wood and have always claimed that these were the absolute origin of the " duck-walk " so universal later. Our first ones were made with stripped branches from the trees of the wood, but soon gave way to a better article made up in a saw-mill in Armentières and brought out in stripped pontoon wagons. The second line consisted of a series of breastworks—digging was quite impossible ; water-level was already ground-level.

We also made a sketch map of the wood with local names—it was printed at General Headquarters and issued in the Brigade.*

On the 18th, Fishbourne was wounded, the enemy staged a " hate "

* Our local names survived through the war and many are on the Ypres 1/40,000 map with the *Official History, Military Operations, France and Belgium, October–November*, 1914 ; though I am sorry to see on this map many local names of a very much later date and quite unknown in October–November, 1914, the period to which the volume refers.

on the road behind Ploegsteert Wood, definitely out of hours. His ever-cheery presence and optimism were a very great loss to the Company; his death from spotted fever at Chatham the following year was a very sad ending to his career.

Our work now was mostly all done by day and was greeted with a certain amount of shelling; but an equally great danger was caused by the amateur sportsmen who went after pheasants and rabbits with the Service rifle or revolver. This became quite popular and beneficial to the menu, but was suddenly put a stop to by an irate Brigadier, whose pre-breakfast morning constitutional was rudely interrupted by the dangers of *la chasse*.

All this time, of course, we had odd parties helping the infantry in the line, and we subalterns were out most nights going round our respective parishes trying to give some help—drainage being the greatest trouble.

About now the intensity of the German attacks seemed over and there was a feeling in the air that we must get busy and set our present line in order for the winter. Readjustments of battalion, brigade and division frontages took place and the Division handed over its old friend Frelinghien and all its old line south of the Lys; the 10th Brigade had, as already mentioned, moved up to the left.

The 4th Division line was, I think, roughly as follows and remained so till January, 1915:—

12th Brigade.—Le Touquet on north bank of River Lys to Le Gheer (exclusive).

11th Brigade.—Le Gheer (inclusive) across the front of Ploegsteert Wood to St. Yves (exclusive).

10th Brigade.—St. Yves (inclusive) round left-handed towards Wulverghen, connecting with the 5th Division.

I am not certain of the exact left end of our line—somewhere in front of La Plus Douve Farm, I think.

As regards R.E. help, our Company was to do what it could for the 10th Brigade and most of the 11th Brigade; again I cannot be certain of the boundary, because I never worked actually at Le Gheer myself, but I think the 7th Field Company had the 12th Brigade plus the 11th Brigade bit of the line at Le Gheer. Anyway, we certainly had from Ploegsteert Wood to the River Douve (inclusive). I remained on with the 11th Brigade until November 24th, and so early made the acquaintance of that exceedingly fine unit, the London Rifle Brigade, who joined the 11th Brigade at Ploegsteert on November 20th. This body of men, 95% at least of whom should have been taken out and commissioned instead of being thrown away as riflemen, had a considerable bracing effect on all who came in contact with them; their very freshness and keenness was a stimulant to those of us who might have inclined to a

little " war-weariness " or staleness. They worked with us a good deal on defence works in the wood and were always a pleasure to work with. Two of the main " drives " through the wood, parallel to the line, had been called Hunter Avenue and Bunter Avenue—the latter was officially renamed Bunhill Row,* and so perpetuated the London Rifle Brigade in that area.

The next event of moment was shattering in its suddenness and unexpectedness—leave to the United Kingdom suddenly opened and Evans went off at about ten minutes' notice, on November 22nd, for eight days.

DRAINAGE.

Drainage was a terrible problem to the 11th and 12th Brigades, and the C.R.E. started considerable civilian labour on the dykes and ditches behind the line, enlisting the aid of skilled local drainage experts. All these dykes in our area led into a stream called the Warnave; this stream was so sluggish that it used to change the direction of its flow in sympathy with the prevailing wind of the day —it was speedily given the political name of " McKenna ! " I don't remember the particular political allusion now !

In the front line every trench was a ditch into which the broken land-drains poured their offerings; pumps were almost useless and the fool-proof pump that could compete with the inquisitiveness of the soldier had not been invented. As a result, we gradually helped build up the front line as a breastwork, with splinter-proof cubby holes under the parapet—we called them dug-outs in those days.

ST. YVES AND THE 10TH BRIGADE.

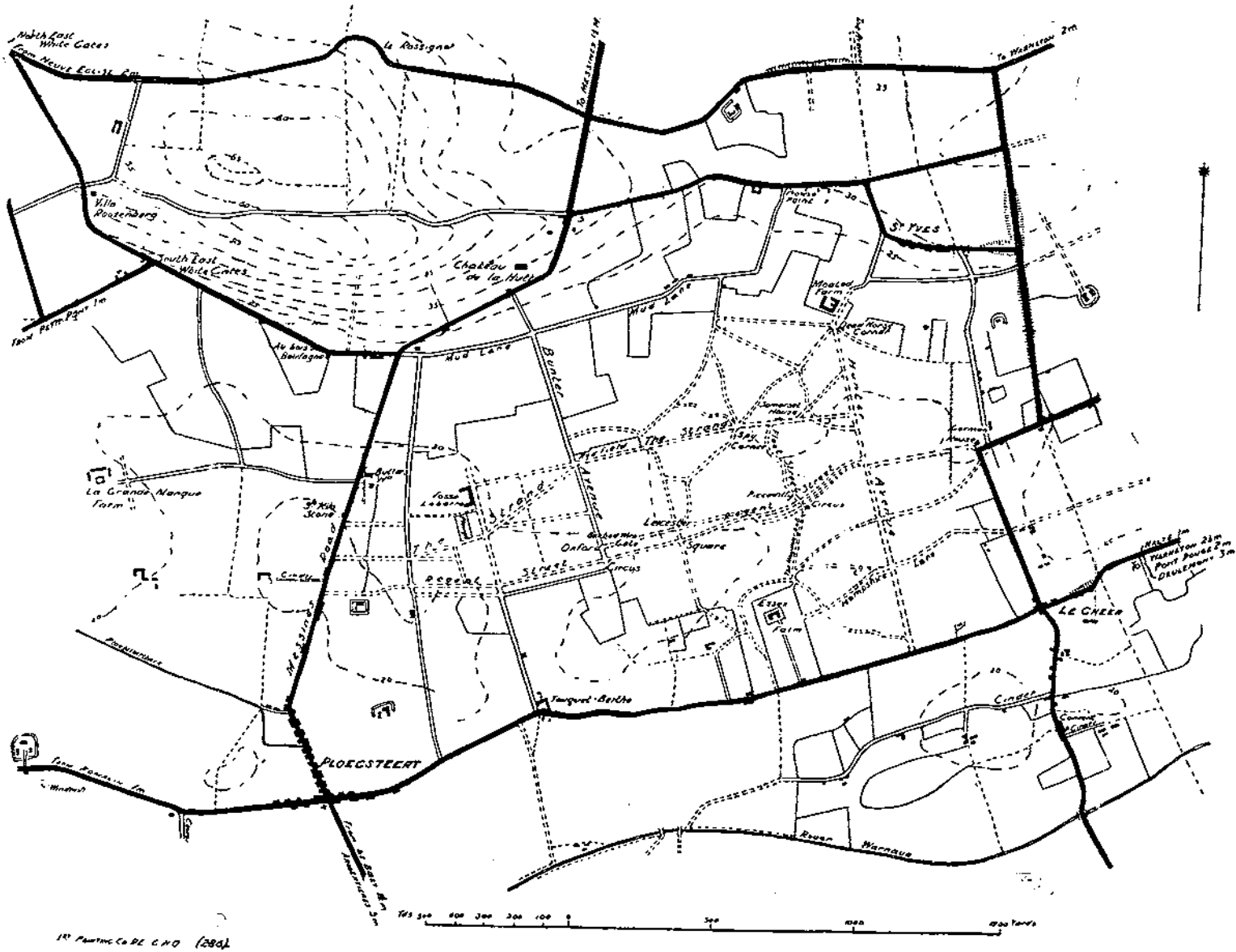
On the night of the 24th, I started work with the 10th Brigade between St. Yves and the main road Ploegsteert to Messines. The " line " here consisted of a series of semi-breastwork erections—we called them " grouse butts." Most of the time I worked with the Warwicks and Dublins. We tried to help in the connecting-up of these works, their improvement (few were bullet-proof) and the addition of so-called dug-outs; the amount of work produced was always in ratio to our own personal relationship with the Battalion Commanding Officer and the Company Commander of the actual bit of line one was working in. Fortunately the Division was a real family party and there was remarkably little friction under the most trying circumstances in those days.

On November 30th, R. L. Withington joined us; the next day Evans returned from leave and Westland took his turn.

I also did some work with the Irish Fusiliers: here better results were obtained by just leaving a selected Sapper with one of the companies—it was Kentish's Company; it was amazing what a lot

* After the peace-time Headquarters of the London Rifle Brigade in London.

PLOEGSTEERT WOOD.



Scale of yards. VI. 5 metres.

of solid useful work this produced. All I had to do was to produce what stores I could and make my number in the line there, some time each night. Kentish and the Sapper did the rest.

On December 2nd two of the sections paraded with detachments of the Division for H.M. The King at Nieppe (Divisional Headquarters). My section was not one of the lucky ones.

11TH BRIGADE AGAIN.

Early in December the infantry wanted the remains of some "houses" or buildings in No Man's Land flattened out. The gunners tackled some that were not too close to our own line, and then the Sappers were asked to tackle the remainder.

I must confess I didn't like this business at all; Martel rather specialized in it and was most successful with two affairs, one at the St. Yves salient and the other down the main road to Messines.

I was given some ruins to tackle in front of the 11th Brigade line, towards the right centre of Ploegsteert Wood. We took out charges ready made-up on planks, put them against the walls and then lit the fuzes on a given signal. We then made a bolt back for cover in preparation for the "hate" which such demolitions usually invited and received.

As I have said before, to blow down a complete house is easy, but to blow down ruins is most difficult—in any case, the heaps of brick left made just as good cover as the ruins of the walls had before. Anyhow the infantry liked having it done, so it was up to us to carry it out.

On the 4th we started on a "duck-walk" up to St. Yves—about a mile of it, I suppose. It was called Mud Lane and was always supposed to be hidden from view—I personally always doubted it, and particularly disliked day work there. I still think I was right and the enemy could see us; anyhow, he caught us good and proper one morning with 5·9-in. stuff and knocked out some of my section. We were not even allowed to bury them nearby, but were chivied away by a burst of machine-gun fire. Both may have been just chance "map shoots," but it was a coincidence that my section would not believe; anyway the job was finished in daylight by December 14th, though we got more shelling.

During this time we also did some sapping work for the infantry, generally so as to establish either listening-posts or sometimes sniper's-posts; in this, again, water and drainage were the trouble.

Westland returned from leave on the 10th, but any further leave was stopped then, at any rate as far as our Company was concerned, and there were rumours of a pending offensive. How the Division could stage an attack, holding such a long thin line without reserves, seemed to us pretty problematical.

Having left the ill-fated Mud Lane on the 14th, we started on

another "duck-walk" communication way to the left centre of Ploegsteert Wood front line (The Strand). Hardly had we started on this when we were shelled again, apparently in a place not previously shelled. There seemed then to be three possible answers to this.

(1) The enemy had at this time produced a sausage balloon, whose occupants may have seen us—but we always reckoned that he was too far away and more concerned with Ypres.
(2) Observation from enemy 'planes—this was limited to marking a map, because there were no 'planes up during these shoots.
(3) Air photos—as far as our side were concerned, a form of observation that was as yet very much in its infancy.

I suspect the last was the most probable solution.

However, we finished the job and also constructed a concealed machine-gun battery in the wood for indirect fire north towards Messines, during the next few days.

THE OFFENSIVE OF DECEMBER 19TH.

The British line now was a little more than 20 miles long, and of this the III. Corps held nearly 10 miles; the 4th Division having quite its share from the Lys to the Douve. We understood that the 4th Division was to take up the attack when progress had been made on the left, namely, when Wytschaete and Messines had been recaptured; operations prior to the 19th did not produce the desired results; nevertheless the Division was ordered to make an attack on the 19th, apparently to pin the enemy down opposite to us.

A spot was chosen opposite Ploegsteert Wood, called the Kink, where the idea was that we might straighten out our line a bit. The Somersets and Rifle Brigade each with, I think, two companies, carried out the attack towards dusk on the 19th; Martel had a detachment on the left with the Somersets, and I was with the Rifle Brigade.

Mud defeated the enterprise from the start, and the advance could only be so slow and laborious that it didn't take many enemy rifles to stop it—actually we drove the enemy out of two or three advanced posts, and when it got dark, managed to wire more or less across the Kink and so deny it to the enemy. Beyond that, the whole action was futile and useless and could never have caused the enemy command a moment's anxiety.

Our Sappers who took part had explosives and sandbags; the former to blow down some ruins if we reached them. We lost some good Sappers in this attack, those who were left were too exhausted to do much wiring, and Martel and I both had to use the rest of our

sections to get any work done that night. The obvious answer is that Sappers should not have gone out till either the objective had been obtained, or till some definite task for us had arisen.

I think the mud that night was about at its worst and I remember seeing two men bending down and start lifting a stretcher with a wounded man—all that happened as they tried to lift, was that the stretcher stayed where it was and the two men went steadily into the mud. This is absolutely no exaggeration.

The next night the other two sections went up and finished off the wiring of the Kink, which we had not had time to do on the 19th—we could have finished that night if it had been possible to get anyone to help carry up more wire and pickets, but there were no spare men anywhere in those days.

Evidently all idea of further offensive was given up because leave reopened, and Major Hoysted went off on the 21st—incidentally, another Territorial battalion, I think a Monmouthshire battalion, joined the Division this day, but went to the 12th Brigade, so I did not at this time see anything of them.

Back to St. Yves.

From the 21st December, and for some time to come, the scene of my labours shifted back principally to St. Yves, and our major effort there was joining up the " grouse butts " across the tips of our right-angle salient by continuous sandbag breastworks. It was never a nice locality and work up at St. Yves took a steady toll of the section.

St. Yves has really some considerable fame overdue to it—this village provided the scene for all Bruce Bairnsfather's original drawings in *The Bystander.* Perhaps some will remember " Old Bill " apprehensively approaching the village pump to get water, and the legend, " I know they'll 'ear the damn thing squeakin' " —one of my jobs was to sandbag this pump and the approach to it.

The originals of these sketches and many others were done in charcoal on dug-out and ruined house walls ; more elaborate pictures were on the walls of the Brigade support " billet " at the Grande Manque Farm, west of Ploegsteert Wood.

Bairnsfather was Machine-gun Officer to the Warwicks, and consequently our paths at night in St. Yves frequently crossed.

Christmas Day, 1914.

The XIX. Saxon Corps was opposite to us at this time ; they made the first overtures for a " truce " on Christmas Eve by shouting across No Man's Land ; they also gave the lead to the " truce " by putting up, after dusk, fairy lights along their trenches and in a few cases small, lighted Christmas trees.

The very real benefit of the truce which followed and was observed till midnight on Christmas Day, was that both sides were able to bury the dead lying out in No Man's Land. Many exaggerated tales were afterwards circulated about parties actually crossing over and inspecting each other's trenches, etc., etc.—but in actual fact, few on either side left their own wire.

Everyone was able to see his own line in its proper perspective by day, which was an advantage, and one or two useful tips or pointers as to which way to try and run drainage were obtained. To those in the line the 25th was a real breather, but it was hardly to be expected that Higher Authority could approve. The 26th saw the resumption of shelling and sniping, after due warning on both sides. A day or two later the following order arrived :—

> "The Commander 2nd Army directs that informal understandings with the enemy are strictly forbidden to take place. AAA He further directs that any officer or N.C.O. found to be responsible for initiating any such understandings or for acquiescing in any such understanding proposed by the enemy will be brought before a Court Martial AAA This Order is to be at once communicated to the unit under your command."

On Christmas Day itself, in the evening, an A.S.C. officer from the Divisional train arrived at our Du Don Farm with Princess Mary's gift boxes of 'baccy and also with Their Majesties' Christmas card. These were given, one to every one of us, but only after the O.C. had signed a certificate as to the exact "state" of the Company. The utmost care was taken to see that the exact right number was given out. Our unfortunate interpreter—now much thinner!—was not allowed one, to his great disgust. It did seem bad luck—I think he put in an official protest and eventually got one.

It was certainly rather galling to find some time later that these gift boxes had been distributed pretty well wholesale in England. Some of our men—my groom amongst them—had, treasured at home, the Queen Victoria chocolate box presented during the South African War.

Very soon after Christmas, though possibly it may not have been until January, a padre came to see us and asked if he could arrange a service for us. We cleared out a cowshed in the farm and the padre held a Holy Communion service there—it was most simple and impressive. I don't think that any of us who attended are ever likely to forget it.

THE CLOSE OF THE YEAR.

Changes were in the air now—new formations were being trained at home, and officers with war experience were wanted to help in the training. The army in France was at last beginning to be reinforced

ARMENTIERES, OCTOBER, 1914.

C. E. Fishbourne. F. C. Westland. B. K. Young. G. le Q. Martel.
D. M. F. Hoystesl. G. F. Evans.

2.—PLOEGSTEERT VILLAGE.—The church at the village cross-roads. It was subjected to a regular "hate" which was a nuisance, as all traffic had to go past this point —we eventually had to make a deviation road.

3.—The "Torres Vedras" line behind (or west of) the village—semi-breastwork type of construction.

Diary of an RE Subaltern 1-3

4.—Ploegsteert Village.—Looking north up the Ploegsteert Messines road behind the wood. Fishbourne was wounded on this road just by the house on the left. "Butler's House" is at the end of the road on the right.

5.—Ploegsteert Wood.—An example of our original type of corduroy path or "duck walk."

6.—Somerset House (Bn. H.Q.)—an early attempt at a built-up, bullet-proof "dug-out"; the roof was splinter and, we hoped, also weather-proof.

7.—Support line breastworks (splinter-proof) which were started late December or early January, '15. Note the early form of barbed wire "gooseberries" ready to be taken out at night.

8.—Second line breastwork, garrisoned by 1st Rifle Brigade.

9.—The front line (actually in March, 15)—the shallowness of the trench and inadequacy of protection in the cut and cover dugouts will be noticed.

10.—St. Yves.—Moated Farm, between St. Yves and Ploegsteert Wood—developed as a strong point.

11.—The main street, looking east. We made a concealed sandbag Artillery O.P. in the roof of the Post Office on the left.

12.—The Machine Gun Officer's (Bairnsfather) "Residence," just west of the village. The walls within were adorned with some of the originals of his best drawings, done in charcoal.

13.—Front line "trenches" at the salient where the line bent back nearly 90° round the village.

14.—Trenches at St. Yves, March, 1915.

15.—One of the "Grouse Butts" N.W. of St. Yves and facing north towards Messines.

Diary of an RE Subaltern 12-15

and new faces were appearing on all sides to fill the terrible wastage. The old original B.E.F. had done its bit and had literally disappeared, so I think this is a fit moment to close this diary. The 4th Division always remained a happy family ; but now it was a new family, and very different from that of only four months back. As regards the Company itself, Westland went to the 59th Field Company on December 28th, and was replaced next day by M. Luby (who succumbed to measles soon after !).

Major Hoysted came back from leave on December 30th, Martel going off in his turn the same day.

One more change—Dobbie, our Adjutant, joined the Staff, and Evans* left us to take over Adjutant.

So, of the original officers, Martel and I were the only two left in the Company. As regards the men, I should say there had been nearly a 50% turnover by now.

Trench Warfare in 1914.

Trenches, wire, dug-outs, etc., as known in 1914, were very primitive articles to those of twelve months' later. Of tools and stores, we had practically none, and the majority of the few tools that could be collected were of "local" pattern and not suited either to British infantry or the task in hand. The winter was spent by us in what really amounted in brief to "helping the infantry make bricks without straw." I am afraid this recital of mine hardly conveys the general wetness, muddiness and inadequacy of our so-called front line with its miserable cubby-holes called "dug-outs." The weather was desperate—rain, frost, snow and mud were our portion. Of the infantry of those days it is impossible to speak too highly—even at the end of the year only one company of a battalion at a time was ever out of the line, and even then that company was used of a night as a working party. To their unfailing friendliness and hospitality to my section and myself, and to the whole of our Company, I should like to put on record this expression of my very real appreciation and gratitude.

We Sappers were so few and the Divisional line so long, that our small efforts were necessarily lost to some degree when compared with all the multitudinous tasks that cried out for accomplishment. Of the first six divisions of the B.E.F., we were the last to get a third Field Company—namely, the 1st West Lancs (T.A.), on 1st January, 1915 ; they naturally required a considerable period of initiation, and no sooner had they taken their place in the day's work than the 7th Company were sent to some other new division —the 4th Division went up to Ypres for the second battle with only the 9th Company and the 1st West Lancs.

* Evans was replaced after a considerable interval by C. G. Ling.

CONCLUSION.

Throughout all this period the sending of R.E. sections to brigades was, no doubt, ordered by Divisional Headquarters, but the result was that Field Company section subalterns had an unrivalled chance of "running their own show." The most sympathetic and helpful of Company Commanders could not be in two places at once, and what our sections did, or tried to do, was always arranged direct between us subalterns and the Brigade Commanders. The result was that we got to know how to tackle the Brigadiers and Battalion Commanding Officers, and I think it can be said that affairs generally went smoothly. Later in the war, it was my experience that this personal contact was necessarily lost and it was the Field Company Commander who really "liaisoned" with the Brigadier—in practice this was the natural result of adding a third Field Company and so having one per Brigade; but naturally it limited one's own personal horizon.

In the early days of trench warfare we were 90% on night work, and then by day we had to go to the Brigade Headquarters concerned to arrange any details for the next night's work—such as, when wiring, to see that neighbouring battalions and the gunners were warned; or to try and obtain either a working party or a carrying party. There is no doubt that the Section Commander of an R.E. Field Company had a fine life in those days.

Another great problem of the two-company organization was rationing when on detachment. A Field Company had one supply G.S. wagon belonging to the Headquarter Company of the Divisional Train—during the early days, the wagon, with our C.Q.M.S., would leave the Company one night in, say, the 12th Brigade area and have to find us the next night in, say, the 11th Brigade area; to the C.Q.M.S.'s eternal credit he always found us.

Detached sections were more difficult and sometimes we had to rely on the hospitality of infantry battalions—a Field Company on the move has no means of sending rations to sections who may be four or five miles away. Often, no sooner had we arranged to be rationed through some unit, than we were sent off to some other quite different formation. But we never went really hungry!

NOTE BY LIEUT.-COLONEL F. C. WESTLAND, R.E. (*retired*), ON THE "BAILLY AFFAIR."

In the December number of *The R.E. Journal* (page 553), Major B. K. Young mentions that the Bailly bridge was prepared by me for demolition, but under subsequent orders left intact. It may be of interest to relate my part in what he refers to as the "Bailly

affair." I quote from the record I wrote up whilst on leave in December, 1916, which was based on the diary I kept at the time.

"29th. . . . I was sent out to prepare the bridge at Bailly for demolition. On the way I met some Cavalry and R.H.A. They said there wasn't a German within 50 miles. Having got to the bridge, I put out pickets, etc., and placed my charges for demolition. Various Cavalry and R.H.A. kept coming across from the west. Bailly was on the south edge of the most southern map we had. I got a copy of *Punch*. It was the first mail of any sort we had received.

"30th. Sunday. At 3.45 a.m. I was told to send the section back to rejoin the Coy. I kept Corpl. Goodfellow with me. It was a thick foggy night and morning. During the night I heard the bridges north of me blown up by Fishbourne and Martel, but I got no orders.

"During the morning we hung on. At intervals we were given Cavalry pickets to hold the bridge, which were withdrawn, leaving Goodfellow and myself alone. At 10.30 a.m. I got definite orders from 2nd Army Corps *not* to blow up the bridge, and at 5.30 p.m. I was told to leave and rejoin the Coy. at Troisly-Beure. During the day I read *Punch*. Some 'professional stragglers' turned up and gave Goodfellow and me some eggs. . . . During the day we heard gun fire to N.W. An Intelligence Officer came across in a car and said the 'situation was highly favourable.'

"At 5.30 p.m. Goodfellow and I pushed off without maps to locate the Coy. He carried the exploder and I had the guncotton (about 25 lb.) and we had some horrible hills to go up."

After an interval of nearly twenty years I am not able to remember any further details. The whole party, including myself, were on bicycles. The message ordering me not to demolish the bridge was a written one; the others were, as far as I can remember, verbal. The former, which I still have, ran as follows:—

"D.R. No. of Message 4
TO Offr. R.E. BAILLY Bridge
G.H.4 30
If bridge has not already been destroyed it is not to be blown up AAA This order overrules any other order you may receive to blow it up.
From Second Corps Time 8.45 a (Sd) X."

It will be agreed that these instructions were fairly definite. It was lucky for me and Corpl. Goodfellow that the Germans did not arrive twelve hours earlier than they did.

GIRDER ERECTION OF THE DE MONTMORENCY BRIDGE ACROSS THE JHELUM RIVER AT KHUSHAB, INDIA.

By CAPTAIN J. R. SIMPSON, R.E., *Asst. Executive Engineer, N.W. Railway.*

[This paper was read at the Session of the Punjab Engineering Congress in March, 1932, and thanks are due to the Punjab Engineering Congress for permission to republish.]

THE de Montmorency bridge, which was opened by the Governor of the Punjab, Sir Geoffrey de Montmorency, on April 25th, 1931, forms a combined railway and road connection across the Jhelum River on the Sargodha–Khushab branch line of the N.W. Railway. On the completion of the rail-*cum*-road bridge across the Chenab River at Chiniot in March, 1932, and the railway bridge across the Indus at Kalabagh in August, 1931, an alternative route from Lahore to Waziristan became available. (Photograph No. 1 shows a general view of the completed bridge.)

There are one or two novel features referred to in this paper relating to the design and methods of erection which are described in detail in the body of the paper: these are the provision of overtaking stations on the cantilever roadways and the methods of obtaining the correct camber in the various lengths of roadway cantilever girders; and the moving out into position of the inner and outer main girders, and connecting together the pairs of main girders at close spacing by means of specially designed pneumatic tools.

The bridge consists of 15 spans, each of 159 ft. centre to centre of piers, with a clear span of 144 ft.

STANDARD OF LOADING.

The de Montmorency bridge is designed to carry a single line of broad-gauge (5 ft. 6 in.) railway to M.L. Standard Loading of 1926, which is equivalent to a train hauled by two locomotives of 22½-ton axle load, and for the Roadways British Engineering Standard 10-unit highway load, which is equivalent to a 10-ton axle load followed by 4½-tons axle loads, spaced 10 ft. apart.

FOUNDATION OF PIERS.

The piers and wells are brick in cement mortar. Twin octagonal well foundations were employed and they were sunk to an average depth of 90 feet.

The wells, piers, guide bunds, and approach banks were built by the Construction Branch, N.W. Railway, and are not dealt with in this paper.

Discharge of River.

The discharge varied from a minimum of 300 cusecs in the cold weather to a maximum of about 550,000 cusecs during the monsoon.

Girders.

The spans are made up of half through-type truss duplicated trusses and were designed and erected by the bridge division of the N.W. Railway. The details of designs were approved by the consulting engineers, Messrs. Rendel, Palmer & Tritten, Westminster, London.

The steelwork has been largely made up from railway spans released from the Kaiser-i-Hind bridge across the Sutlej River at Ferozepore. In all, 6,752 tons have been used in the superstructure, 27 per cent. of this being of new material, which includes six new trusses manufactured by a constructional firm in India. The work entailed closing over half a million rivets at the site of girder erection.

The second-hand material was dealt with in the bridge department workshop at Jhelum, the girders being strengthened and remodelled there as required. Each span was assembled in the yard at Jhelum to ensure correct fabrication before being sent to site for erection.

As the main girders are duplicated, separate arrangements were necessary for the erection of inner and outer girders.

The weight of each pair of inner girders without flooring was 130 tons.

Girder Erection.

The girders were erected on the approach banks and rolled forward into position, this method being chosen in preference to either floating out on pontoons or erecting in position from temporary staging. The method adopted was certainly the most economical, while it afforded independence of river conditions The velocity reaches 10 ft. per second during the summer months and sudden rises amounting to as much as 9½ ft. in one day have been recorded.

The first pair of inner girders was assembled and riveted without cross-girders and stringers, on the main approach bank.

The girders were then launched across the staging and lowered by jacks to their normal position (see Fig. No. 1, Sheet 2, and Photo No. 2), after which cross-girders and stringers were fitted and riveted. The inner girders of No. 2 span were then assembled and riveted on the main approach bank, and launched through the girders of No. 1 span into their position on No. 2 span.

To permit of the inner girders of No. 2 span passing freely through the inner girders of No. 1 span, the girders of No. 2 span were

assembled at 11 ft. 6 in. centres, and on arrival at their position on No. 2 span were re-spaced to their normal 18 ft. 6 in. centres (see Fig. 5, Sheet No. 2).

While cross-girders and stringers were being fitted on No. 2 span, the inner girders of No. 3 span were being assembled and riveted on No. 1 span, and were subsequently launched between inner girders of No. 2 span on to No. 3 span.

Similarly the inner girders of No. 4 span were assembled on No. 2 span and then launched through No. 3 span on to No. 4 span.

Photo No. 2 shows the inner girders of No. 4 span being launched.

Special spring-borne trollies were designed for running out the girders. They were fitted under the lower booms of the inner girders, to run along two tracks along the staging.

Each trolly having one 3-in. axle was capable of taking 10 tons, the wheels being double-flanged to keep direction. The weight of each trolly was ½-ton.

This arrangement ensured that alignment was maintained and provided a more rapid method requiring less labour than by using rollers. Using these trollies, a pair of inner girders weighing 135 tons was moved 477 ft. in 20 minutes.

Fig. No. 2, Sheet 2, gives the trolly details and they can be seen in position in Photo No. 2 and on Fig. 1, Sheet 2.

Each pair of inner girders was launched with 3 :2 blocks and 3½-in. wire rope. The movable block was attached to the pair of inner girders to be launched, the standing block was fastened to the pier immediately ahead of the temporary staging.

The running end of the wire rope was attached to a 10-ton steam crane, which by moving off the bridge, launched the girders into their final position. The steam crane can be seen on No. 1 span in Photograph No. 2, during the launching of No. 4 span.

The object of assembling No. 3 span inner girders on No. 2 span, etc., was to save length and cost of laying trolly track.

The outer girders were assembled and riveted at their normal centres, 24 ft. 10 in., on the main approach bank, and were then picked up by a special traveller consisting of frames mounted on three bogie trucks and wheeled forward to their respective spans, lowered on to their bearings and connected to the inner girders.

The traveller frames, made from angles and channels, were subsequently dismantled and the material used for bracings on small spans elsewhere. These frames on the bogie trucks are in the form of a "T," the outer girders being suspended by slings from the ends of the arms of the "T." There were two frames to each bogie truck, making six frames in all for lifting a pair of girders (see Fig. 3, Sheet 2, and Photo No. 4).

The arrangement was simple to operate as the bogie trucks worked on the permanent way track. It was found that 60 men were

Photo 1.—General view of completed bridge from the Shahpur end.

Photo 2.—Showing the inner girder of span No. 4 being launched.

Girder erection de Montmorency bridge, India 1 - 2

Photo 4.—View showing traveller on abutment ready for moving the outer girder into position.

Photo. 5.—General view from the Shahpur end of the completed bridge, showing the cantilevered roadways with crossing stations.

Girder erection de Montmorency bridge 4-5

sufficient to push forward the three bogie trucks carrying a pair of outer girders.

As erection of the outer girders started with the centre spans and worked back towards both ends of the bridge, wheeling forward of the outer girders could not take place until all inner girders were complete. While the inner girders were in course of erection, it was possible to assemble six outer girders on each approach bank. The number of outer girders being assembled on the approach bank was only limited by length of straight and width of bank, and number of men and tools available.

On completion of the inner girders, the outer girders were carried forward, one pair of outer girders being dealt with every two days. The great advantage of the frames was their ability to pick up the girders at any distance from the bridge and wheel forward, the same frames and bogie trucks being used from both ends of the bridges alternately.

As an alternative means of carrying the outer girders forward, gantries running on tracks on the top booms of the inner girders were considered. This method, however, would have meant providing a track on the top booms of the inner girders, spanning the gaps between the inner girders, and providing trollies for the outer girders on the approach bank.

The built or shop camber of both the outer and inner girder was 2·75 in. After riveting and launching the outer girder the camber was on an average 2·20 in.

After launching inner girders, and fitting flooring and bracing, their camber was on an average 2·07 in.

To distribute the weight of the flooring equally between both pairs of main girders, stresses were introduced at each panel point equal to a total of 16 tons load per girder. This was carried out as follows :—

The span consisting of inner girders and flooring was raised on jacks until the holes in the diaphragms connected to the main girders at the central panels coincided with the holes in the outer girders at that point, when drifts and bolts were inserted. The span was then lowered until the two panels on each side of the centre coincided, when drifts and bolts were inserted. The lowering was continued and connections similarly made, until the final central camber in each girder was 2·14 in.

During the official tests before opening the bridge a deflection of 0·44 in. was recorded under a double-headed test train drawn by HG/S class locomotives at low speed, equivalent to a uniform load of 308 tons per span. Owing to the stiffness of the floor system, which acts as a relief to the main girders, the deflection of the complete span is about 31 per cent. less than for the trusses alone.

The riveting of the connections between inner and outer main

girders was carried out by Bohler pneumatic hammers. These tools (13½-in. overall length) were specially obtained for working in confined spaces and successfully closed rivets up to 1-in. diameter, thus enabling the girders to be spaced much closer together than would otherwise have been possible. Photo No. 3A shows one of these hammers in use.

ROADWAYS.

The two roadways carried on cantilevers outside the main girders are provided with overtaking stations at every second pier to permit fast-moving vehicles to pass bullock-carts, draught animals, etc. The width of the roadways is 10 ft. and is increased to 18 ft. for a distance of 32 ft. at each overtaking station. This form of construction is an entirely new feature as far as the writer is aware, and is illustrated in Photograph No. 5 and on Fig. 2, Sheet 1. Cantilever girders, 6 ft. 6 in. deep, resting directly on the piers, form the main support to the widened roadway.

In order to obtain a level surface for the roadway, the initial camber necessary for each of the three lengths of cantilever girders was determined for the first overtaking station by stressing the girder with known weights attached at various points, the resulting deflection being noted and corrected for in all the overtaking stations, by making adjustments at the connections to the main steelwork.

The channel connections between roadway cantilever brackets and railway cross-girders carry the tension component of the bending moment. These are subject to a maximum unit tensile stress of 4·8 tons per square inch under dead plus live and impact loads, and were initially stressed to about 3 tons per square inch before rivet holes were filled by means of a 25-ton calibrated hydraulic jack; this obviated tension in the rivets forming the web connection between the brackets and the main structure.

The surface of the roadway consists of a 3½-in. thickness of cement concrete on steel troughing.

AIR COMPRESSOR.

Motive power for riveting hammers, drilling machines, and pile-driving, etc., was supplied by one Ingersoll Rand X.P.V. compound air-compressor, with a capacity of 1,000 cu. ft. of free discharge per minute, steamed by stationary locomotive-type boilers.

PILING FOR TEMPORARY STAGING.

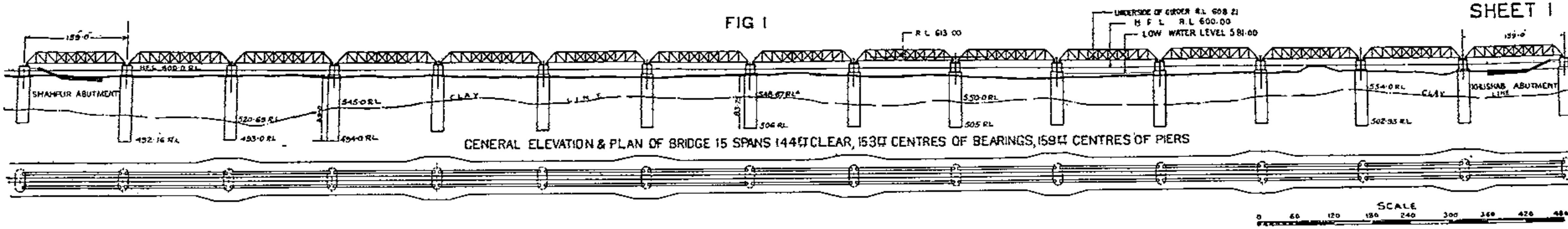
For pile-driving for temporary staging, a steam pile hammer weighing 4,000 lb. was used, suspended from a 40-ft. timber derrick carried on a pontoon (see Photo No. 3).

The pontoon consisted of eight steel water-tanks each measuring

DE-MONTMORENCY BRIDGE ACROSS RIVER JHELUM AT KHUSHAB FOR COMBINED RAIL & ROAD TRAFFIC

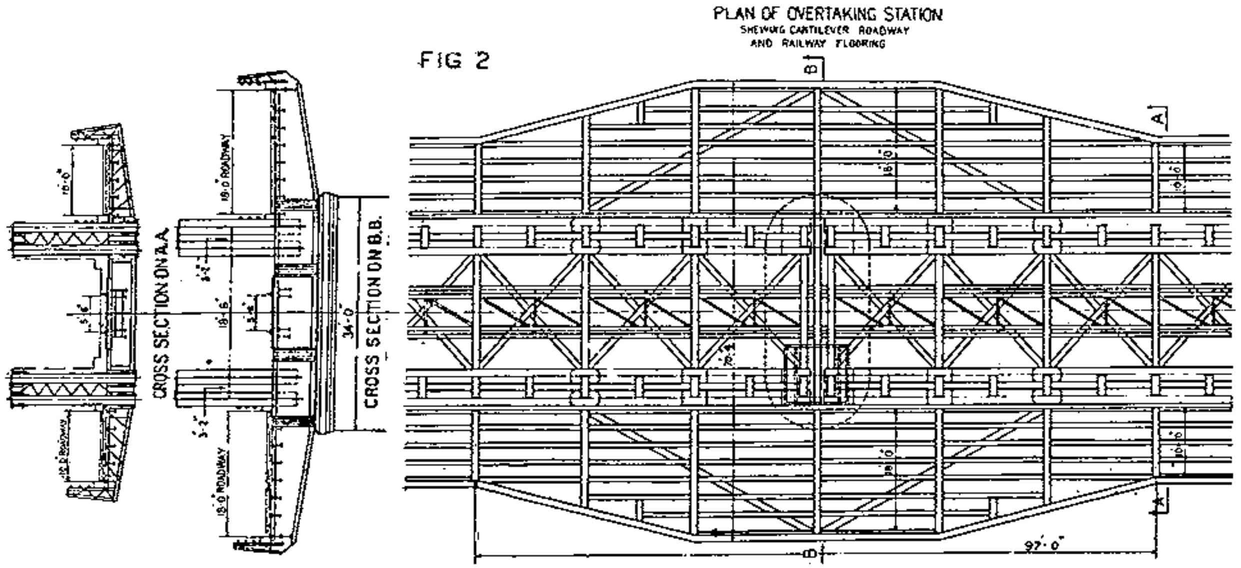
SHEET 1

FIG 1



GENERAL ELEVATION & PLAN OF BRIDGE 15 SPANS 144 FT CLEAR, 153 FT CENTRES OF BEARINGS, 159 FT CENTRES OF PIERS

FIG 2



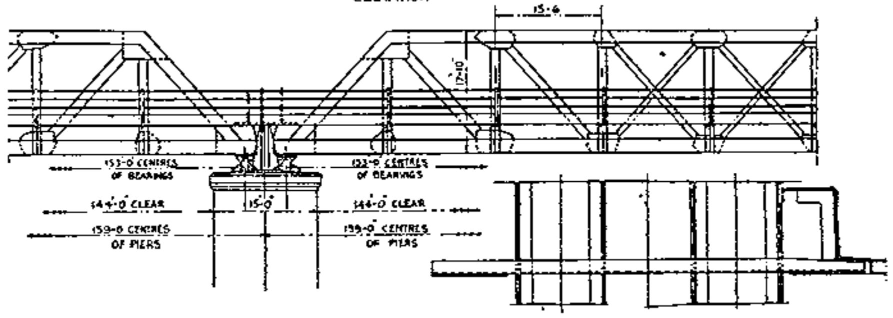
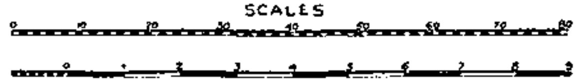


FIG 3

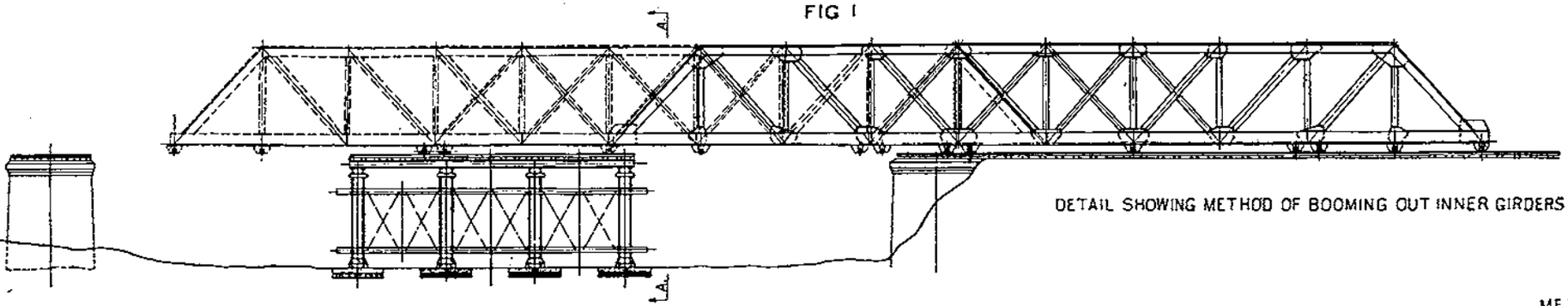
DETAIL SHOWING ATTACHMENT OF ROADWAY BRACKET TO RAILWAY CROSS GIRDER

DY. CHIEF ENGINEER BRIDGES N.W.R.



DE-MONTMORENCY BRIDGE ACROSS RIVER JHELUM AT KHUSHAB FOR COMBINED RAIL & ROAD TRAFFIC

FIG 1



THE STAGING IN THE WATER CHANNELS WAS SUPPORTED ON TEMPORARY WOODEN PILES

DETAIL SHOWING METHOD OF BOOMING OUT INNER GIRDERS

CROSS SECTION ON A.A.

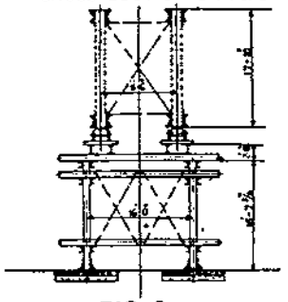


FIG 5

METHOD OF RESPACING THE GIRDERS FROM 11-6 TO 18-6 CENTRES

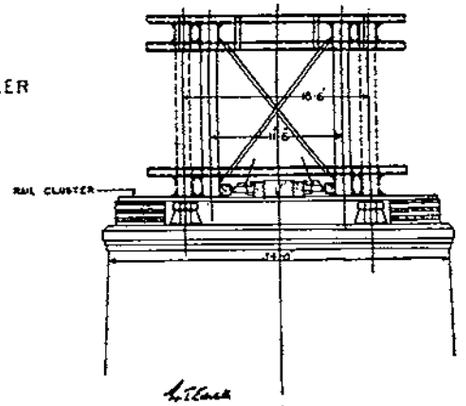
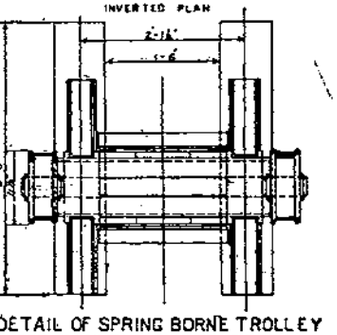
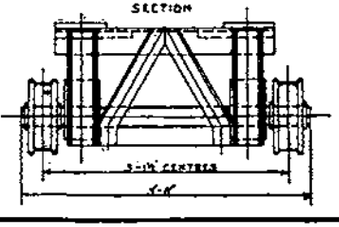


FIG 2



DETAIL OF SPRING BORNE TROLLEY FOR LAUNCHING INNER GIRDERS



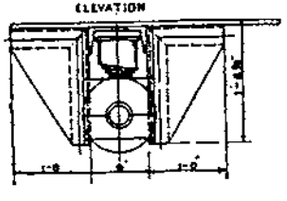
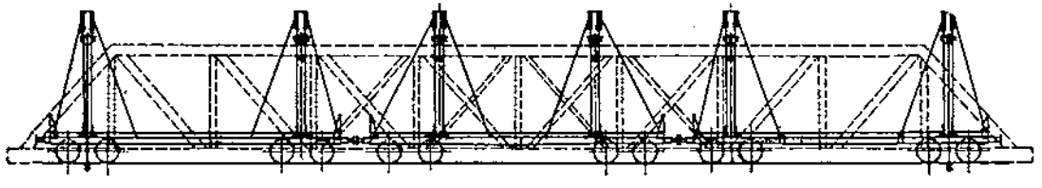
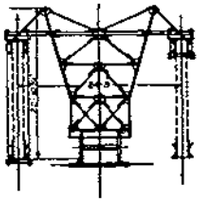


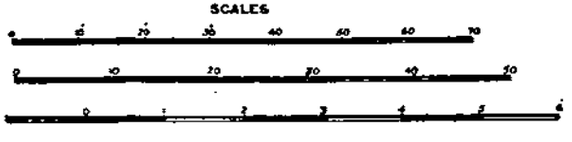
FIG 3

DETAIL OF TRAVELLER FOR MOVING FORWARD OUTER GIRDERS



CROSS SECTION OF TRAVELLER





Dy CHIEF ENGINEER (BRIDGES)
N. W. R

16 ft. x 8 ft. x 5 ft., bolted together to form a 32-ft. square. *Niwar* (coarse tape) soaked in white lead was used for caulking the joints.

The tanks were strutted with timber to withstand water pressure and 18 in. x 6 in. R.S. joists 32 ft. long and 12 in. x 6 in. R.S. channels were laid longitudinally and transversely to strengthen the pontoon and distribute the weight of derrick.

The advantage of the pontoon was that the daily variations in the river level, averaging 1 ft., did not affect the pile-driving.

In cases where scour was excessive and it was not possible to drive piles for erection of temporary staging, it was intended to float out the nose of the inner girder on the pontoon, but this was not found to be necessary as there was no excessive scour and staging was used throughout.

Temporary staging in all cases was founded on *sal* wood piles 35 ft. long, 16 piles being used for the staging, grouped under the centre of each span.

Most of the piles were extracted by inverting the pile hammer and suspending it from the main girders above, the pile hammer driving against a yoke attached to the piles.

During the monsoon some of the piles were extracted by making fast one end of a rope to the pile and the other end to the main girders and allowing the next flood to scour out the bed and free the pile.

Labour.

With the method of girder erection described, assembling and riveting of each pair of girders occupied seven days, launching, fitting and riveting cross-girders another seven days, each pair of inner girders being completed in a fortnight.

About 350 men were employed in the ordinary way and 100 of these were semi-skilled men.

With double the above labour, and working from both ends of the bridge, it was found possible to double this output. Work proceeded through the monsoon of 1930, the highest flood experienced being within 1·5 ft. of the maximum flood for the last 40 years.

Climate.

With high temperatures, which reached a maximum of 119° in the shade, cases of sickness were not uncommon, being as much as one per cent. of labour per day. With 350 men there were 105 fresh cases of malaria per month during the months of August and September, 1930.

Cost.

Work was completed at Rs. 200 (£15) a ton. With new steelwork, the cost would not have been less than Rs. 350 (£26 5s.) per ton.

TEMPORARY ROADS DEPARTMENT—III.

A NEW METHOD OF SURVEY FOR ROADS.

By "ROADSURVEY."

IN these days it is possible, on payment of a small fee, to take a correspondence course in almost any subject. On completion of the course the student will be an expert in his subject and will, within a very short period, be paying so much in super-tax, that he would have been far better off if he had never taken the correspondence course at all. On the other hand, he may get only a signed diploma, value one farthing.

A study of this article will not make the reader an expert road surveyor. Neither will it necessarily help him to get an increase of pay. On the other hand, if he wishes to try for a road survey job under the Colonial Office—an interesting and well-paid job *when* there is one going—he may find the following brief outline of a new method of surveying roads of some interest and assistance. He will, unfortunately, get no diploma !

It must be clearly understood that this method was evolved to meet the peculiar conditions met with in the Gold Coast Colony, and that it has been proved very efficient in bush country. There is no doubt, however, that the same general method, suitably modified, would prove equally satisfactory in any type of country. In fact, it has now been adopted by the S.M.E. for instruction to Y.O. and surveyors' engineering classes.

A previous article gave some hints for finding the best general route for a road. In order to understand the following pages, it would be advisable for the reader to dig out the last number of the *Journal* (December, 1933), and to refresh his memory by hastily glancing through the "words of wisdom" appearing under the heading, "We Discuss Some Survey Problems."

The object of the survey is to produce an accurate contoured plan of the approximate line of the road so that the best possible location may be put on the plan and then cut on the ground.

The work may conveniently be divided into the following stages :—

1. Running the Preliminary Line.
2. Plotting the Preliminary Line.
3. Topo-ing the Preliminary Line.
4. Putting the Location Line on the Plan.
5. Running the Location Line on the Ground.
6. Plotting the Profile.
7. Putting on the Grade Line.

1.—Running the Preliminary Line.

The preliminary line (so called) is run by means of bearings taken with a 4½-in. prismatic stand compass.

Having centred the compass over the starting point, it is set at the required bearing. This is obtained :—

(1) From a bearing of a line drawn on a map to show the route chosen on the reconnaissance.

(2) By sighting the vertical hair on a control point which can be seen, *e.g.*, a saddle in a line of hills, an outstanding tree, a house on a rise, etc. This method is very seldom possible in thick bush.

(3) By setting the vertical hair on a " cooee " given by a boy posted at a point previously marked on the reconnaissance by means of a blazed tree or peg.

The next thing to do is to run a line through the bush on this bearing. Guide pegs (as Plate I) are used for this purpose.

One of these pegs is held vertically about 10 to 15 yards from the compass, and moved until it is approximately in line with the vertical hair. At a sign from the surveyor it is stuck into the ground and then the top is moved until the tip is exactly in line with the hair.

A second peg is then placed about midway between the first and the compass, and is aligned in a similar manner. It is very important to align the farther peg first, otherwise it cannot be seen and aligned properly.

Directly these pegs are correctly placed, the cutters proceed with the cutting, the headman keeping the line by placing pegs every 10 to 15 yards. The headman must be able to run a straight line without constant checking by the surveyor, because this leads to a great waste of time and much bad language, and because a line reset by checking is very seldom accurate.

Native headmen can become amazingly efficient " peggers " with training and are often much better at it than the surveyor himself. It is well worth spending some time on training such men.

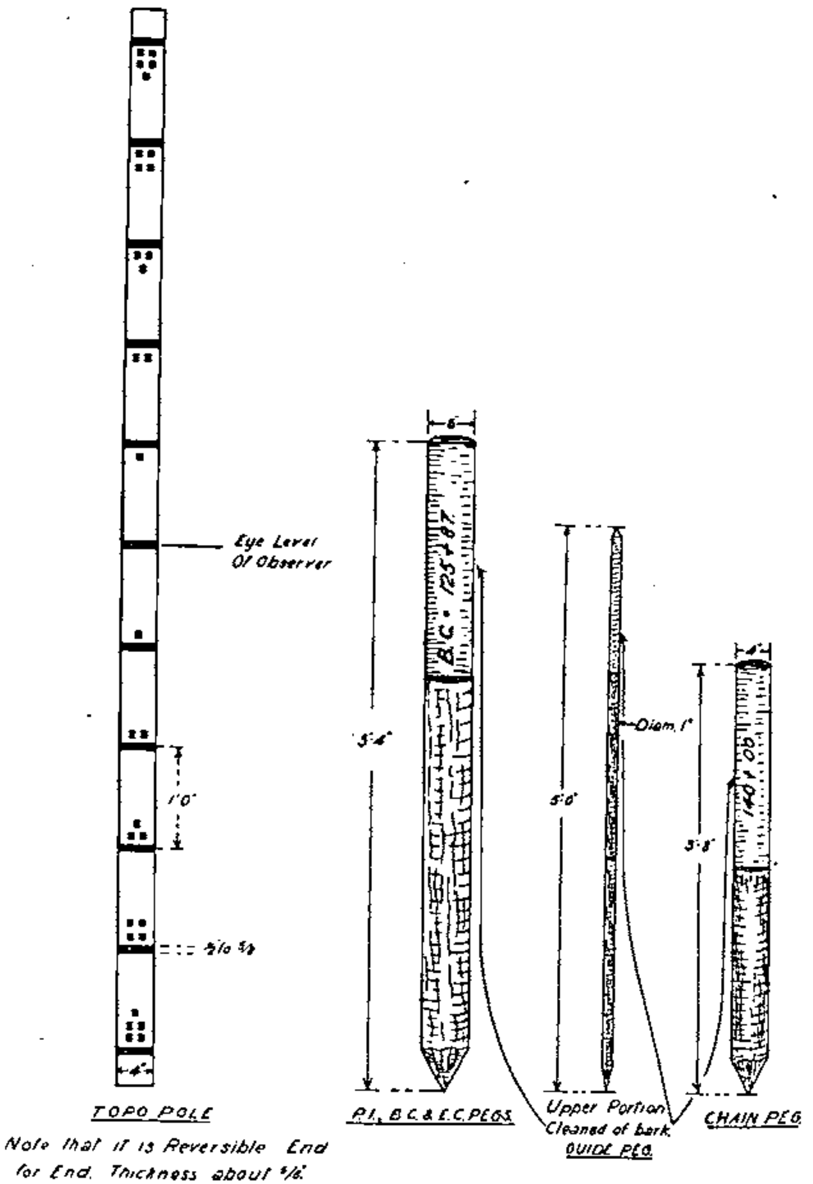

Eye Level
Of Observer
1'0"
4"
6"
5'4"
B.C. 125+87
5'0"
Diam. 1"
5'8"
1401+00
4"
TOPO POLE
Note that it is Reversible End for End. Thickness about 5/8"
P.I., B.C. & E.C. PEGS
Upper Portion
Cleaned of bark
GUIDE PEG
CHAIN PEG

PLATE I.

The forward bearing is written down in the compass book (see Plate II) and the place marked with a T.P. peg (T.P. = turning point). This peg is similar to a guide peg, but is cut with a flat side at the top, so that the number of the T.P. (*i.e.*, T.P. 00; T.P. 1, etc.) may be written on it.

The line is then cut and pegged until a control point is reached, or some obstruction such as a large tree, a house, an obviously unsuitable piece of ground like a steep hill or bad swamp, is encountered. It will then be necessary to cut on a new bearing.

EXAMPLE PAGE OF TRAVERSE BOOK.

Station or T.P.	Forward Bearing.	Check Bearing.	Total Chainage.	Intermediate Chainage.
392	235° 15′	55° 15′	1756 + 16	
393	248° 30′	68° 15′	1760 + 20	4 + 04
394	246° 15′	66° 15′	1763 + 50·5	3 + 30·5
395	246° 00′	65° 45′	1775 + 89	12 + 38·5
396	240° 45′	60° 15′	1778 + 68	2 + 79
397	246° 30′	66° 15′	1779 + 97	1 + 29
398	249° 15′	68° 45′	1786 + 15·5	6 + 18·5
399	251° 15′	71° 15′	1792 + 61	6 + 45·5
400	250° 30′	70° 30′	1804 + 31	11 + 70
401	248° 45′	69° 00′	1808 + 02	3 + 71
402	247° 45′	67° 45′	1814 + 43	6 + 41
403	249° 45′	69° 30′	1820 + 71	6 + 28
				64 + 55
			+	1756 + 16
				1820 + 71

PLATE II.

The compass is set up and aligned on to the last two pegs and the check reading taken. This bearing should equal the forward bearing plus or minus 180°, and if it fails to do so by more than 0° 30′, the line has not been kept straight and must be run again. If the line was half a mile long, it can be understood what a waste of time this re-running will be, when it is realized that a mile of traverse represents a hard day's work in medium bush. Therefore, when running long straights, the line should be tested periodically with the compass, especially when traversing difficult country.

The check bearing is entered in the compass book and two pegs aligned on the new bearing. A T.P. peg is placed at the point of the set-up and the number written on it.

This procedure is repeated all along the route.

It might be thought unnecessary to stress the fact that a compass is a delicate instrument, but curious things have been done with it.

In one case, a surveyor, on stepping over a tree trunk, found himself face to face with a black mamba. The only weapon immediately to hand was the compass on its stand, with which he straightway struck at the advancing reptile. He missed badly and the compass was irretrievably damaged, but the snake "went to bush" with all speed. Incidentally, it may be of interest to state that in the writer's experience the black and green mambas do not attack human beings unprovoked, although a writer in the 1933 July number of *Blackwood's Magazine* definitely states that these are the only two snakes which have this peculiarity.

In another instance, it was found impossible to get the location line (see later) to run correctly on the ground, using the bearing taken off the plan. Every possible check was made; surveyors burst into tears; reliefs were hurried up from headquarters.

The whole trouble was due to the fact that the compass had been set up too near a railway when running the preliminary line. Even a wristwatch may throw the needle out, and it is not advisable to wear one when running a line with the $4\frac{1}{2}$-in. compass.

Behind the cutting gang come the chaining gang. Their job is to obtain the distances between the T.P's, so that the line may be plotted.

This gang must work at least three chains behind the cutting party, for otherwise they will disturb some of the pegs which are vitally necessary for continuing the line on the correct bearing.

At every chain (100 feet) and T.P. they place a chain peg (Plate I). The number of the chain is written on it in red or blue chalk. The chainage of the T.P's is marked in chains and pluses. That is, supposing T.P. 1 is 365 feet from T.P. 00, the marking on the former chain peg will be 3 + 65.

Chain pegs are also placed at stream banks and beds, and at changes of slope, *i.e.*, summits of hills, bottoms of gullies, etc. All chain pegs should be well driven in.

The chainman who is booking enters the details of the chainage, and of the vegetation through which the line is passing, in the chain book (Plate III). It is advisable for the surveyor to go back to inspect the chainman's work as opportunity offers, otherwise they get slack and make mistakes. Such mistakes lead to appalling troubles later on.

Although it is not possible to plot distances on a scale of 400 ft. to 1 in. to a greater degree of accuracy than 5 ft., the chainman should be made to book measurements to the nearest 0·5 ft. to prevent a multiplication of small differences in the same direction, and to keep the chainman up to the mark.

Behind the chainmen come the levelling gang.

The best instrument for this work is the 6-in. quick set level, and the use of two levelling staffs gives a great saving of time.

EXAMPLE PAGE OF PRELIMINARY LINE CHAINAGE BOOK.

		1780	
		1779 + 97·5	T.P. 397
	B	1779	
		1778 + 68·5	T.P. 396
Note.		1778	
A = cocoa farms.		1777	
B = light bush.	B	1776	
C = medium bush.		1775 + 89	T.P. 395
D = thick bush.		1775	
		1774	
	A	1773	
		1772	
		1771	
		1770	
		1769	
		1768	
		1767	
		1766	
		1765	
	C	1764	
		1763 + 70	Bank of stream.
		1763 + 50·5	T.P. 394
		1763 + 20	Bed of stream.
	D	1763	In the stream.
		1762 + 70	Bank of stream.
		1762 + 50	Crosses road from Adeambra to Proso.
		1762	
		1761	
		1760 + 20	T.P. 393. Change of slope.

PLATE III.

A level peg is placed at every chain peg (including all those at T.P's, streams and changes of slope) and the heights entered in the level book in the ordinary way. Heights should not be read more accurately than to one-hundredth of a foot.

Whenever possible, the levels should be based on some known height, such as a survey beacon or bench mark. In other cases an arbitrary starting-level must be chosen, but this level should be such that no minus levels will occur on the route.

Grim experience makes the expert pegger. But one point may prove useful.

If the line passes very close to a tree, and it is at all doubtful if the pegs can be seen clearly, cut down the tree. As a general rule it is a waste of time to cut down softwood trees of more than 6-in. diameter, and hardwood trees of more than 4 in. It is quicker to peg round them.

(Problem 1. How would you peg round a tree? Answer: Parallel lines, right angles, isosceles triangles and all that sort of thing!)

A few (how few!) surveyors can keep to the correct general direction, in spite of alterations in the bearings necessary to pass trees and bad places. It is fairly easy to do so if there are many control points on the line, but as a general rule it is much safer to plot the results (roughly) as the line is cut.

2.—Plotting the Preliminary Line.

The accurate plotting is done in camp at the end of the day's field work.

Only the forward bearings of the traverse are plotted, the check bearings merely confirming the forward bearings. Before starting to plot, these should be checked over again to ensure that no gross errors have been made.

The necessary information is obtained from the compass book (Plate II) which is completed from the chain book.

The plotting is best done on squared paper, ruled 1/16th. It matters not "one jot nor tittle" whether magnetic north and south runs up and down or along the paper, but be sensible! Once upon a time a surveyor made his magnetic axis run diagonally across the grid and he did *not* live happily ever after. A brief, but sad, story!

An example of a plotted preliminary line is shown in Plan I, together with the topo, which is explained later. The distances are set off at a scale of 400 feet to 1 inch. The T.P's should be numbered in black ink; the chainage marked in red, every fifth chain being numbered.

When a fresh start has to be made owing to the line running off the paper, always re-plot the last five or six inches of the line, as this overlap is essential for putting on the location line.

The protractor should be set (for bearings) on *either* the horizontal *or* vertical lines of the squared paper, but always carry out the same procedure, as the squares on the paper are rarely "true."

3.—Topo-ing the Preliminary Line.

Before the plan is any use for locating the final route, it requires contouring. This is done by means of cross-sections and the topo pole (Plate I).

A cross-section is a line, normally 500 ft. long, cut on each side of the preliminary line, approximately at right angles to it. It starts from a chainage peg, and the distance apart of any two cross-sections (on the same side of the line) is normally three chains, although this distance depends very much on the nature of the ground.

Topo work is very slow and exhausting, so that unnecessary cross-sections should never be cut. On the other hand, the final line depends entirely on the information supplied by the topo, so that all doubtful places must be carefully examined by means of cross-sections.

The chain boys are given a list of the cross-sections to be cut, with their bearings (magnetic) and length, and (using a hand compass) they superintend the cutting of them by some of the boys, while the surveyor carries on with another piece of the preliminary line.

Make the boys cut good, clean, straight cross-sections. A little (very little !) topo-ing along bad cross-sections will tell you why.

The plan is too big to pin to a plane-table, and would suffer considerably if taken to bush every day, so tracing paper is used for topo-ing in the field.

A piece of tracing paper is cut to the size of the plane-table and pinned over the plan. Two " registration " lines should be drawn down the sides of the tracing paper corresponding to the grid lines on the plan, so that it can later be placed back on the plan in the same position.

The positions of the T.P's are then marked, and the lines joining them, marked off in chains, are drawn in. Indian ink should be used, for otherwise the lines will disappear if it rains and when the surveyor drops beads of perspiration on to the paper.

Now stretch a piece of squared paper over the plane-table and pin the tracing paper over it in the correct position by means of the " registration " lines. The angles of the cross-sections can now be set off correctly, but this should not be done until these angles have been checked on the ground with the hand compass.

All is now ready for the topo-ing " picnic," provided that you know how to topo !

The principle of the topo pole (Plate I) and eye-level is very simple. The eye-level works on the same principle as the Abney level. The centre mark on the pole is made at the eye-level of the person who is to use it. Further marks are made at intervals of one foot up and down the pole, five such marks being the maximum that can be used with the normal person. It is very important to make the pole reversible ; that is, to read correctly whichever end is placed on the ground, for obvious reasons. The marks are marked to suit the convenience of the individual.

A little thought will show that the eye-level and topo pole is an easy and quick means for obtaining differences in level, *i.e.*, topographical detail.

To give a simple and short description of the main principles of topo work, suppose that the surveyor has reached chain peg 1,852 on Plan I. The height of the level peg here is 525·3 ft. (taken, to the nearest tenth of a foot, from the level book).

First the surveyor takes the bearing of the cross-section on the right-hand side of the preliminary line (facing away from T.P. 00) and writes it in the topo book (Plate IV). In this case it is found to be 154°.

It is better not to take the plane-table up the cross-section, but to keep it on the preliminary line and plot the results *immediately* after completing the entry of the details of the cross-section in the topo book.

Do not leave the plotting of the detail until after the return to camp. It is true that it can then be done in peace and comparative comfort, and the results will look splendid. But unfortunately they will be very inaccurate, as it is not possible to remember the formation of the ground covered. Furthermore, you will be found out, because when the profile of the location line is compared with the contouring on the plan, the inaccuracies of the latter will be painfully obvious!

At chain peg 1,852 the ground (on the right) is seen to be falling. The surveyor stands beside the chain peg, his feet level with the level peg, and the boy with the topo pole goes up the cross-section until he reaches a point where the reading on the pole (taken through the eye-level) is 0·3 *above* the centre mark. The surveyor now knows that the foot of the pole is at the point where the 525 contour crosses the section, but it is necessary to know the distance of this point from the chain peg at which he is standing.

The measurements along the cross-sections can be obtained by pacing or chaining. The latter method, although it requires two boys with a chain, is much the more accurate, and takes little longer. It is recommended as the best method to use, especially over rough ground.

The surveyor goes along the whole length of the cross-section, putting down the distances at which each contour crosses the line.

Places where streams or paths occur should also be marked and the direction in which each contour is running *must* be drawn in, because otherwise it is impossible to draw in the contours between the cross-sections correctly. If the contours are very inaccurate, the plan will be quite useless.

When the slope changes, put in a spot height. Several are shown in Plate IV.

Having completed the cross-section, plot the results on the

tracing before proceeding down the left-hand section. The 6-in. ivory protractor and scale is the best instrument to use. Mark the value against some of the contours, so that there is no doubt that the correct ones are joined up when the details on the next right-hand cross-section are obtained.

The left-hand cross-section is then dealt with in the same manner, and so the contouring goes on until the surveyor decides that nothing would induce him to stumble down another cross-section that day.

SPECIMEN PAGE OF TOPO BOOK.

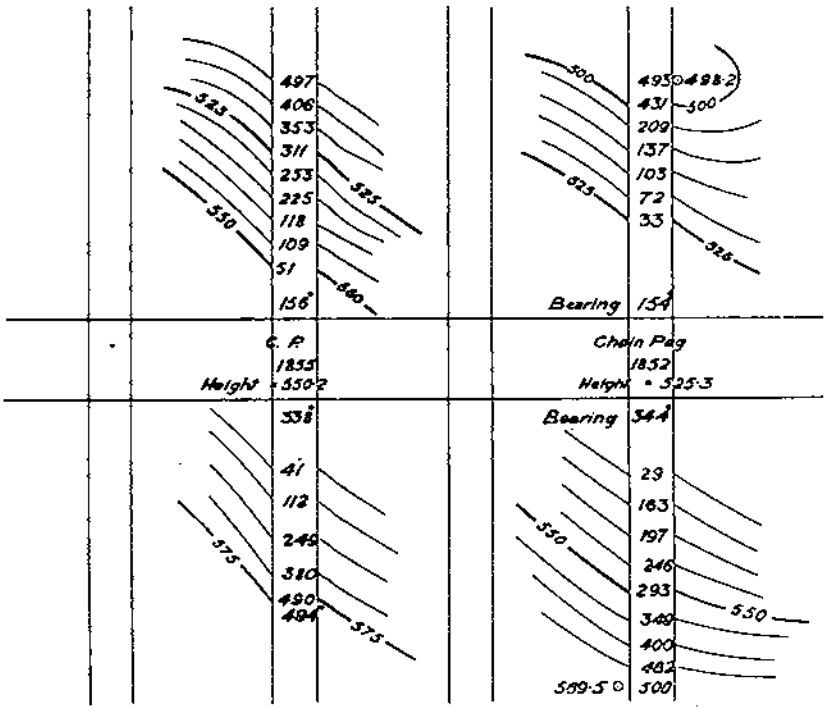


PLATE IV.

The tracing is refitted on to the plan in camp, and the details of the topography traced through red carbon paper. This process should not be delayed, as tracing paper is very liable to contract or expand, and if this occurs before the tracing is completed, the plan must be inaccurate.

The contours are then inked-in in brown, the streams in blue, any spot heights being marked in black. Flood heights are shown by dotting round the rainy season flood area in blue. Plan I shows a specimen completed and ready for drawing on the location.

A study of the plan that has now been completed may show that a better location line with longer tangents or easier curves might lie on ground not yet topo-ed. Should there be any such areas, branch preliminary lines must be run. The procedure is exactly the same as for the preliminary line, but a branch prelim. should never be run closer to it than ten chains, as the cross-sections from both lines will cover the intermediate area.

When running a branch prelim. always join it at *both* ends to the preliminary line, as this gives a check on the accuracy of the bearings and of the levelling. If the levels disagree by more than 0·2 ft. per mile, they must be re-run to find out where the levelling error lies. It should be remembered also that if a native leveller has access to the original level books, his level check will usually work out at 0·00 !

Any places where rock is known to occur should be very carefully marked on the plan, because road construction in rocky ground is very expensive. If the position of such rock is shown accurately, it can generally be avoided when putting the location line on the plan.

4.—PUTTING THE LOCATION LINE ON THE PLAN.

Now we come to the most interesting part of the whole survey (definitely a " good thing "). At the same time, it is the hardest part to do really well. But as it can be done at headquarters, in comparative " coolth " and comfort, there will be great competition for the job.

In a previous article the main principles for the grading and curvature of a road were enumerated and described. It is essential that these should be understood and memorized before any attempt can be made to put the location line on the plan, so the reader will need to search his bookshelves (or waste-paper basket) before reading further.

No one can hope to put on a good location line without a lot of practice, but it is not possible to put on one that is any use at all unless the rules for grading and curvature are followed and certain other points remembered.

A short summary of the latter is given below :—

(1) The road must obviously pass through any control points, such as villages, which have been laid down in the first instance. There will also be other control points such as saddles, toes of steep spurs and previously selected bridge sites on large streams.

(2) In country which is not mountainous, it is usually best to decide the positions for the tangents first and to put in the curves afterwards. Having decided on one set of tangents and adjusted curves to them with a curve chart (a piece of

tracing paper with curves of varying degrees drawn on it) a rough profile can be plotted from the topography. In doubtful cases, several trial profiles can be made in this way and the line gradually improved.

(3) The chief difficulty is to decide what earthworks are permissible in order to improve the alignment or grade. This matter is particularly important when putting the grade line on the profile, but it must be remembered that if the location line is bad, the grade line cannot be put on without using enormous cuttings and embankments to keep the gradients down to the maximum allowed.

In difficult cases draw a rough profile of two or three trial location lines, so that the one requiring the least earthworks can be found.

(4) There are two places where " blind spots " occur on a road—at a horizontal curve and at the top of a hill.

Whenever possible make these two blind spots coincide by arranging that the horizontal curves occur at the tops of hills.

(5) Maintenance charges are also a consideration when choosing the location line. Cuts in good soil are cheaper to maintain than fills, and can usually be made with very steep sides (10/1).

(6) Rock is expensive to cut, and should be avoided, except for bridge foundations, where its presence gives a great saving

(7) The total quantity of banking should be kept as small as possible, but where embankments are unavoidable, they are much cheaper to construct if they occur within three chains of a cutting, as the spoil from the latter can be used for making them.

(8) Whenever possible, precede and follow bridges with at least three chains of straight.

(9) A road in side-long greater than 1 in 10 tends to be expensive in construction and maintenance.

Plan II shows Plan I with a location line put on it. The profile for this location line is shown in Plan III, which should be studied at the same time.

5.—Running the Location Line on the Ground.

It is now unfortunately necessary to go out into the " mid-day sun " again and run the location line on the ground. This is done in the same way as the preliminary line and so requires little explanation.

It will be seen that most of the location line tangents intersect the preliminary line in one or more places. The bearing of the

tangent to be run should be taken off the plan, and the compass set up at the point of intersection nearest to the middle of the tangent.

The location line is *always* run on a forward bearing; that is, the first two pegs for the line are always placed with the compass pointing towards the finishing point of the preliminary line. Pegging can, of course, be done backwards or forwards or both ways at once.

The cutting and pegging of the tangents is done in exactly the same way as for the straights between T.P's, and two cutting parties, working on two tangents simultaneously, are essential for speedy work.

When a tangent does not intersect a preliminary line, its distance from it is measured (on the plan) down a suitable cross-section. This distance is then chained on the ground, the compass is set up at the correct point and the line run in the usual way.

The tangent must be run straight. If not, the line on the ground will not be that shown on the plan. Nothing is more unsightly than a crooked tangent, and the cost of construction, if the incorrect line is pegged, may easily be doubled. Also, correcting a wrong line is most maddening work in the bush. Therefore, always check the line frequently by ensuring that it cuts any given cross-section at the correct distance (measured off the plan) from the preliminary-line chain peg.

It is also a "good thing" to start running tangents from control points. Examples of these are:—

(1) Where a tangent just misses the nose of a spur, or is situated on steep side-long where an error of 5 ft. will necessitate a large increase in cut, probably in rock.
(2) Bridge and ferry crossings.
(3) Saddles.
(4) Village "High" Streets.

When the point of intersection (P.I.) of two tangents has been found and its position checked on the plan, the curve joining the two tangents must be run.

This is a terrible business, on paper, although quite simple on the ground. There are several methods of doing it, but the chain and deviation angle is the best to use in bush country. No mathematical principles will be explained and only a simple example (taken from Plan II) will be given.

The forward bearing for the first tangent on the line is 203° 20′, and for the second is 260°.

The "angle of intersection" between the two tangents is 260° — 203° 20′ = 56° 40′.

In Plate V an extract is given from a table of tangent lengths (T.L.) for a 1° curve with certain angles of intersection. The degree

of curvature (C) of the curve to be run is 8°. Then the distance in feet of the beginning of the curve (B.C.) and the end of the curve (E.C.) from the point of intersection of the two tangents (P.I.) is given by dividing the tangent length of a 1° curve by the degree of curvature to be used.

$$\frac{\text{T.L.}}{\text{C}} = \frac{3{,}088}{8} = 386 \text{ ft. or } 3 + 86 \text{ chains.}$$

EXTRACT FROM TABLE OF TANGENT LENGTHS FOR A 1° CURVE.

Angle of Intersection.	Tangent Length.
54°	2919·4
54° 30′	2951·0
55°	2982·7
55° 30′	3014·5
56°	3046·5
56° 30′	3078·7
57°	3110·9
57° 30′	3143·4
58°	3176·0

PLATE V.

The chaining gang, which has been chaining the location line in exactly the same way that it chained the preliminary line, arrives at the P.I. and informs the surveyor that it is 2,166 chains 25 ft. from the beginning of the line.

The B.C. will therefore be at chain (2,166 + 25) − (3 + 86); that is, at chain 2,162 + 39.

The location line is marked on the ground by pegs at every chain. It is necessary, therefore, to know the bearing of chain peg 2,163 from the B.C. (2,162 + 39) and the bearing of every chain peg round the curve. Finally, the E.C. must be pegged.

The distance from the B.C. of the first chain peg (2,163) on the curve will be 61 ft. The bearing of this peg is found by multiplying the distance of this peg from the B.C. by the degree of curvature and by $\frac{3}{10}$, the answer obtained (in minutes) being added to (or subtracted from) the bearing of the first tangent.

$$61 \times 8 \times \frac{3}{10} + 203° 20' = 146' + 203° 20' = 205° 46'.$$

The length of the curve (in chains) is given by dividing the angle of intersection of the tangents by the degree of curvature.

$$\frac{56° 40'}{8} = 7{\cdot}08 = 7 + 08 \text{ chains.}$$

The pegs round the curve will therefore be :—

2162 + 39 = B.C.
2163
2164
2165
2166
2167
2168
2169
2169 + 47 = E.C.

2162 + 39
7 + 08
2169 + 47

The bearings at these pegs are found as follows :—

Peg at which bearing is required.	How the value of the change in bearing (from that used at the last peg) is found.	The value of the bearing to be put on the compass when set up at the peg in column 1.
B.C. 2162 + 39	See above. $61 \times 8 \times \frac{3}{10} = 146' = 2° 26'$	205° 46′
2163	Add the value obtained for the change of bearing at the B.C. to ½C. $2° 26' + 4° = 6° 26'$	212° 12′
2164	This value is given by adding (or subtracting) C. C = 8°	220° 12′
2165	Ditto. Ditto.	228° 12′
2166	Ditto. Ditto.	236° 12′
2167	Ditto. Ditto.	244° 12′
2168	Ditto. Ditto.	252° 12′
2169	Obtained as for that at chain peg 2163. The distance of the E.C. from the last chain peg on the curve is 47 ft. $47 \times 8 \times \frac{3}{10} + 4° = 113' + 4° = 5° 53'$	258° 05′
E.C. 2169 + 47	Obtained as for B.C. (2162 + 39) $47 \times 8 \times \frac{1}{10} = 1° 53'$	259° 58′ (260° is the bearing of the next tangent).

The calculations for all curves are made in a curve book, each curve being numbered, so that if any pegs are afterwards found to be missing, they can be replaced without re-calculating the curve.

Owing to the fact that minutes and feet are taken to the nearest whole number, the value obtained for the bearing of the running-off tangent may be as much as 2 minutes out (as in this example). This theory is inelastic and should not be overworked. If a greater

error is obtained, there is a mistake in the calculations, which must be worked out again.

The method of running the curve on the ground is very simple. Set up the compass at the B.C. with the vertical hair at the required bearing. Obtain the distance required (61 ft. in the above example) with the chain, and make a boy hold a colour pole at the end of the chain. The pole is moved until it is in line with the vertical hair of the compass and the place marked. This gives the position of chain peg 2,163 (example above) and the various pegs round the curve are obtained in the same way.

There is some difference of opinion as to the accuracy with which a road curve should be run. If the curve is run absolutely true, the E.C. will fall on the line of the next tangent and will be at a distance from the P.I. (always checked by chaining) equal to the tangent length (3 + 86 in the example above).

The office *wallah* or the curve-running genius may lay down the rule that the end of the curve must fall within one foot of the correct position for the E.C. This is a council of perfection and such accuracy is often difficult to obtain in the bush.

A good rule evolved from experience is that with curves of 8 chains or over the E.C. must fall within a circle of 3-ft. radius with the true E.C. as centre. With curves of length less than 8 chains the radius of the circle of error must never exceed 1/300th of the length of the curve, *i.e.*, 2 ft. for a curve 6 chains in length.

When the error is within this limit move the E.C. on to the line of the tangent and readjust the positions of the preceding chain pegs so as to even out the error throughout the whole curve.

If the error is greater than the limit, the curve *must* be re-run, because some gross error, such as taking the wrong bearing, must have been made.

Nasty annoying little things may happen when running a curve :—

(*a*) The P.I. may be inaccessible, or fall inside a large tree.

(*b*) One or more pegs on the curve may fall inside a large tree, or in the middle of a swarm of " driver ants."

(*c*) A fallen tree or rapid change of slope may make it impossible for the surveyor to see the pole.

Space will not permit solutions to be given here, but the writer will be very pleased to start the usual correspondence course on the subject !

The location line is levelled in the same way as the preliminary line, the levels being checked on to the latter at least every 50 chains. An error of more than 0·2 ft. per mile should not be allowed.

When a river will require a bridge bigger than a single 20-ft. span, a detailed section of the crossing should be made, especially where

there are rock foundations. Bench marks should also be established at most stream crossings or major earthworks.

Whenever possible, use the same compass for the preliminary and location lines, or if this cannot be done, find the difference between the two compasses, so that the necessary addition, or subtraction, can be made to every reading taken off the plan. If this is not done, the location line on the ground will not correspond with that on the plan, and frightful chaos will result.

6.—PLOTTING THE PROFILE.

This is usually done when the levelling of each day's work on the location line is completed. The profile is plotted on squared paper to a scale of 400 feet to the inch horizontal and 20 feet to the inch vertical.

It is most important to avoid making any mistakes, as the estimate for the road depends on calculations based on the profile. In the case of errors, extras will have to be paid for and this will produce some pithy paragraphs from the authority producing the money for the road.

The value of the level at each chain is written on the profile (see Plan III) and the positions of the curves are shown by a red line drawn along the bottom of the profile. The positions of the streams are marked, and the flood levels indicated with a blue dotted line.

Before commencing the plotting, glance through the levels so that the position chosen for the first level is such that as great a length of line as possible may be plotted before a new starting-point has to be chosen. This sounds too obvious, but many a man has run off the paper (which should not be more than 12 in. wide, for convenience) after plotting a few chains.

7.—PUTTING ON THE GRADE LINE.

This is the final part of the survey that will be described in this article. Like putting on the location line, it is a difficult thing to do well, but it is very interesting work which can be done in comfort at headquarters.

The whole difficulty lies in deciding what are, and what are not, economies in earthworks. The principles for the maximum, average, and minimum grades must be adhered to, and there are certain other principles which must not be overlooked. But after that, experience and common sense are the only arguments for and against any grade line.

Every car driver knows the unpleasant effects and danger due to sudden changes of grade, such as those often met with on bridges over canals in England. The unpleasantness is particularly obvious

to the passengers in the back seats, who may have their heads banged violently on the roof, or, in an open car, may find themselves sitting on the hood shouting to the driver to stop. He will not do so (1) because he cannot hear them, (2) because he has done it on purpose. Many valuable articles, if not people, have been lost in this way!

Another danger of a sudden change of slope is the lack of visibility. When considering horizontal curves, 300 ft. was taken as being the minimum safe field of view. It is therefore undesirable to use a change of grade over the top of a hill or round a curve that will further reduce this distance. But when the change of slope occurs at the bottom of a hill on a straight piece of road, the question of visibility does not arise. The deciding factor in this case is the comfort of the road user. Although there may be some difference of opinion on the point, experience seems to show that a 4% change of slope is the maximum that can be negotiated without strain on the driver or his vehicle.

The following principles for the change of grade can therefore be laid down :—

(1) On a curve or over the top of a rise the change of grade must not exceed 3%.

(2) At the bottom of a hill, when the road is straight, the change of grade should never exceed 4%.

The vertical curves can be drawn on the profile freehand. It is a waste of time, and generally means unnecessary expense in construction, to use a compass.

The size of culvert or bridge to use over a stream or river is a difficult problem. Empirical formulæ can be used, but experience of the local conditions is much the best guide. It is most important to make the height of the banking at least 6 inches to 1 foot (according to the size of the culvert or bridge) above the culvert or bridge, and in no case should the level of the banking be less than 2 ft. above the flood level shown on the profile.

To avoid objectionable bumps, the approach grades to bridges should not exceed 1% and they should be kept level for 50 ft. on each side of the waterway whenever possible.

The plan should always be considered in conjunction with the profile when putting on a grade line, otherwise vital culverts will be left out and some unnecessary ones may be put in. The most likely places where the latter fault will occur are on the top of a ridge or down the middle of a spur.

Plan III shows the profile for the location line on Plan II. No claims to perfection for this grade line are made, but the reasons why the dotted line is bad admit of no dispute, and are enumerated below.

At A the slope is greater than the maximum allowed.

At B there is a change of slope of 7%.

At C there is a very rapid change of slope. Lorries travelling at speed would leave the ground and the limit of visibility is less than 300 ft.

At D the road is level in a cutting. There is no proper drainage, water will stand in the side drains and may flood the road.

If the road was at ground level at E, there would be no proper drainage on the uphill side of the road and a culvert would be necessary. This would be as expensive as the banking and not so satisfactory.

At F the use of the ground level would make the slope too steep.

If there is no banking at G, the road would always be in a soaking condition, as it is running through marshy ground.

At H the line is too near the flood level.

With the completed profile before him, the surveyor can lie back and pause awhile before embarking on the somewhat tedious business of estimating the cost of his line. Some hints on how to do this will be given in the next article. But before completing his brief correspondence course on road survey, the reader may justifiably expect some information as to the time required to carry out this type of survey and some figures of the cost.

It is most difficult to give a precise answer to these questions. It depends on so many factors—the type of country, the size of the gang employed, the skill of the levellers and chainmen, the efficiency and drive of the surveyor himself. All that can be said is that in country like the Gold Coast Colony, the beginner during his first year should attain a speed of about 6 miles a month. During his second and subsequent tours he would probably be able to reach a speed of some 12 miles a month, but in easier country with a better climate much greater speeds could be obtained.

The size of party recommended for a start (in bush country) is one European surveyor, one native surveyor or leveller, three or four native chain-boys, one headman (who acts as pegger), and 30 to 35 boys.

The average cost of the Gold Coast Road Surveys carried out over a period of six years worked out at just under £50 per mile. This figure included all overhead charges, cost of an H.Q. staff, pay of officers and N.C.O's on leave in England, cost of passages, etc. This figure was approximately 6 % of the cost of construction.

Survey work in bush is a tiring and often an infuriating pastime, but road survey has the great advantage that it requires neither incomprehensible computations nor " chasing stars." Furthermore, no one can fail to be thrilled by driving a car all out along a road surveyed and constructed by himself.

Try it and see !

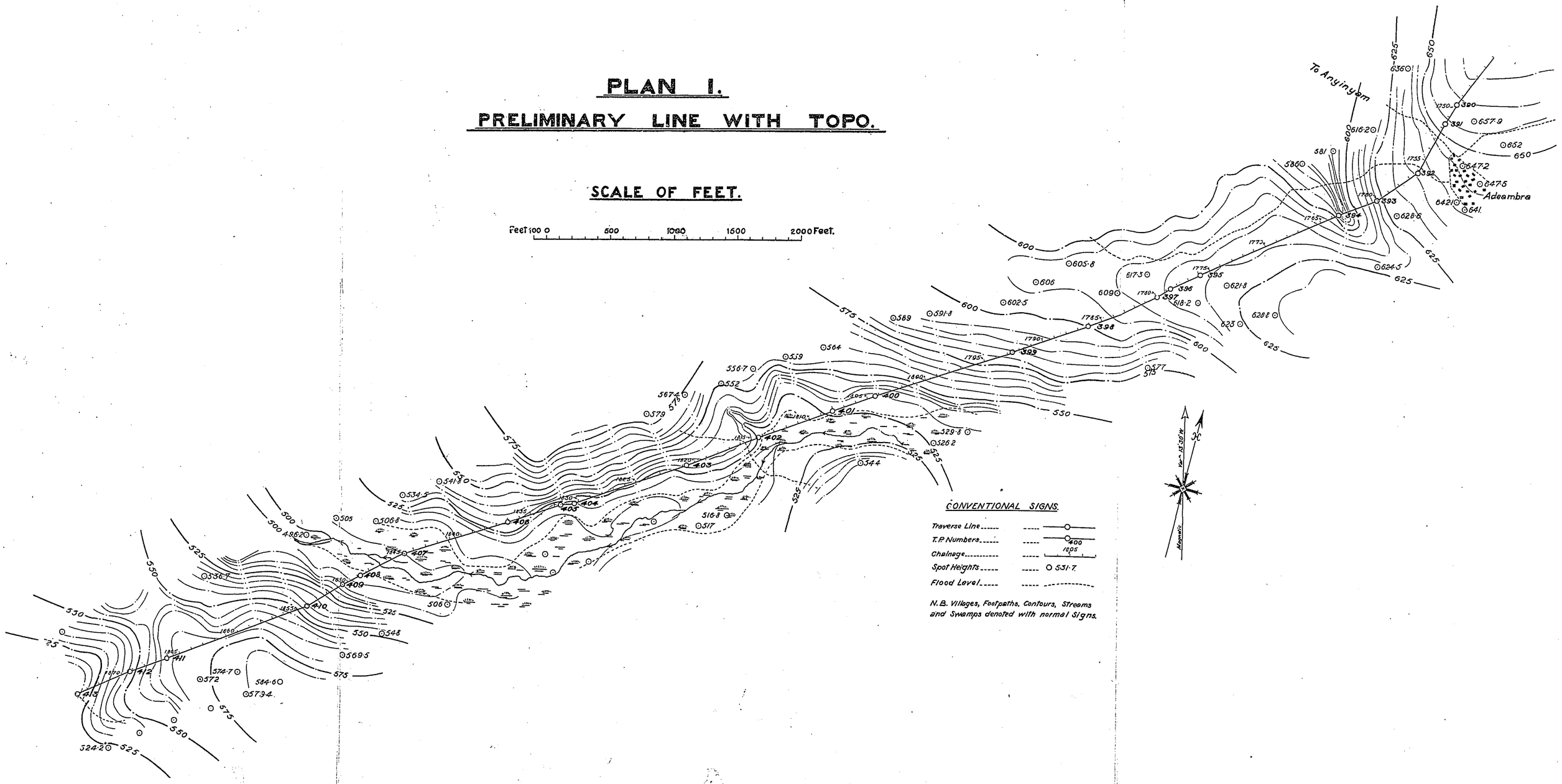
(To be continued.)

PLAN I.

PRELIMINARY LINE WITH TOPO.

SCALE OF FEET.

Feet 100 0 500 1000 1500 2000 Feet.

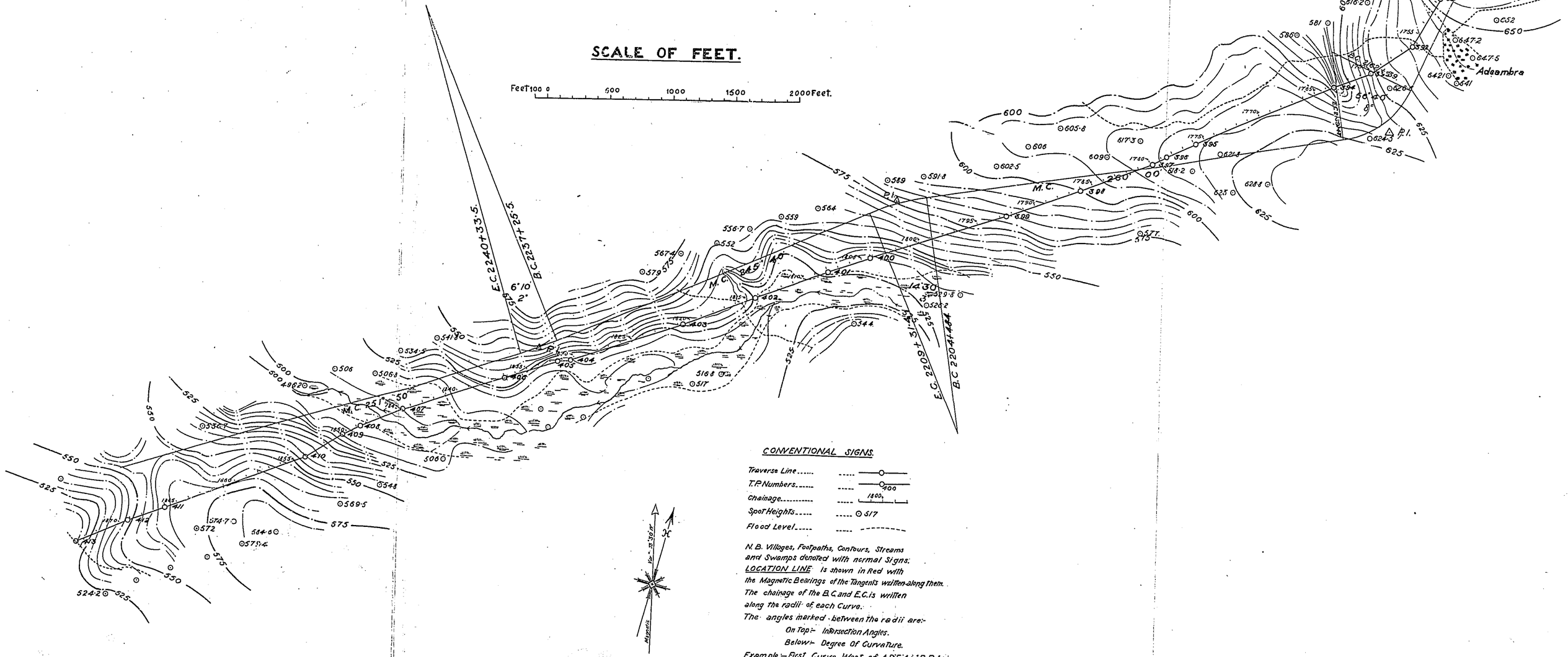


PLAN II.

THE LOCATION LINE.

SCALE OF FEET.

Feet 100 0 500 1000 1500 2000 Feet.



CONVENTIONAL SIGNS.

Traverse Line.....

T.P. Numbers..... 400

Chainage..... 1400

Spot Heights..... ⊙ 517

Flood Level.....

N.B. Villages, Footpaths, Contours, Streams and Swamps denoted with normal Signs:
LOCATION LINE is shown in Red with the Magnetic Bearings of the Tangents written along them.
The chainage of the B.C. and E.C. is written along the radii of each Curve.
The angles marked between the radii are:-
On Top:- Intersection Angles.
Below:- Degree Of Curvature.
Example:- First Curve West of ADEAMBRA:-
Intersection Angle. 56° 40'
Degree Of Curvature 8°

PLAN 111.

THE PROFILE.

CONVENTIONAL SIGNS:- .... Ground Line - Location Levels. ———— Correct Solution to Grade Line. -·-·-·-·- Bad Solution to Grade Line. 3° Positions of Curves Longitudinally

EGYPT AND THE SUDAN

ROUTE TRAVERSED BY WAR OFFICE EXPERIMENTAL CONVOY 1933.

30° 35°

MEDITERRANEAN SEA

ALEXANDRIA

PORT SAID

MILES 50 0 50 100 150 200 250 MILES

30°

CAIRO

SUEZ

WASTA

BENI SUEF

ZAFARANA

EGYPT

MINYA

GOOD, WIDE, STRAIGHT MUD ROADS

HURGHADA

ASYUT

ROUGH GOING

TANTA

LIBYAN DESERT

LIMESTONE HILLS

SOHAG

NARROW WINDING MUD ROADS

GIRGA

K'ENA

NAG HAMMADI

QU'SEIR

RED SEA

YABSA PASS

LUXOR

KHARGA

CRUSTED SAND

ISNA

25°

EDFU

BARIS

GRAVEL PLAINS

ASWAN

HEAVY SAND & GRAVEL PLAINS.

KURKUR OASIS

TROPIC OF CANCER

HILLY & ROCKY.

PATCHES SOFT SAND

R. NILE

FIRM SAND

UNDULATING SANDY PLAIN

HALAIB

EL SHEB

EGYPT

ANGLO-EGYPTIAN SUDAN

WADI HALFA

LEVEL SANDY PLAIN

VERY GOOD GOING

DUNGUNAB

OASIS

BROKEN AND BOULDER STREWN

SANDY PLAIN

NUBIAN DESERT

ABRI

GRAVEL PLAIN

GOOD GOING

SANDY PLAIN

20°

BROKEN & STONY

DONGOLA

ABU HAMED

PORT SUDAN

SUAKIN

GRAVEL PLAINS WITH SOME SOFT PATCHES

UNDULATING GRAVEL PLAIN

KHANDAQ

MEROWE

R. NILE

TOKAR

ABIDIA

BERBER

SOFT SAND

DEBBA

MAATUL WELLS

ATBARA

ANGLO-EGYPTIAN SUDAN

WADI EL MELIK

HILLS

SAND DUNES

BROKEN GROUND

R. ATBARA

SHENDI

ELEIN SPRINGS

BUSH & CULTIVATION.

HARD SAND & EARTH TRACKS

HUMMOCKY & GRASSY PLAINS

OMDURMAN

KHARTOUM

ERITREA

KASSALA

VERY BUMPY GRASSY PLAINS & BUSH COUNTRY

EIN MANSUR WELLS

BAQARIYA ET TUWAL WELLS

EL GETEINA

15°

WAD MEDANI

WADI EL MELIK

GRASS & BUSH

BUSH & CULTIVATION

SODERI

GEDAREF

GRASS & SCATTERED BUSH SOFT SANDY TRACK

MAGRUB WELLS

ED DUEIM

TRACKS OF HARD EARTH.

SENNAR

BARA

SPARSE BUSH.

HEAVY SAND TRACK UNDULATING GRASSY PLAINS.

EL OBEID

KOSTI

R. BLUE NILE

ABYSSINIA

EL FASHR

EN NAHUD

RAHAD

UMM RUWABA

TENDELTI SPARSE BUSH COUNTRY

R. WHITE NILE

L. TANA

30° 35°

THE QUETTA EARTHQUAKE, 1931.

By CAPTAIN H. B. HARRISON, R.E.,
O.C. 19th Field Coy., Royal Bombay Sappers and Miners.

DURING August, 1931, the country round Quetta was shaken by a series of earthquakes, which caused considerable damage, and temporarily cut off communication with the rest of India.

This article is a brief account of these earthquakes, with particular reference to the work done by the 19th (Field) Company, Royal Bombay Sappers and Miners, in helping to restore communications and in salving property.

QUETTA AND ITS SURROUNDINGS (see Sketch Map).

Quetta itself is situated on the Baluchistan Plateau at a height of approximately 5,500 ft. above sea-level, at a distance of 80 miles from the Afghanistan border. The garrison comprises the greater part of the 2nd Indian Division. Quetta also contains the headquarters of the Baluchistan civil administration and a large Indian city.

The Engineer troops consist of two Field Companies and a Divisional Headquarters Company, which at the time of the earthquake were the 19th and 20th Field Companies and the 42nd Divisional Headquarters Company, all of the Royal Bombay Sappers and Miners. An Army Troops Company has since been added.

Quetta is separated from the rest of India by a range of mountains rising to a height of about 10,000 ft. above sea-level. These mountains are pierced by two passes, the Bolan Pass and the Chappar Rift, through one or the other of which land traffic between Baluchistan and India normally passes.

The Bolan Pass is the more important of these, and through it a road and a railway have been constructed.

The road, in spite of steep gradients on the portion Kolpur-Sibi, is suitable for motor traffic, including lorries.

The railway is a single line for the greater part of its length, but the section between Abigum and Kolpur has been laid double to avoid a reduction in capacity on account of the steep gradients, which vary from 1 in 30 to 1 in 25. All trains on this section have to be banked, the depot for the banking engines being at Mach.

THE CHAPPAR RIFT.

A branch line runs from Quetta through a deep gorge known as the Chappar Rift to join the main line at Sibi. This is a single line throughout its entire length, and has insufficient capacity to supply Quetta by itself. It was the line originally built prior to the construction of the Bolan railway, but is now of secondary importance.

The only town of any importance between Quetta and Sibi is Mach, which contains a railway colony, the Baluchistan Central jail and an Indian bazaar. The remainder of the country on the hill up to Quetta is barren and sparsely populated.

DESCRIPTION OF THE EARTHQUAKES.

The first shock occurred in the early hours of the morning of August 25th, and although somewhat awe-inspiring, it had little material effect, beyond bringing down a few chimney stacks. Slight shocks of diminishing intensity were felt at intervals of about half an hour throughout the 25th and 26th, and by the morning of the 27th had died away.

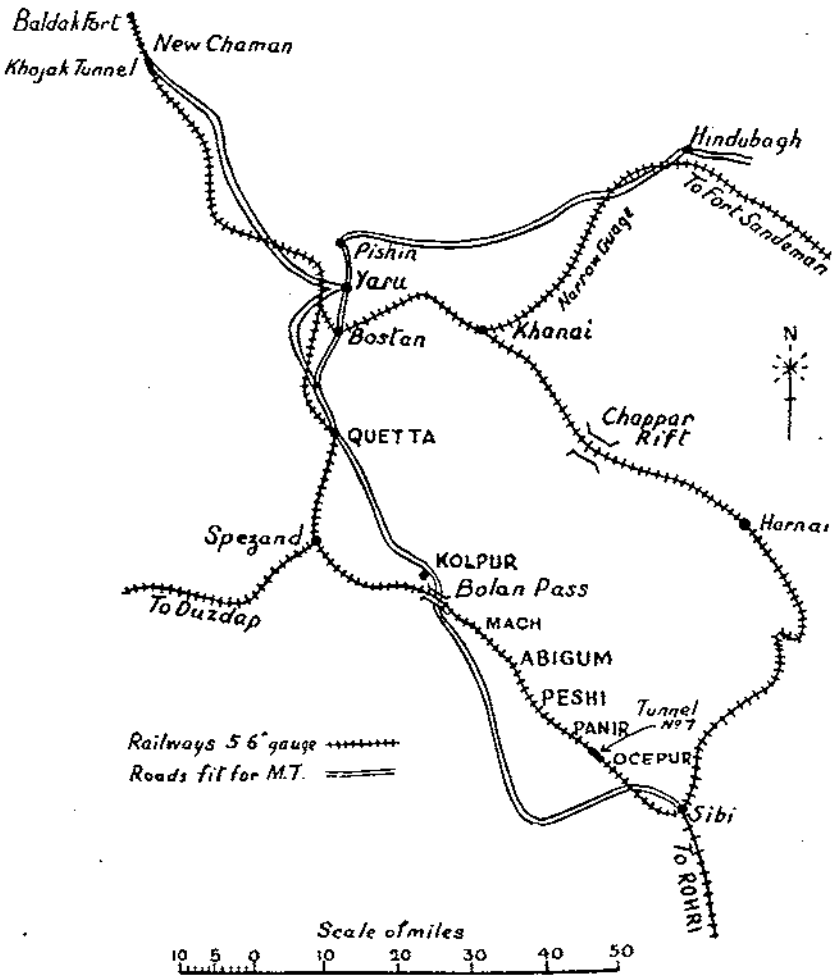
As slight earthquakes are not uncommon in Baluchistan, it was generally assumed that this earthquake, though more severe than usual, was now over. At 9 p.m. on the 27th, however, there was a severe shock which lasted about a minute. Numerous "after-shocks" were felt, at first in rapid succession. These "after-shocks" gradually diminished in frequency and intensity, until by early in October slight shocks only were felt at intervals of a few days and by the middle of the month they had ceased altogether.

EFFECT OF THE EARTHQUAKE.

The centre of the disturbance was in the neighbourhood of Mach, and in consequence in Quetta itself comparatively little damage was done and no lives were lost. On the morning of the 28th August news from outside began to come into Quetta, and it was found that the situation in other places was more serious. It appeared that both the road and railway were blocked between Kolpur and Mach, and that the line through the Chappar Rift had also been damaged. Little or no information was available regarding the situation in Mach and beyond, and rumours of all sorts were rife. By no means the least startling of these was that the hills in the neighbourhood of Mach had become actively volcanic. This, fortunately, proved to be untrue.

One section of the 20th (Field) Company, reinforced the next day by the remainder of the Company, was immediately sent off in three-ton lorries to repair the road, and was able to reach a point about a mile north of Mach by the evening of the 28th.

THE QUETTA EARTHQUAKE.



By the morning of the 29th the situation was more or less clear, and a general idea of the damage had been obtained. This fell naturally into three categories, the road, the railway, and the town of Mach.

The Bolan Road.

Between Quetta and a point about a mile north of Mach little damage had been done apart from a few rockfalls, which were easily cleared. Beyond this, however, heavy rockfalls and landslides had done a great deal of damage and in one place the road had been obliterated for a distance of several miles.

The Railway.

The branch line *via* the Chappar Rift had been damaged by rockfalls. This damage, however, was not serious, and the line was used again within three days.

The main line through the Bolan Pass had been blocked by rockfalls and landslides, and one bridge had been rendered unsafe.

Further, the cliffs overhanging the line had been so shaken that there was a considerable risk of further falls blocking the line again after it had been cleared.

Mach.

With the exception of the jail, which was of recent construction, the town of Mach had been razed to the ground. The jail itself had been badly damaged, the outer walls had collapsed in places and the prisoners had been evacuated and were being guarded by the local police in an open enclosure.

The railway bungalows and the bazaar had collapsed, the water supply had failed, and supplies of food were running short. To make matters worse, the Karachi mail, which was in Mach station at the time of the severe shock, was still in the station, being unable either to go forward or to return to Quetta.

IMMEDIATE ACTION.

The Road.

As already stated one section of the 20th (Field) Company left Quetta on August 28th and was able to reach a point about a mile north of Mach by that evening. From here on the road had vanished, and a deviation had to be made. On the arrival of the remainder of the Company on the 29th this was put in hand, and lorries containing supplies were able to reach Mach on the 30th. The Company continued its work until September 6th, by which date road communication with Sibi had been re-established. This was done partly by

clearing away the rockfalls, and partly, where the road had been entirely destroyed, by the means of deviation through the dry bed of the Bolan River.

The Railway.

As stated above, the damage done to the Chappar Rift branch was small, and the railway authorities were able to open this line for traffic within three days.

The actual work of restoring through-communication on the main line was undertaken by the railway. A material train was got through as far as Mach on the evening of Sunday, August 30th, and a limited service between Sibi and Quetta was opened on September 2nd.

WORK DONE BY THE 19TH FIELD COMPANY.

As soon as communication with Mach had been established, it was decided to send Engineer troops to assist in the salvage of property from the ruins. At 9.30 a.m. on 31st, whilst firing on the range, the 19th Field Company received orders to send by lorry to Mach two sections, to be ready to move in two hours. The gist of the orders was that as much property as possible was to be recovered, but that no attempt was to be made to clear the site or to classify materials.

One of the company officers at once left Quetta by car with the Political Agent of the district to reconnoitre the work to be done. He was followed by Nos. 2 and 3 Sections in three-ton six-wheeler lorries. The whole detachment had arrived by 6·p.m. and were able to start work on September 1st.

As already stated, Mach was almost entirely in ruins, though fortunately the loss of life had been small. Two warders had been killed in the jail, and about six people had been killed in the bazaar. As the weather was very hot, almost all the railway colony had been outside their bungalows, and there had been no loss of life in this area, though several people had narrow escapes.

All their belongings had, however, been buried in the ruins of their houses, and in most cases they were left with nothing but the clothes they stood up in.

It was, therefore, imperative that the work of salving property should be started as early as possible, and that corpses of goats, dogs, donkeys, etc., buried in the bazaar should be removed to avoid the outbreak of an epidemic.

The morale of the people had been badly shaken by the earthquake, they were in a state of apathy and in no fit condition to start work for themselves. The object of sending troops was, therefore, twofold, firstly to start the work of salvage, and secondly to restore the morale of the people.

The area was divided into two sections, the railway colony and the bazaar, and one section of the 19th Field Company was allotted to each, No. 2 (Mahrattas) being given the former and No. 3 (Punjabi Mussalmans) the latter.

The Railway Colony.

The houses in this area were bungalows, and the construction was the same in all cases, namely, masonry walls with C.I. sheet roofs, supported on coupled rafters made from 60-lb. rails. As a result of the earthquake the walls had collapsed inwards, letting down the roofs, which remained almost intact on top of the debris. The work to be done, therefore, resolved itself firstly into the removal of the roof, and secondly the clearing away of debris inside the house to enable the contents to be removed.

The Field Companies in Quetta have recently been partially mechanized by the issue of three 30-cwt. Morris 6-wheeler lorries, and one 30-cwt. 6-wheeler breakdown lorry per company. The latter proved particularly useful for the most difficult job, the removal of the roof.

In the case of a small bungalow, it was possible, by attaching to the ridge the three-ton power winch of the breakdown lorry, to pull the entire roof clear of the ruins. In the case of a large bungalow the bolts joining together the various sections of the roofs had to be cut, and the sections removed separately.

The state of the contents of the various bungalows varied in each case. As a rule the furniture was usually broken beyond repair, but cupboards and boxes, though damaged in themselves, usually seemed to have preserved their contents more or less intact. In consequence most of the clothes, money, silver and plate were recovered undamaged.

Perhaps the most remarkable piece of salvage was the discovery of a gramophone and records unharmed underneath a small table, which had itself been reduced to matchwood and buried under about four feet of broken masonry.

In all, eight bungalows, including the railway hospital, were dealt with. Work was started on September 1st and completed by September 3rd, only half the section being employed on the last day.

The Bazaar.

The work in this sector was of a different nature to that in the railway colony. The houses for the most part were double-storied, being as a rule small shops in which the shopkeeper and his family lived upstairs, while the goods were stored on the ground floor. They were built of mud walls with a flat roof supported on wooden rafters. As a result of the earthquake the roof and the top part of the walls had fallen in, leaving the lower part of the walls standing

A portion of Mach Jail showing a wall under which two warders were killed.

Bungalow in Railway Colony at Mach.

Bungalow in Railway Colony at Mach.

The Quetta earthquake, 1931 1-3

Mach Bazaar.

Work in progress on the cliff in Mach yard.

Quetta-Sibi road, near Mach, showing the effect of the earthquake.

The Quetta earthquake, 1931 4-6

to a height of 8 to 10 feet, the space in the middle being filled with rubble and broken beams.

Apart from the removal of the beams, for which the breakdown lorry had to be employed on two or three occasions, the work consisted purely of excavation.

Surprisingly little damage had been done to the contents, which, except where they had been struck by a falling beam, were as a rule salved almost intact.

The bazaar contained in all about 100 houses, of which 20 of the largest were salved by the section. Work on the remainder was undertaken by the occupants, whose morale had been raised by the example of industry set by the Sappers. In this they were assisted by the gangs of coolies employed by the Extra Assistant Commissioner, who also undertook the work of clearing the main street.

Work was started on September 1st, and by the evening of the 5th, the salvage was completed, the main street was clear, and the corpses of the goats, dogs and donkeys had been removed and burnt.

Work on Behalf of the N.W. Railway.

As already shown, the actual restoration of communications was undertaken by the railway authorities, who had been able to start a restricted day service by the 2nd September. The sites of most cuttings had, however, been badly shaken, and further falls were constantly occurring as a result of the "after-shocks," which were still being felt.

The railway authorities accordingly applied to the Baluchistan district for help in removing the loose sides of the cuttings, and permission was given for the 19th Company to undertake the work.

A special agreement was entered into between the Company and the railway, and work was started by each section as soon as it had finished its salvage work in Mach.

In all eight cuttings were dealt with, one between Kolpur and Mach, one in Mach yard, and six between Peshi and Ocepur.

The work was undertaken as follows: No. 2 Section started work in Mach on September 6th, completing it by the morning of September 10th. No. 3 Section moved to Peshi on September 6th, where it was joined by No. 2 Section on September 10th. From this place five of the tasks in the Peshi-Ocepur area were undertaken and were completed by September 18th. On September 19th both sections moved camp to the site of the sixth task at Tunnel No. 7, about two miles north of Ocepur. On October 4th No. 2 Section returned to Quetta, while No. 3 Section moved to Kolpur to carry out the last task between Kolpur and Mach. This was completed by October 8th, and on October 9th the section returned to Quetta.

No. 2 Section at Mach.

At the south end of Mach yard inside the home signal the line ran under a cliff about 80 ft. high. For a length of about 100 feet this cliff had been badly shaken, and constant rockfalls were occurring. These had blocked the up line, and the down line was endangered. The task resolved itself into cutting back the whole face of the cliff to a slope of about 60 degrees, by when it was hoped that all loose pieces would have been removed and the danger of further falls averted.

The top 10 feet consisted of earth and stone, and could easily be removed. Below this, however, solid rock was encountered. This had been broken up by the earthquake, but the individual pieces were too heavy to be removed with crowbars, and blasting had to be started. The greatest care had to be exercised in blasting to avoid blocking the down line, and consequently small charges of country black powder were used in boreholes from 3 feet to 3 feet 6 inches deep. The result aimed at was to break the rock up into pieces sufficiently small to be moved with crowbars and this was usually obtained with a charge of from 5 to 6 ounces per borehole.

No rock drills were available at this stage of the work, and all holes had to be " jumped " by hand.

Work was started on the morning of September 3rd, with one half of No. 2 Section, and was continued throughout the day. Owing to the treacherous surface of the cliffs, and to avoid accidents, it was found necessary to rope the men working on the face back to piquets driven into the ground at the top. Fortunately no accidents occurred among the men, either at Mach or at any time during the work for the railway.

By the evening of September 3rd all the loose material had been cleared away from the top, and work had started on the hard rock underneath.

The railway had in the meantime decided to put in a cross-over on the " down " side of the block to enable both lines to be used between Mach and Abigum. Work had been put in hand on September 3rd, and the line had been broken after the passage of the last train. At 8 p.m. the two gangs of coolies employed on the work downed tools for the night and refused to go on with the work. As the line had to be open to allow for the passage of the up mail train at 9 a.m. on the 4th, the railway officer in charge of the work appealed to the Sappers for help.

It was decided to use No. 2 Section, who were on the spot, and work was started at 9 p.m. The work was heavy, and besides the actual laying, the cutting and drilling of rails were involved. At 3 a.m. on the 4th the line was declared to be safe for traffic, and work was stopped.

Work on the cliff was again started on the evening of September 4th, and was continued day and night in six-hour shifts until completed on the morning of September 10th, on which day No. 2 Section moved down to join No. 3 at Peshi.

Work at Peshi.

No. 3 Section moved down from Mach to Peshi on September 6th, and as stated above were joined by No. 2 Section on the 10th. In all, five jobs were undertaken from Peshi Camp, being completed by September 18th. The work to be done in this area was of a similar nature to the work done at Mach. The sides of the cuttings had been shaken by the earthquake and all loose material had to be removed to obviate the risk of fresh falls occurring. The railway between Abigum and Sibi is only a single line, and to avoid any risk of delay to traffic work could be undertaken only at night, when no trains were running. This was not altogether a disadvantage, as the weather was very hot by day, and work at night was comparatively pleasant. Illumination was at first provided by means of Kitson paraffin lamps. The light from these was found to be inadequate, and they were replaced by acetylene flare lamps. The illumination from these lamps was satisfactory, a length of about 200 feet of the work being lit up by two lamps. The men were rested during the day, were taken to the work on the last down train in the evening, and were brought back to camp by the first up train in the morning.

Peshi itself consisted only of the station buildings, there being no town or village within several miles. There was a small hot spring which provided sufficient water for the station staff only, and water for the men was provided in tank wagons specially sent by the railway.

The rock encountered was similar to that met with at Mach, and no particular difficulty was experienced in carrying out the work. Small boreholes were still being used, and as a rule three series of blasts could be carried out each night, and the last two hours spent in clearing the line in readiness for the passage of the first up train.

Work at Tunnel No. 7.

The first job in this area was at Tunnel No. 7, about two miles north of Ocepur. As water was available on the site both sections moved into camp there on September 19th. At this place a piece of cliff about 200 feet long, 100 feet high, and 20 feet thick at one end, tapering to 4 feet thick at the other, had pulled away from the main hill and was overhanging the line.

This had to be reduced in height sufficiently to render it safe and a portion of the thin end required removing altogether.

The soil was a form of natural lime concrete known locally as "aggregate." It was too hard to work with a pick and shovel, and

was too porous for the use of country powder. Gelignite was found to give a fairly satisfactory blast, and this was used almost entirely.

Both sections worked on the job day and night in eight-hour shifts. Great care had to be taken to avoid blocking the line when a train was due, and an elaborate system of hand signalling was brought into use. Fortunately it was possible from the top of the cliff to see the line for about two miles in each direction, and throughout the work only one train was held up, and that only for a few minutes. The site of the work was only about 900 feet above sea-level, and the weather was unpleasantly hot. Sandflies were a plague after dark, a mosquito net being no protection, and the only effective safeguard was a liberal application of bamber oil, large quantities of which were got down from Quetta and issued to the men.

For this job the railway had provided an Ingersoll-Rand Compressor and rock drills. These proved very useful, and boreholes up to a 10-foot depth were used with satisfactory results.

By the 3rd October the top of the cliff had been lowered by about 15 feet, and about 30 feet had been removed from the thin end. The cliff was then declared to be safe, and both sections left on the morning of October 4th, No. 2 returning to Quetta and No. 3 moving into camp at Kolpur.

No. 3 Section at Kolpur carried out one more job, very similar to the work done at Mach. No particular difficulty was experienced, and the section returned to Quetta on October 9th.

To sum up, the work done both in salvage and for the railway afforded valuable training to the two sections employed. An opportunity was given to test the capabilities of the breakdown lorry, the men were given useful practice in night work both under good and bad conditions of lighting, and valuable experience was gained in blasting in the kind of rock met with in Baluchistan. The earthquake and its consequences provided an interesting experience which should have been of value to all ranks.

THE EFFECT OF MODERN METHOD AND MACHINERY ON ROAD-MAKING IN WAR.

(Communicated by the R.E. Board.)

1. Introduction.

Developments which have been taking place in the last few years in road-making methods in countries where large partly-developed tracts exist, are of considerable interest to military engineers. The evolution of machinery for the formation of the road and the use of various types of road oils, bitumen emulsion, etc., to form a waterproof surface to tracks, which previously could only be used for heavy traffic in dry weather, have considerably speeded up the construction of all-weather roads in such countries. The method of surfacing usually known by the American name of "mix-in-place" work, which consists in the mixing and laying of binder and aggregate on the surface of the road by the use of machinery, has enabled long stretches of road to be surfaced so quickly that many officers see in it the solution of the problem of rapid road-making in war. In this paper the extent to which modern developments can be relied on to speed up roadwork is examined. Technical details of purely engineering interest are omitted as far as possible.

2. The Two Main Divisions of Road Construction.

The work involved in road construction falls into two main divisions :—

(*a*) The earthwork and drainage required for the preparation of the formation.

(*b*) The artificial surface laid on the formation. In some types of road, this includes both a "foundation" and a "surface" course.

Both parts of the work are normally necessary, since the natural soil will rarely stand up to heavy continuous modern traffic without some form of surfacing.

Either part may prove to be the governing factor in the net rate of construction of a road. The adoption of an extremely rapid method of surfacing will not increase this net rate unless the formation

can be prepared equally fast. It should be the aim of the engineer to organize the whole work so that the progress of the two divisions of the work is balanced.

3. The Effect of Modern Methods and Machinery.

Modern methods and machinery may accelerate both divisions of road work considerably :—

(*a*) *Earthwork and drainage.* A mechanical excavator, ditcher or grader will do the work of some 200 men. The use of such plant will greatly reduce the time and labour spent on this part of the work. Road-making machinery can travel across country and work well ahead of completed stretches of road. Wherever the situation permits full use to be made of machinery, the preparation of the formation should keep pace with all but the most rapid types of surfacing. The actual rate of work achieved will depend on many local factors, and any definite figures would be misleading.

There are, however, limitations to the use of such plant. Hilly or broken country may prevent it moving forward to work ahead of the finished road. Outcrops of rock may require blasting, where pneumatic drills will reduce the labour needed, but will not greatly increase the rate of progress. Soil which contains large boulders or is infested with roots will hold up and possibly damage excavators and graders. In war, elaborate machinery cannot be risked close to the enemy, within range of his artillery. These factors must be carefully weighed before the time-saving effect of machinery in any given case can be rightly estimated.

(*b*) *Surfacing.* Macadam roads are slow to make, and require much stone unless the soling foundation is omitted. Concrete roads can be made more rapidly and need rather less material, but must be given time to set before traffic is allowed over them.

The development of the mix-in-place method of surfacing shows a possibility of considerably speeding-up the provision of an all-weather road. As this form of construction is relatively new it will be considered in some detail in order to arrive at a correct estimate of its possibilities.

4. Mix-in-place Methods—General Description.

The expression " mix-in-place " denotes a method of construction —not a type of surface. A mix-in-place road is one in which the

surface coat is formed by mixing an aggregate with a bituminous binder on the road bed itself. The nature of the aggregate is immaterial, and may vary from the natural soil of the formation to a gravel or stone quarried elsewhere and brought to the site.

For the most rapid work, the natural soil of the formation can sometimes be used. This avoids the carriage of great quantities of stone or aggregate, which is often the limiting factor in the rate of construction of other types of surface. Very rapid progress is achieved with the aid of machinery: graders, either tractor-drawn or self-propelled, spread the aggregate, the binder is applied by pressure distributors, and the whole is mixed and again spread by graders assisted by disc and agricultural harrows. It has generally been found that pneumatic-tyred motor-traffic itself is the best way to consolidate such surfaces, after light rolling.

5. Possibilities and Limitations of Mix-in-place Roads.

When first introduced, mix-in-place roads, using the natural soil as aggregate, seemed to be successful only in localities possessing a dry climate and certain types of soil. Recent experience, however, points to a wider field of usefulness. The four principal factors which affect the military value of these roads are (a) Quality of soil and binder, (b) Climate, (c) Traffic-carrying capacity, (d) Difficulties of construction.

(*a*) *Quality of Soil and Binder.* It seems possible to bind many types of soil with binders of different characteristics, weather conditions and the relative dryness of the soil being critical factors in determining the best binder to use. The correct adjustment of the proportion of the binder is important. The difficulties of damp soil can generally be got over by the use of a suitable bitumen emulsion. Very fine soils containing a high percentage of humus, or soils containing a large proportion of clay, are not likely to give satisfactory results as far as can be ascertained by present experience.

Hard gravel or stone aggregate will give a better wearing surface than earth, but must contain a proportion of fine material as well as coarse to give a firm compact surface. On most roads there will consequently be stretches where the natural soil of the road bed cannot be bound successfully. But such stretches should form a small proportion of the total length of road, and may still be surfaced by a mix-in-place method, using a suitable aggregate imported from elsewhere.

(*b*) *Climate* affects considerably the time taken by the surface to dry out and harden. In dry weather the road should be fit for traffic after 3 days: in showery weather, a safer estimate would be 8 days: continuous rain will prevent hardening until a dry period occurs. Care during laying and rolling and devices such as the addition of a little cement during mixing will materially reduce the time of hardening. In a country where there are regular wet and dry seasons, no delay should be experienced with work done in the dry season. Once hardened, the surface will probably be unaffected by subsequent wet weather, but it is always desirable to give a surface-dressing and chipping after the mix has dried out.

(*c*) *Traffic carrying capacity.* This type of surface has no artificial foundation. The road depends for its strength on the capacity of the subsoil to carry the traffic when kept dry and protected by the wearing surface. Great attention must therefore be paid to the drainage and consolidation of the formation. The extent to which these roads will stand up to heavy military traffic is still rather uncertain. The tendency of modern vehicles is towards larger tyres and more numerous wheels, which results in less wear and tear on the surface. A mix-in-place surface which contains hard gravel or stone aggregate should suffer little under traffic. One in which earth has been used should last long enough to enable a more permanent surface to be added later, if necessary, at comparative leisure: such roads are, however, generally unsuitable for use by horse-traffic or iron-tyred vehicles.

(*d*) *Difficulty of Construction.* As with all novel forms of work, technical difficulties of execution tend to be exaggerated. The technique of mixing is no harder to master than that of concrete-making. In both cases careful supervision rather than skilled labour is needed to obtain good results.

6. PLANT-MIX METHODS.

In situations where mix-in-place cannot be used, surfaces of natural soil with a bitumen binder can be made by the use of a concrete mixer sited close by. These methods have been used with success, and result in more thorough mixing than the "mix-in-place" methods, but the rate of progress is, of course, considerably slower.

7. Conclusions as to the Military Value of Modern Developments.

In *forward areas* traffic is widely dispersed and possesses considerable cross-country capacity. Here the demand is for a rapid method of dealing with short stretches of road, *e.g.*, bridge approaches and other defiles, where a passable surface is required in a few hours. Machinery is out of place, and the amount of road-making needed is too small to justify its employment. A mix-in-place surface will not harden quickly enough to supplant expedients, such as the slab road, which can be open to traffic as soon as it is laid: but it may possibly be of value in situations where the road is not required for immediate use. Tactical road-making in forward areas is in the main unaffected by modern developments.

In back areas, broadly speaking, behind refilling points, the greater weight, concentration and lack of cross-country capacity of traffic demand serious road-making. Here modern methods and machinery will have a marked effect. The use of machinery to speed up earthwork and drainage and the adoption of the mix-in-place method of surfacing will greatly increase the rate of construction of new roads. Existing roads and tracks can be resurfaced rapidly. In many situations the large amount of transport hitherto required for road stone can be avoided by the use of aggregate found on the spot. It does not seem unduly optimistic to expect a considerable increase in the strategic mobility of a force to result from the employment of modern methods of road-making.

It is very necessary, however, that the subject should be carefully studied in detail by engineer officers, as the extremely optimistic reports on this subject which have recently appeared in the daily Press are liable to give an incorrect idea of the problems involved, and might lead to disaster if accepted on their face value.

THE WAR OFFICE EXPERIMENTAL CONVOY, 1933.

By LIEUTENANT H. P. DRAYSON, R.E.

INTRODUCTORY.

IN the early spring of 1932, the War Office sent an Experimental Convoy of four military vehicles on a long-distance trip of 5,600 miles in Egypt and the Sudan, away from garages and repair shops and passing through a great variety of climate and terrain. These four vehicles covered the route without any major defects, and from the experiment much information was obtained as to the capabilities of different types of vehicles in varying conditions. The report, subsequently issued by the War Office, has been widely circulated, and no attempt will be made here to repeat this information.

Following on the lines of the 1932 trials, another convoy was sent from Cairo in the summer of 1933, to amplify the results already obtained. With this object in view the size of the convoy was increased to six vehicles, including three new types, and notable among the points on which information was required were the questions of vehicle cooling and tyre equipment. The test was to be carried out in the summer, when high atmospheric temperatures would be experienced, and various makes and types of tyres were to be compared. The route chosen was one which would take the convoy away from all civilization and even habitation for long stretches, and over country which has in parts never been surveyed, never traversed by motor vehicles, and seldom crossed by Europeans even on camels. Thus not only would the vehicles receive a comprehensive test but also knowledge of new routes would be obtained.

COMPOSITION.

The vehicles selected for test were :—

Crossley 30 cwt. W.D. Type, 6-wheeled lorry, with a 19·6 h.p. four-cylinder engine.

Commer " Raider " 30 cwt. 4-wheeled lorry, with a 20·9 h.p. six-cylinder engine.

Morris " C " Type 30 cwt. 4-wheeled lorry, with a 24·8 h.p. four-cylinder engine.

Morris 12/15 cwt. W.D. Type Van, with a 17·9 h.p. four-cylinder engine.

Hillman "Wizard" Touring Car, with a 21·9 h.p. six-cylinder engine.

Morris "Minor" 8 h.p. four-cylinder Car with standard 2-seater body and equipment.

It is of interest to note that a Morris Van, a Crossley 6-wheeler and the same Commer "Raider" had formed part of the 1932 convoy, and information would thus be obtained as to the improvement in performance effected by a different tyre equipment.

The personnel consisted of five officers, nine other ranks and three native servants. The British personnel were drawn from units of the cavalry, Royal Artillery, Royal Engineers, Royal Corps of Signals, Royal Tank Corps and Royal Army Service Corps, stationed in Cairo. In addition a liaison officer was lent (as interpreter) to the convoy by the Sudan Government, and was able to prevent any violation of local customs. His local knowledge of the climate, inhabitants, and customs of the country not only helped considerably, but also made the trip very much more interesting.

Choice of Route.

The route chosen lay for the most part over long waterless stretches of uninhabited desert, so that the convoy had to be self-supporting as regards its equipment. Careful preparation had to be made for the carrying or supply of sufficient petrol, food and water, as well as all the equipment required for camping, navigation, salvage, etc. In addition, spare parts had to be carried for use in case of breakdown or accident to any one of the vehicles, all of which were of different types. The Appendix gives an account of the arrangements made and the equipment used.

Nature of Country.

The convoy left Cairo on the 3rd April, 1933, and drove along mud roads up the cultivated Nile Valley for some 230 miles to Asyut. There was no difficulty in this part of the journey, though the *fellaheen* with their goats, sheep, donkeys, and camels are still unappreciative of the speed of modern motor vehicles, and are singularly slow in getting to the side of the road. Though obviously disliking the moving convoy, with its attendant train of dust, these simple folk would crowd round and "rubber-neck" whenever the convoy halted, and it was a source of considerable interest to them to see the vehicles unloaded.

At Assiut the convoy camped on the edge of the desert, in the barracks of the 3rd Infantry Brigade of the Egyptian Army. The officers were entertained to tea by the Egyptian officers, while the

band played selections of Arabic music. Egyptians are renowned for their hospitality, and it was some hours later, after much hand-shaking and benediction, that the guests left with well-lined maws. Bathing in an excellent modern swimming bath was an added attraction at this camp.

From Asyut the route lay over the desert along the Darb el Arbain or "Forty Day Road," along which, in the past, countless caravans of slaves and camels had marched from Kuttum in the Western Sudan to Egypt. After two days Kharga was reached, the centre of a chain of oases stretching for some 140 miles along a sandy depression. Another three days' march brought the convoy to El Sheb, an oasis flanked by a ruined watchtower, which was formerly used for preventing the illicit smuggling of ivory into Egypt. Continuing southwards the Egypt-Sudan frontier was crossed, and a halt made at the little oasis of Selima, hidden away on the western side of a range of hills. Beautiful soft clear water abounds throughout the year at a distance of about three feet below the ground level. A supply of petrol, which had been sent out by camel transport from Wadi Halfa and dumped here, was picked up, and as direct a line as possible was followed across unsurveyed desert to Dongola on the River Nile. Although mosquitoes are rare at this time of year, there were unfortunately a few of them at large at Dongola, and three of the N.C.O's were bitten and infected. After a short stay at Dongola, the scene of Kipling's "Little Foxes," some of whose pads can still be seen ornamenting the District Commissioner's house to-day, a course parallel to and about seven miles west of the river was followed to Debba. On the way a slight detour was made to pass through Sali, the native village of the convoy's cook, Fadl, who had not been home for 20 years. News of the approaching convoy had gone ahead, and in the middle of the track, leading through the village, flanked on either side by red and yellow banners, lay Fadl's old father, who was determined not to miss seeing his long lost son. Everyone rushed out of his dwelling. The men all shook Fadl by the hand, and he was embraced by about fifty women and girls, who were ostensibly his cousins, his sisters and his aunts. The fatted calf was brought out first to be slaughtered, but instead of this a sheep was killed and amidst general rejoicing was presented to the convoy, which could not continue its journey until sweetmeats, dried dates, and native tea had been consumed.

The stretch of 820 miles from Asyut to Debba consisted of barren desert, providing nearly all varieties of desert going, including firm, gravelly and sandy plains, a maze of broken limestone hillocks interspersed with patches of soft wind-blown sand, sandstone hills rising from sandy plains, rocky and boulder-strewn country, ground closely covered with stones like petrified water-melons, belts of soft dunes, crusted sand which disintegrated into fine powdered clay, and

wadis (dry water courses) with beds of soft sand. Among the more prominent features were a long climb up to a plateau 450 feet above Asyut, a steep descent of 500 feet down the Yabsa Pass into the Kharga depression, and an unexpected escarpment with a sheer drop of 300 feet to the plain below. In the last case it was only after a long reconnaissance over very rocky going that a way down was found some four miles to the east. After the edge of the scarp had been cleared of rocks it was possible to drive the vehicles down the crest of a razor-backed ridge of sand. For one stretch of forty miles, there was a featureless plain of firm sand, over which speeds of 50 miles per hour were possible. Only the compass and the tracks left by the vehicles gave any indication of direction, as the horizon was an unbroken curve in all directions, and the mirage on all sides resembling water produced the effect of driving on a sandy island. Except in the Kharga depression and at Dongola, this part of the route was devoid of any sort of animal or insect life, and the only relics of any life lay in the skeletons of innumerable camels, sign-posting at frequent intervals the Darb el Arbain. Shortly before reaching Debba a detour had to be made to avoid a belt of sand dunes. But the Morris Van fitted with semi-air wheels in front and 15-inch air wheels behind was able to show that with a large bearing surface, such as these tyres produce, even dunes of soft sand are by no means an insuperable obstacle. With such tyre equipment the intensity of pressure on the ground is about 8 lb. per square inch, compared with a pressure of 12½ lb. per square inch produced by a walking camel.

Leaving behind the pink and white houses of Debba and the fertile Nile Valley, the convoy travelled in a south-westerly direction down the Wadi el Melik to the Wells at Baqariya et Tuwal, where a second petrol dump had been laid down. The Wadi el Melik is the bed of an extinct river, now forming a shallow depression, stretching for about 350 miles from its mouth at Debba. Its main course is defined by a belt of trees and bushes. The country, which commences as open desert, becomes more and more covered with grasses and more and more bumpy as one proceeds southwards. In places the Wadi narrows to a width of about two miles and is flanked by ranges of broken sandstone hills and barred by a continuous belt of soft crescent shaped dunes across its width, and in others it opens out into a grassy plain with no well-defined course. To avoid these belts of dunes, the convoy had to take to the foothills, which were extremely rocky and boulder-strewn. A few Kabbabish Arabs were met watering their camels at Mastul Wells, where water is found at a depth of 30 feet. Only one of these wells produces water that is fit for human consumption. Fifty miles farther on, four more Arabs with a few camels were resting in the shade of a tree. With their desert hospitality they invited us to drink some water obtained nearby

from Bir Sibur, a well producing a small quantity of water, which was dirty and unpalatable. Another 80 miles of hummocky and rocky going brought the convoy to El Ein spring at the foot of Jebel Nagashush, a range of hills sixty miles long, which is reputed to be a good hunting ground for Barbary sheep. A plentiful and permanent supply of good water can be obtained from a rock pool, and a herd of camels was seen moving away from it after watering. This spring is well marked, as on the edge of a spur of Jebel Nagashush about 1½ miles to the east there is an unmistakable isolated portion of rock resembling the ruins of an ancient castle. After journeying 130 miles southwards from El Ein over patchy country, the wells of Baqariya et Tuwal were reached, and here were the first signs of any habitation since Debba, some 300 miles back. There are 60 or 70 wells about 25 feet deep which produce an unlimited supply of good drinking water, and round the wells there is grouped a permanent Arab settlement. Thousands of camels, cattle, sheep, goats and donkeys water at the wells throughout the year. During the summer, as the pastures and wells dry up farther west, the Arabs bring their flocks eastwards towards the Nile, until they reach these permanent wells, where they settle until after the rains, when they wander over the western pasturelands again.

From Baqariya the route lay westwards over unsurveyed and little-known country, heading *via* the Meidob hills for El Fasher, the capital of Darfur province, which was the scene of operations in Ali Dinar's rising of 1916.

This country west of the Wadi el Melik is known as the *gizzu* area. *Gizzu* is the generic name of a group of grasses which grow on and consolidate a country of sand dunes. In particular the *tabas* grass forms round its roots a hard hummock of sand of about 15 inches diameter and one foot high. These hummocks with their plumes of bushy grass are scattered at intervals of two to three feet, making it impossible to drive a car so as to avoid them. A painful succession of jolts is inevitable. Another prolific type of grass, known as *heskanit*, is covered with burrs, which attach themselves to clothing, equipment or skin without distinction, and are extremely difficult to remove. They become embedded in the tread of the tyres, and give them the appearance of a stubbly growth of beard. Unless a wire mesh guard is set in front of and well clear of the radiators, they become choked with these burrs and have to be frequently cleared out, a difficult operation and a tiresome one, as whoever is doing the clearing has afterwards also to rid himself of these tenacious burrs. In this area, too, at intervals of about half to three-quarters of a mile there are *khors* (dry water courses) with beds of soft sand, and often with steep banks, running in a general north and south direction. Trees and bushes generally grow in profusion in these *khors*. To cross a *khor* thus often entails dropping very slowly into the soft

1.—The convoy north of Kharga oasis.

2.—Sand dunes in Wadi el Melik.

3.—Camp Cookhouse, showing chicken run.

The War Office experimental convoy, 1933 1-3

4.—Rocky country south of Selima.

5.—Camp at oasis of El Sheb.

6.—Crossing river Atbara.

The War Office experimental convoy, 1933 4-6

sandy bed, picking a circuitous route between the bushes, and climbing out on the other side. As soft sand taken slowly nearly always causes wheelslip and the wheels then dig themselves in, the result was that nearly every crossing needed careful reconnaissance on foot, and then the extensive use of the steel channels and canvas mats, which was a laborious and painful job, as the steel channels used to get extremely hot with the sun blazing down on them in a shade temperature of about 110° Fahrenheit. It is little to be wondered at that, travelling over this country of continuous bumps, with *khors* to cross at such frequent intervals, the rate of progress should be greatly slowed down. Instead of covering the anticipated 60 or 70 miles a day, 23, 14, and 26 miles were the results of three days' really hard work. To anyone sitting at home with water hot and cold laid on and available in unlimited quantities, with tankards of foaming ale to be had for the asking, it may seem incongruous to think that a glass of cold water could have any great value. But in such circumstances, where one gallon of tepid water per day for all purposes was the ration, values are very greatly altered. After some hundred miles of this going the convoy reached the Jebel Heitan, a ridge of black hills, flanking a rocky plateau, across which it seemed impossible for vehicles to proceed. Since a vehicle test, and not exploration, was the object of the trip, and since shortage of water, excessive consumption of petrol and signs of sickness amongst the personnel were not conducive to making a long detour round the unknown northern edge of these hills, the convoy returned to Baqariya over this very unpleasant country, which is far more suited to camel transport than to motor vehicles. Rock pictures have been discovered in this area, and it had been hoped that some articles of archæological or geological interest might be found, but the only ones seen were some Anag graves, circular piles of stones grouped round the bases of granite outcrops. There was some animal life to lend interest to the country. Dorcas and Ruffifrons gazelle were in places numerous, and near Jebel Heitan some Addra gazelle (*ril*) were seen. The last are unmistakable, as they are larger than most other types of gazelle, and are for the greater part white in colour. In one place a pair of Oryx horns was found. Ostriches and bustard were seen, as well as some small white foxes and large Warrender lizards. One gazelle, which galloped in front of the convoy over one of the rare smooth stretches, maintained a speed of about fifty miles an hour. From time to time a gazelle or bustard graced the dinner table, and formed a welcome variation to the menu.

On arriving back at Baqariya, dirty and bearded, the personnel experienced again the joys of ample water supply, which were appreciated as never before. The ordinary camp bath, made of green Willesden canvas, is normally an uninviting affair, but after one has

been deprived of even such luxuries as this for some days, it affords a most comforting and welcome relief.

The next stage was one of 84 miles southwards to Sodiri, during which the same bad going continued. But the country gradually changed its nature, and thick bush was encountered for part of the way.

From Sodiri to El Obeid, a distance of 128 miles over heavy sand tracks, was covered in a day's run, a very satisfactory performance.

From El Obeid to Cairo, the convoy followed in the reverse direction the route taken in 1932. As the route was known, most of its difficulties were minimized, and deviations to avoid patches of desert country, known to be very bad, provided a slightly easier route. This stretch served as an excellent means of comparing the performances of the vehicles, taking part in the 1932 and the 1933 convoys. One or two points are worth mentioning, as the conditions were not quite identical.

Although the rainy season was not yet due, thunder, lightning, and rain, as well as some fierce sandstorms were experienced between El Obeid and Khartoum. Along this stretch there is a cleared track, regularly used by cars and lorries, running for the first 150 miles through undulating grasslands and park-like country. This track is of red sand, deeply rutted and cut up in places, particularly where it crosses the *goz* (sandy ridges), and where it passes through villages. The remaining 250 miles traverse firm earth and sand tracks, running through bush country and cultivation. The effect of the rain was to make the sand rather more compact, but the earth tracks became very soft and greasy. The treadless air wheels, which were so efficacious in soft sand, were very prone to skid in the mud. At Kosti, where the convoy crossed the River White Nile by the roadway cantilevered out from the side of the railway bridge 400 yards long, caution was necessary, as the 30-cwt. lorries had only about two inches clearance on each side. But with the aid of a pilot ahead on foot assisting to direct the lorry drivers, no trouble was experienced.

From Khartoum to Abidia the route lay parallel to the River Nile over earth and sand tracks, running through sparse bush country and cultivated land. The River Atbara had to be crossed. The only ferry available was a decked-in native boat, normally used for ferrying touring cars. It had just sufficient buoyancy to carry the 30-cwt. lorries (the Crossley had to be unloaded), with the freeboard reduced to a negligible minimum, so that it shipped an incredible amount of water and had to be baled out after each crossing.

North of Abidia, the country close to the river is very broken, so a detour had to be made over open desert for 111 miles, coming into the river again at Abu Hamed. A more easterly route was taken than in 1932, and better going was experienced.

Another desert stretch of 226 miles, following the line of the railway, built by Girouard in 1897 (*vide The Royal Engineers Journal*, June, 1933, page 327), brought the convoy to Wadi Halfa, where the River Nile was crossed without difficulty on two large decked-in barges towed by a river steamer. From here the route to Idfu lay over 267 miles of waterless desert, devoid of all forms of life. On one day during this stretch, the temperature at 4.30 p.m. was 115° F. in the shade, and a burning wind blew all night, making sleep extremely difficult.

From Idfu to Cairo there were mud roads, running through the cultivated Nile Valley, and the only difficulties experienced were caused by the pedestrians and animals which wandered dreamily in the middle of the road, and by the dense clouds of dust thrown up by the vehicles. The convoy crossed the River Nile over the barrage at Isna and back again at Nag Hammadi, and arrived back in Cairo early in June, having set out 63 days before.

Summary of Time and Distances.

(*a*) *Time.*

Running days	41
Days for maintenance and writing reports	18
Rest days	4
Total	63 days.

The average working day when running was of 9 hours, composed as under :—

Running time	6½ hours
Halts for checking tyre pressures, changing drivers, etc.	1 hour
Loading, unloading and maintenance in camp	1½ hours
Total	9 hours

(*b*) *Distance.*

The total distance travelled was 3,557 miles, over types of ground which may be roughly classified as :—

Earth roads	760 miles
Cleared tracks and firm sand	500 miles
Heavy sand	280 miles
Barren desert of all types, with hilly and rocky country	1440 miles
Grassland and bush country, intersected with numerous dry watercourses	580 miles

(*c*) *Progress.*

An average of 87 miles per running day was maintained at an average speed, excluding halts, of 14·4 m.p.h. The best day's run was 181 miles at 23·1 m.p.h. The worst day's run was 14 miles at 2·6 m.p.h.

HALTS AND DEFECTS.

(*a*) *Halts.* During the whole trip the convoy had the following involuntary halts on the road :—

For mechanical defects	8 hours
Owing to overheating of engines	4¾ hours
Owing to difficulties of terrain, *e.g.*, soft sand reconnaissances, etc.	11½ hours*

(*b*) *Tyres.* There were only nine punctures in 92,500 wheel miles.

(*c*) *Cooling.* The "Still" type of radiator proved very efficient even in temperatures of well over 100° F.

(*d*) *Springs.* The total spring breakages were three leaves and one clip.

(*e*) *Other Mechanical Defects.* One gear box became slightly damaged, but the defect was remedied without difficulty. A starter motor jammed on two occasions. Although carburetter air filters were fitted, sand and dust continually found their way into the carburetters, which needed frequent cleaning. A track rod was bent, due to hitting a large boulder. One exhaust valve was burnt out and was replaced. These were the only defects worth recording.

CONCLUSION.

Although the route chosen had to be altered, satisfactory results were obtained from the test. The performance of the vehicles taken on these two convoys is now known in a wide variety of conditions of both climate and terrain. Their ability to stand up to excessive and prolonged strain and jolting is proved. Only in certain minor details did some of the vehicles fail. Throughout the two trips, totalling some 9,000 miles, there was no serious defect in any vehicle, and involuntary halts on the road were surprisingly few—a great tribute to British design and workmanship.

The country encountered west of Baqariya Wells shows fairly conclusively that, although the desert in general is suitable for the operation of mechanical transport, there are stretches where it would be more economical, efficient and speedy to use camel transport. Over such stretches petrol consumption reaches an extremely high

* This time does not include three days when the thick grass country and numerous *khors* made reconnaissance on foot too frequent an occurrence to record accurately.

figure, and the problem of petrol supply is a serious one. Another point to be borne in mind is that country over which a few vehicles can manœuvre fairly easily may be a very difficult problem for a train of M.T. vehicles, particularly where there is anything in the nature of a defile, as once the surface of sand has been disturbed, its bearing power becomes considerably lessened.

However, the experiment has shown that modern British vehicles are capable of operating over unknown desert country, away from tracks, repair shops and outside help, and it is to be hoped that these and future tests will enable the manufacturers to produce the means of overcoming more easily what difficulties at present exist.

APPENDIX.

As previously stated, careful arrangements had to be made for the supply of petrol, water, food and equipment. An outline of the arrangements made and methods used is given below :—

PETROL.

The performance of the new vehicles in desert country was not accurately known, so that petrol consumption figures had to be estimated and an allowance made for contingencies. The figures adopted proved satisfactory, except in the case of some excessively bad going west of Baqariya Wells, where the petrol consumption rose to three times the normal. The convoy could carry enough petrol for a stretch of 350 miles, but in two cases 600-mile stretches of uninhabited desert had to be crossed. To allow for this, petrol had to be taken out on camels and dumped at Selima Oasis and at Baqariya Wells before the arrival of the convoy.

WATER.

Arrangements had to be made for carrying an eight-days supply of water, which would provide a reserve in case of a breakdown on the route and subsequent delay. An allowance of one gallon per man per day was reckoned on, and this allowance proved by no means excessive on a long tiring day's driving (and pushing) in a shade temperature of about 105° F., where there was no shade other than that provided by the vehicles themselves.

Four methods of carrying the water were tried out :

(*a*) *Fanatis* (camel tanks) carrying 12½ gallons. These are robust but heavy to handle, and the water becomes very hot.

(*b*) Two 28-gallon tanks, built into the forward end of the Morris lorry. These had drain plugs projecting below the body, so that water could be drawn off at any time, without disturbing the load. They are most convenient to use, though again the water does not keep cool.

(*c*) Canvas water containers, carried in a webbing cradle, and fitted with a brass screw cap. The water evaporates through the canvas, and the temperature is consequently kept low. The containers hold seven gallons when full, but the daily wastage from evaporation is about one gallon. They are light and easily packed when not in use.

(*d*) Canvas water bottles, holding ¾ gallon. These can be slung on the sides of the vehicles and the water kept cool, but the wastage from evaporation is considerable. They need frequent scrubbing, and sand and dust adhere to the wet canvas. Unless the canvas is kept clean the water becomes foul, and also the evaporation is nullified so that the water does not keep cool.

FOOD.

Standard food boxes were prepared containing enough of every article of food to last the convoy for a week. These boxes were dispatched to various points along the route and picked up as the convoy passed through. A fortnight's supply was normally carried, as well as a reserve box of iron rations.

Along the Nile Valley, fresh meat, eggs and vegetables could be obtained, but the desert was for the most part devoid of animal life. Crates of live chickens were always carried at the beginning of each desert stretch, and such gazelle or bustard as were shot gave a periodical variation to the menu. Where fresh vegetables were unobtainable, lime-juice was found to be an excellent anti-scorbutic and refreshing drink.

Cooking gear, crockery and cutlery were reduced to a reasonable minimum, and to avoid breakages were packed in special felt-lined boxes. Much time and worry was saved by packing each type of utensil in its own labelled box.

CAMP EQUIPMENT.

The normal method of making camp was to draw up the lorries abreast at intervals of 11 feet. Tarpaulins were stretched over the gaps between the vehicles to give head cover, and canvas screens round the back as a wind-break. Thus three shelters were formed, which were used for writing and feeding purposes, and on windy nights for sleeping. Folding tables and camp stools were easy for packing and sufficiently rigid for normal purposes, though the heavyweight of the party periodically proved too much for the canvas seats of the stools.

The officers had their camp beds, and the other ranks had "biscuit" mattresses, which proved more satisfactory than the hammocks used in 1932. The risk of sharing a bed with a scorpion was of little account, compared with that of falling out of a hammock. Petrol lamps were of great value, and, provided they were properly looked after, gave little trouble. The wall of an E.P. tent made an admirable wind-break for the cookhouse.

SPARE PARTS.

All spare parts likely to be required had to be carried, as the convoy had to operate far away from garages and repair shops. The six vehicles were all of different types, and spares had to be carried for each vehicle, making a bulky and heavy load.

SALVAGE EQUIPMENT.

For use in cases where the vehicles stuck in soft sand, stout canvas mats were carried, about fifteen inches wide and thirty feet long. The canvas was double thickness, and every four inches a bamboo rung was sewn between the two layers. These mats were very portable and efficient and better than the rope and bamboo ladders used in 1932. In addition, steel channels were carried, and were used in very soft patches, to give the rear wheels, which had sunk far into the sand, a solid bed on which to run out. The combination of channels in front of the rear wheels and canvas mats laid out in front of the front wheels proved very successful.

The channels were also of value when crossing small ditches, and when loading the vehicles on to barges. Picks and shovels formed part of the lorries' normal equipment.

WIRELESS.

A short-wave wireless set was carried in the "Commer" Raider. This set, including its batteries and charging set, only weighed 10 cwt., and occupied very little space, so that the lorry could carry a ton of other stores in addition.

Throughout the trip wireless communication was maintained with Cairo, and *via* Ismailia with Khartoum. The progress of the convoy was reported daily, and on two occasions, when sick men had to be treated, the wireless set proved invaluable in obtaining speedy assistance from the Royal Air Force.

Wireless time signals were received from Europe every evening, which gave a daily check on the rate of the chronometers used in connection with the astronomical observations for latitude and longitude.

MEDICAL.

A fairly comprehensive supply of medical stores was carried, sufficient to cope with what minor ailments or accidents were likely to occur. In addition all ranks were instructed in simple first-aid and precautionary methods. During the trip, medical assistance was given to various sick Arabs, who were encountered along the route, and who were extremely grateful for what help could be given to them.

COMMUNICATIONS.

As mentioned above, wireless was relied on for communicating daily with Cairo. Ground strips and code signs were carried for use in case of air co-operation, and a simple system of flag signals within the convoy served to give warning of bad going, temporary stoppage of a vehicle, etc.

NAVIGATION.

As a great deal of the route lay over desert country, waterless except for oases and wells at long intervals, and as some of this country had never been surveyed and some only mapped approximately from the route reports of camel travellers, the necessity for accurate navigation was apparent. The method adopted in all the desert stretches was a compass and speedometer traverse. A brief outline of the instruments used is given below.

(*a*) *Maps.* A collection of 54 map sheets was made, covering the route. The majority of these were on a scale of 1/250,000, which is a very convenient scale for a car traverse. The course was plotted on the map during the day's run, and adjusted at night to conform with the position of the camp, fixed astronomically. It was not possible at the start of a day's run to lay down a definite line to follow, as the accidents of the ground affected the course to some extent. Detours to avoid ranges of hills, sand dunes or rocky country had to be allowed for, also the prevailing wind forms a series of ridges over the surface of the sand, which cause the driver of a car to follow instinctively the easiest route, which lies in the same direction as the ridges.

(*b*) An aero-compass, type P.4, mounted on Sorbo pads on the floor of the Hillman "Wizard" between the front and rear seats, was used throughout for maintaining direction. At Cairo, before starting out, the compass was swung, and the corrector box adjusted to counteract, as far as possible, the local magnetic attraction of the various metal parts of the car, and a table of compass errors was made. These errors were found to alter slightly during the trip, and fresh tables were made at Dongola and at Khartoum. In featureless country the use of this compass proved to be a reasonably accurate and very simple method of maintaining direction.

(*c*) A sun compass was carried, but was not used, as the aero-compass proved satisfactory. This compass, which is fixed to the dashboard of the leading car, resembles a simple sundial. A vertical stile throws the sun's shadow on a horizontal shadow ring, graduated on its plane upper surface into 360°, and on its cylindrical edge into 180°, both clockwise and anti-clockwise. The sun's azimuth is set on this latter scale at half-hourly intervals, and an arrow disc is set to the required bearing on the upper scale. The car is then driven in such a direction that the shadow of the stile falls over the arrow. This instrument, which gives true bearings directly, is normally very accurate, but with increasing altitudes of the sun over 65° its accuracy falls off, especially in the middle of the day, when the sun's azimuth changes very rapidly.

(*d*) Prismatic compasses were used for taking bearings to features when sketching in detail on the maps.

(*e*) A 3½-inch micrometer theodolite was used for obtaining the latitudes and longitudes of camps. Longitudes were obtained by observing altitudes of pairs of east and west stars, and latitudes from observed altitudes of Polaris. These fixed positions, which should be accurate to within half a mile, were invaluable for checking the compass traverse in featureless or unsurveyed country. Difficulties did from time to time arise, and for three successive nights between Kharga and El Sheb, contrary to the usual custom of this part of the world, heavy banks of cloud obscured the whole sky throughout the night, so that no observations could be made at all. There was thus no check on the compass traverse, which fortunately proved sufficiently accurate to enable the convoy to arrive at the oasis of El Sheb.

(*f*) Two mean time chronometer watches were carried, and their rate checked daily by wireless time signals. By receiving these time signals during the astronomical observations, great accuracy of the observed times was obtained.

(*g*) An aneroid barometer and a survey thermometer were used for obtaining heights along the route, and for computing the refraction for the astronomical observations. Owing to the excessive jolting the index correction for the barometer altered considerably during the journey, and the lack of control points rendered its readings somewhat unreliable.

(*h*) The speedometers of the six vehicles were checked before leaving Cairo and their errors noted. Distances were measured by taking the mean of the corrected speedometer readings, making allowance for any of the vehicles having left the course for reconnaissance or other purposes. In confined or broken country, where course had to be changed approximately every hundred yards, these distances were only approximate, but in open country they proved to be extremely accurate.

SAINT THOMAS'S MOUNT POWER STATION.

By BIJLI.

I.—GENERAL CONSIDERATION.

IT is thought that a brief description of a typical M.E.S. power station in India may be of general interest to all R.E. officers.

Saint Thomas's Mount is a small cantonment, situated ten miles south-west of Madras. The garrison comprises two companies of British infantry and one regiment of Indian infantry. There is a civil population of about 4,000. The climate is most aptly described as twelve months' damp, hot weather, of which four months are not quite so hot. The full *punkah* season is from 1st March to 31st October every year. For the remaining months half the reasonable allowance of energy for ventilation is authorized.

Size of the Load.

The original installation gave a total connected load of 93·58 kw. During the first three years of working this increased by approximately 30%. This rate of increase of the load is an important factor to bear in mind when designing a power station, and often a difficult one to determine, because once electricity is readily available the demand for it increases very rapidly. The details of the total connected load during the first three years of working of this power station are given below.

Summary of Total Connected Load.

	1928–29. kw.	1929–30. kw.	1930–31. kw.
Entitled Military Connections.			
Lights in barracks, etc.	30·26	30·26	30·26
Fans in barracks, etc.	52·02	52·02	52·46
Exterior lighting of barracks ..		0·90	0·90
Non-entitled Connections.			
Street lighting of cantonment ..	1·48	1·48	1·48
Private consumers			
Lights and fans	9·82	14·12	28·90
Power			10·16
Total connected load ..	93·58	98·78	124·16

M.E.S. to Generate or to Purchase from an Outside Source.

The nearest outside source of electricity would have been the supply from the Madras Electric Supply Corporation. Their pro-

posal was that they were to extend their mains at a cost of Rs. 14,400 and as the military load alone did not justify this outlay the military were to contribute a monthly sum, in addition to the usual power charges of 5 annas per unit, towards interest and depreciation. This would amount to Rs. 984 p.m. at the beginning and would be reduced according to a sliding scale, as the other than military load was developed. This extra payment to cease when the extra load amounted to 100 kw. After estimating it was decided to install our own generating plant. The results already obtained have proved this decision correct. The " all-in cost " per unit supplied at the consumers' meters, inclusive of on-costs, depreciation and interest, for the first year of working of the M.E.S. Power Station was As. 5.870, for the second year As. 4.01, and for the third year As. 3.60.

The profits on the complete installation, when costing energy at the " All India " rates of As. 6 for lights and fans, As. 4½ for street lighting and power on an unrestricted basis, and As. 3½ for power on a restricted hour basis, were :—

1928–29	Profit Rs.	337
1929–30	,, Rs.	15,282
1930–31	,, Rs.	18,852

The capital outlay on the original generating and distribution plant has been Rs. 138,134 as against a sum of Rs. 14,400 required by the Madras Electric Corporation for a share of the transmission line, etc. However, the M.E.S. are now sole owners of all plant, whereas the transmission line, etc., would have become the property of the Madras Electric Supply Corporation if it had been decided to take a supply from them.

Site of Power Station.

The site selected for the power station is practically ideal. It has the following good points :—

(*a*) It is central, that is to say, as near as practicable to the centre of gravity of the load.

(*b*) It is easy of access, being situated on a main road.

(*c*) An ample supply of good water is available within 100 yards of the station.

II.—Buildings.

1. *Lay-out.*

The power station stands in its own grounds, which also accommodate the Station Superintendent's quarter and those of the power station employees who are required to live near their work, and is of ample dimensions for future extensions, housing stores,

etc. The unoccupied portion of the ground has been planted as an orchard, which should in time yield a revenue. An important point to bear in mind when selecting a site is to take plenty of space for the power station and its auxiliary buildings. This has been most judiciously accomplished in this case.

The design of the building incorporated the following important points:—

(*a*) The fuel tank is near the entrance, it is underground and so not unsightly.

(*b*) The switchboard has been placed at the end of the building nearest to the main road, thereby simplifying and reducing the length of the lead-out to overhead distribution.

(*c*) A separate room distinct from the engine-room has been provided for the water cooling on the north side of the building.

(*d*) The runs of the exhaust pipes have been kept as short and as straight as possible.

(*Note.*—It may appear from the plan that the two exhaust pipes near the main entrance are a nuisance. But, in point of fact, this is not so, because the silencers and the exhaust pipes supplied by the makers of the engines are of ample size, and so it is almost impossible to tell which engine is running when standing in the doorway.)

(*e*) The end wall is easily removable for future extension. An R.S.J. has been inserted across the top to carry the weight of the roof when this is done.

(*f*) The main entrance is at the side and so arranged that a lorry can back right into the engine-room and be unloaded by the overhead crane.

(*g*) The administrative rooms, viz., office and stores, are grouped and on the opposite side of the building to the exhausts.

(*h*) The fan repair workshop, which repairs are charged to a separate budget head, is distinct from the power station workshop. The latter is part of the engine-room, in order to enable fitting of parts to be done quickly and to facilitate supervision.

The only criticism which the authors have to offer regarding the design is with regard to the fuel storage capacity. The original capacity was 3,200 gallons. The present consumption is 1,000 gallons per month. The usual practice in India is to keep three months' reserve of fuel in hand; to enable this to be done it has already been necessary to store fuel in barrels. It is suggested, therefore, that when designing a power station, very ample fuel storage should be constructed (say, 12 months for the initial anticipated consumption).

The buildings consist of three main blocks :—

2. *Power Station.*

This is of brick in lime (with exception of the northern wall which, as stated on page 76, is of brick in clay, in order to facilitate demolition if future extensions take place). The walls are plastered on both sides.

The roof is of Madras terrace (*i.e.*, a flat roof of tiles, concrete and plaster laid over R.S.J's).

In the engine-room there is an overhead crane running the length of the room. Its lifting capacity is 5 tons. Fuel is stored in two steel tanks (1,600 gallons each) in a masonry pit, covered with concrete slabs, and in a concrete tank of 1,700 gallons capacity.

3. *Superintendent's Quarters.*

This is a Class VII (Warrant Officer's quarter) with necessary outhouses. The superstructure is brick in lime plastered, and the roof is of Mangalore tiles.

4. *Driver's and Mechanic's Quarters.*

These are of brick in lime, plastered and are roofed with Big Six Asbestos sheeting.

III.—Generating Plant.

1. *Number and Size of Sets.*

Two 30-kw. generating sets were originally installed, the intention being to add a third identical set after the first two years of working.

Before this third set was installed the question of whether it would be better to install one 30-kw. set or two smaller ones, such as one 20-kw. and one 10-kw., was considered. By making rough approximations and certain assumptions as to the future load on the station, it was calculated that installing two small sets would improve the load factor of each individual set and so give more efficient working of the whole station. The saving in fuel oil alone would be about Rs. 2/4 per diem, viz., Rs. 875 per annum. The difference in capital outlay was Rs. 3,000 in favour of the one large set, which represents an annual saving of Rs. 450, reckoning interest at 6%, depreciation at 5% and maintenance at 4%. The ultimate deciding factor in favour of the one 30-kw. set, however, was that it would be identical with the two existing sets and so reduce the number of spares to be carried to an absolute minimum, each part of any set in the station being interchangeable with the corresponding part of any other set. This advantage finally outweighed all other considerations, and the importance of it for any station abroad,

where the supply of spares is inevitably a tedious, expensive and slow process, can scarcely be too highly stressed.

The load is gradually increasing more or less on the lines predicted. A project is already in hand for a piped water supply to all military buildings. The pumping will be done electrically. This load will help to fill up the valleys in the load curve. The load curves are typical of any power station of this size and are illustrated herewith. A factor which tends to economic running of this station is that there is no really cold weather in Madras, and so fans are used all the year round.

The original hours of running allowed for closing down the station completely for a period varying from two to five hours in the morning whilst the troops were on parade, and from 4 to 6 p.m. during recreation hours. An experiment of running continuously for 24 hours every day was made for two years, in the hope of attracting additional consumers and encouraging existing ones to use more electricity for domestic appliances. The station is now running continuously.

2. *Engines.*

The prime movers are all three identical in all respects so that all parts are interchangeable, as already mentioned. They are each single-cylinder, horizontal, cold-starting crude oil engines, manufactured by Messrs. Ruston & Hornsby, Ltd., Lincoln; their type No. 9XHE. Each engine is of a nominal 60 h.p. So there is ample power available for driving the 30-kw. generators.

These engines have proved extremely satisfactory; they are simple, reliable and efficient. All moving parts are very accessible and the cylinder liner can be withdrawn easily.

They run well on second-grade fuel. The exhaust is practically colourless, except when the atomizer is dirty. Carbon deposit is not excessive. The fuel consumption is excellent and well within the manufacturers' guaranteed figure.

The figures actually obtained from the periodical tests are compared below with the average consumption.

	No. 1 Set. lb./kwh.	No. 2 Set. lb./kwh.	No. 3 Set. lb./kwh.
Periodical Test.			
Three-quarter load	·71	·74	·69
Full load	·68	·70	·61
Average Consumption	·69	·72	·65

The average consumption is carefully recorded for each set every time it is run and provides a measure of the condition of the engine,

which can be ascertained immediately. This method is recommended for adoption in all power stations, because it enables the station superintendent and the staff to take a keen interest in the efficiency of their machines and to keep their running costs down to a minimum.

3. *Cooling Water.*

The original system of mechanical coolers was installed by the Indian Stores Department and proved extravagant and unsatisfactory. It consisted of two Heenan & Froude K4 type mechanical coolers, each driven by a 6-h.p. electric motor by means of belts and shafting. During the first year of working 21·9% of the total energy generated in the power station was consumed by the station auxiliaries, the bulk of it in driving these coolers. The water pumps gave continual trouble, likewise the chains driving them. The noise inside the cooler-room, with only one cooler running, was terrific.

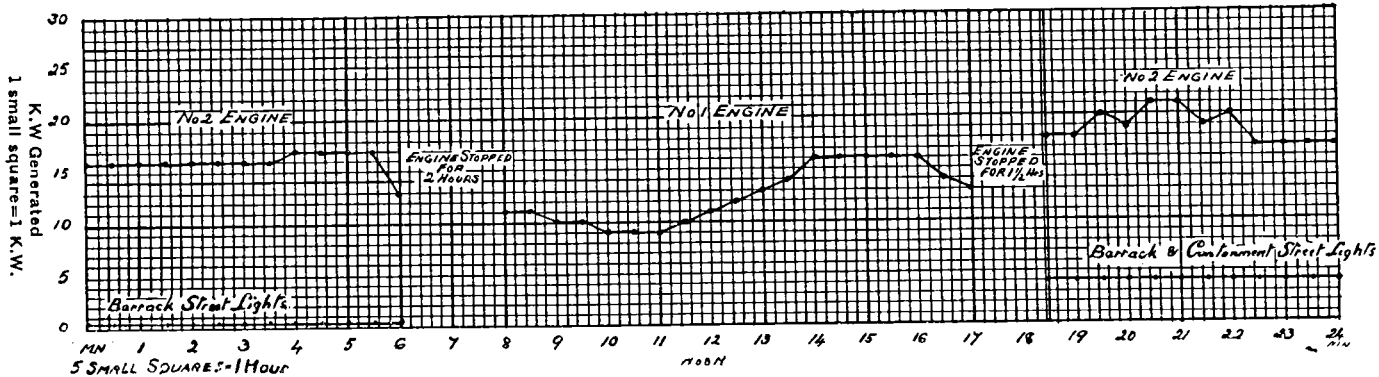
The whole system has been completely remodelled, and is now as shown. The two K4 coolers still remain, but their water pumps have been removed. An underground sump of 1,000-gallon capacity has been built to collect the water after it has passed through the coolers. The 6-h.p. motors have been removed, and replaced by much smaller machines. A 1-h.p. motor now drives the fan of one of the coolers at 690 r.p.m. And a 2-h.p. motor drives the other at 960 r.p.m.

A single-stage Tangye centrifugal pump, capable of delivering 500 gallons per minute against 15-ft. head, has been coupled to one of the 6-h.p. motors, and the whole set sunk in a pit, so that the pump is flooded before the 1,000-gallon sump is full. When the sump is full, a float switch operates an automatic controller, which starts as soon as the sump is empty. It takes just over two minutes to empty the sump and lift the contents into the two 1,600-gallon tanks, which are situated on the roof of the cooler-room. This automatic apparatus has now been working for more than four years without any attention other than oiling of the pump and motor bearings. When the third generating set was installed, an additional Heenan & Froude K3 type cooler (less water pump), driven by a 1-h.p. electric motor, was erected. But this is an unnecessary luxury.

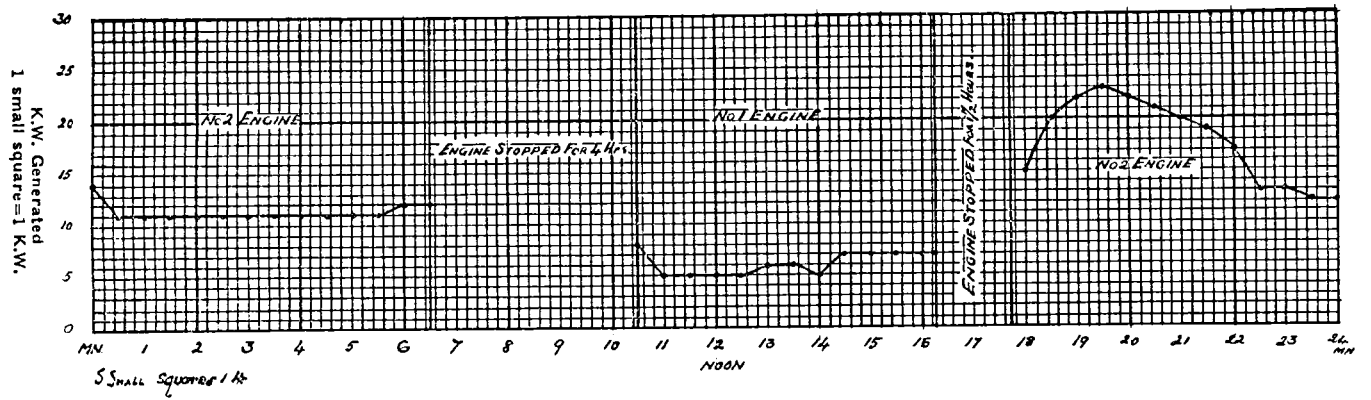
In actual practice during certain seasons of the year, it has been found possible to dispense with mechanical cooling altogether, that is to say, the water is sufficiently cooled by passing through the cooler (or coolers in parallel) without the fan running.

During 1930–31 only 5·3% of the total units generated were consumed in the power station.

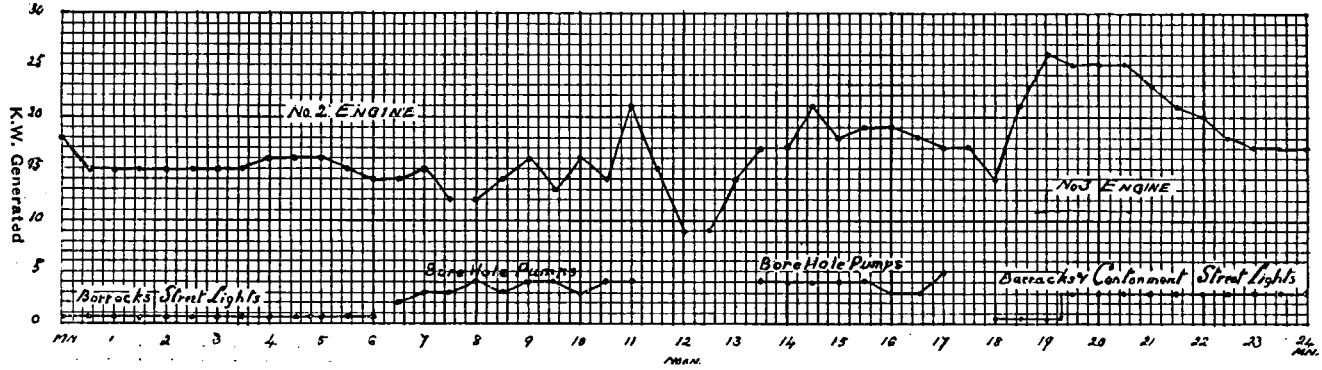
Summer Load Curve of 21st June, 1928.



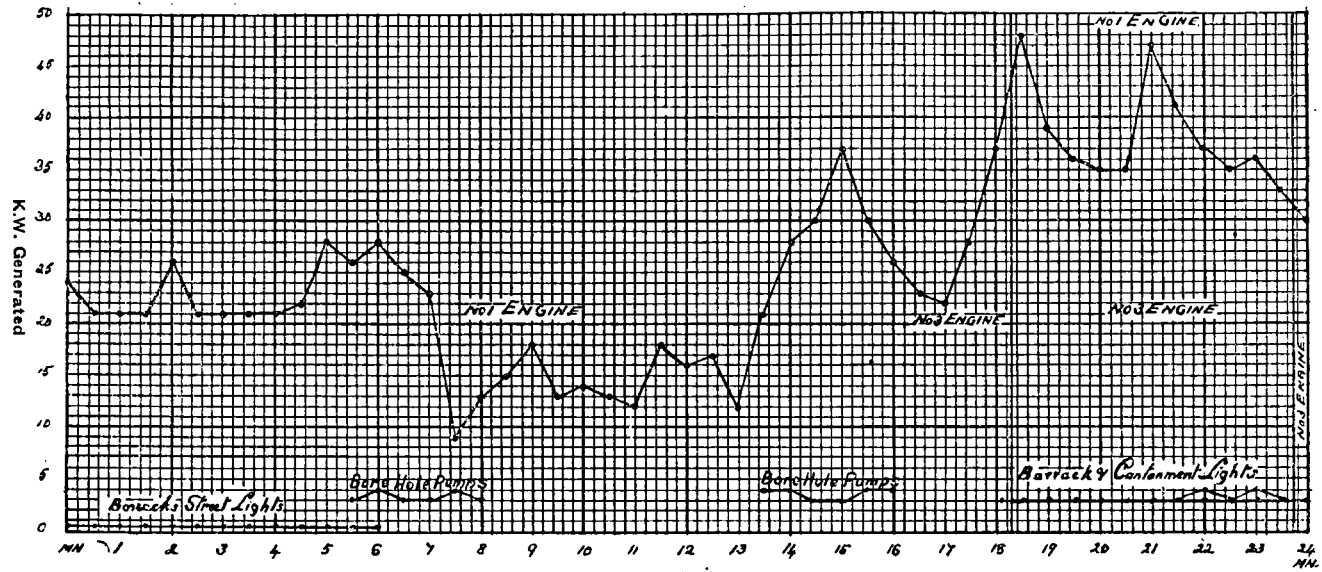
Winter Load Curve of 21st December, 1928.



Summer Load Curve of 21st June, 1933.



Winter Load Curve of 12th November, 1933.



4. *Generators.*

The system of supply of electricity is direct current three-wire, 460-volt between outers with earthed neutral. The generators are each 30-kw. compound wound, semi-enclosed machines, manufactured by Messrs. Metropolitan-Vickers, direct coupled to the prime movers by means of belt and pin type flexible couplings.

The generators are slightly over-compounded so that the bus-bar pressure rises slightly as the load increases. This is found to be extremely satisfactory in practice.

5. *Static Balancing.*

Balancing is done automatically by means of Metropolitan-Vickers static balancers, which are provided on the scale of one per generator, and are each capable of dealing with 15% out-of-balance current on that generator; in actual practice this amount of out-of-balance current has never been encountered.

6. *Switchboard.*

The switchboard is of standard pattern. Generator panels are grouped together on the left, mid-wire meters and control gear in the centre, and feeder panels on the right.

Overload and reverse current trips are fitted to the main circuit breakers of each generator. These are arranged to operate so that an overload on either side of the three-wire system trips the breaker of both outers, an important detail when using three-wire D.C. distributors.

IV.—MAINTENANCE AND OPERATION.

1. *Salaries and Wages.*

The staff employed for maintenance and operation of the power station and distribution system are as follows:—

	Rate of Pay per Month.
1 Station Superintendent	Rs. 220
1 Assistant	Rs. 65
1 Head Fitter Driver	Rs. 60
2 Fitter Drivers	Rs. 50
1 „ Driver	Rs. 40
1 Switchboard Attendant	Rs. 50
2 „ Attendants	Rs. 40
1 Lineman	Rs. 50
5 Coolies, Assistant Drivers, etc.	Rs. 15
1 Sweeper	Rs. 15

In addition to the above men, it is occasionally necessary to employ a few men on Muster Roll, *e.g.*, in the event of storms blowing trees down across the overhead distributors. The Muster Roll payments

vary from Rs. 25 to Rs. 50 per month. Inclusive of these, the average monthly paybill amounts to Rs. 800 approximately.

2. *Fuel.*

The fuel used is supplied by the I.A.S.C. The contract for this varies from time to time. At present the fuel used is a first quality Diesel fuel oil from the Burmah Oil Company, at a cost of Rs. 58 per ton.

From the figures already given for the fuel consumption of the engines, it can be seen that it is entirely satisfactory.

3. *Lubricating Oil.*

The lubricating oil consumption is also very reasonable, the average being ·06 pint kwh. throughout the year. After a series of experiments it was found that Vacuum Mobiloil DTE Heavy was the most suitable, and preferable to any of the lubricating oils normally supplied on I.A.S.C. specifications.

4. *Water.*

As there is as yet no piped water supply at St. Thomas's Mount, water is obtained from a well 55 ft. deep, 100 yards distant from the power station. It is pumped from the well by a hand-operated Boulton & Paul elevator combined with a force pump into an elevated steel tank 29 ft. 6 in. high, containing 1,720 gallons. The average daily consumption of the power station, inclusive of water supplied to the Station Superintendent and employees living in the compound, is 400 gallons. It takes four coolies about four hours every day to pump this amount.

5. *Working Costs.*

The actual expenditure or maintenance and working costs during the financial year 1930–1931 was Rs. 20,480.

During this same period the total number of units generated was 154,613; of these 145,165 were actually supplied to consumers, and of the remainder 666 were lost in the mains, 8,172 were consumed in the power station, and 610 units were used for testing.

From the foregoing it will be seen that the working cost per unit generated is As. 1·79. The cost of distributing a unit is As. 0·34, thereby making a total working cost of As. 2·03 per unit generated and distributed.

6. *"All-in Cost" of Electricity.*

In assessing the "all-in cost" per unit supplied the present practice is to make the following assumptions:—

(*a*) "On costs" for supervision, inspection, administration, etc., amount to 10% of the actual cash expenditure on working costs.

(*b*) Interest is reckoned at 6% of the capital expenditure.
(*c*) Depreciation occurs on the capital expenditure at the rate of :—

1% for buildings.
2% for overhead lines.
5% for oil engines, generators, switch-gear and cables.
6% for machine tools and compressors.
10% for tools.

The actual figures during the same financial year for these items were as follows :—

	Rs.	as.	p.
On costs	2,047	14	11
Interest	8,288	0	0
Depreciation	4,747	3	0
Net working costs	20,018	14	11
Total " all-in costs "	35,102	0	10

Total units supplied to consumers 145,165. Therefore " all-in cost " per unit supplied—As. 3.6.

The capital costs were as follows :—

Generation.

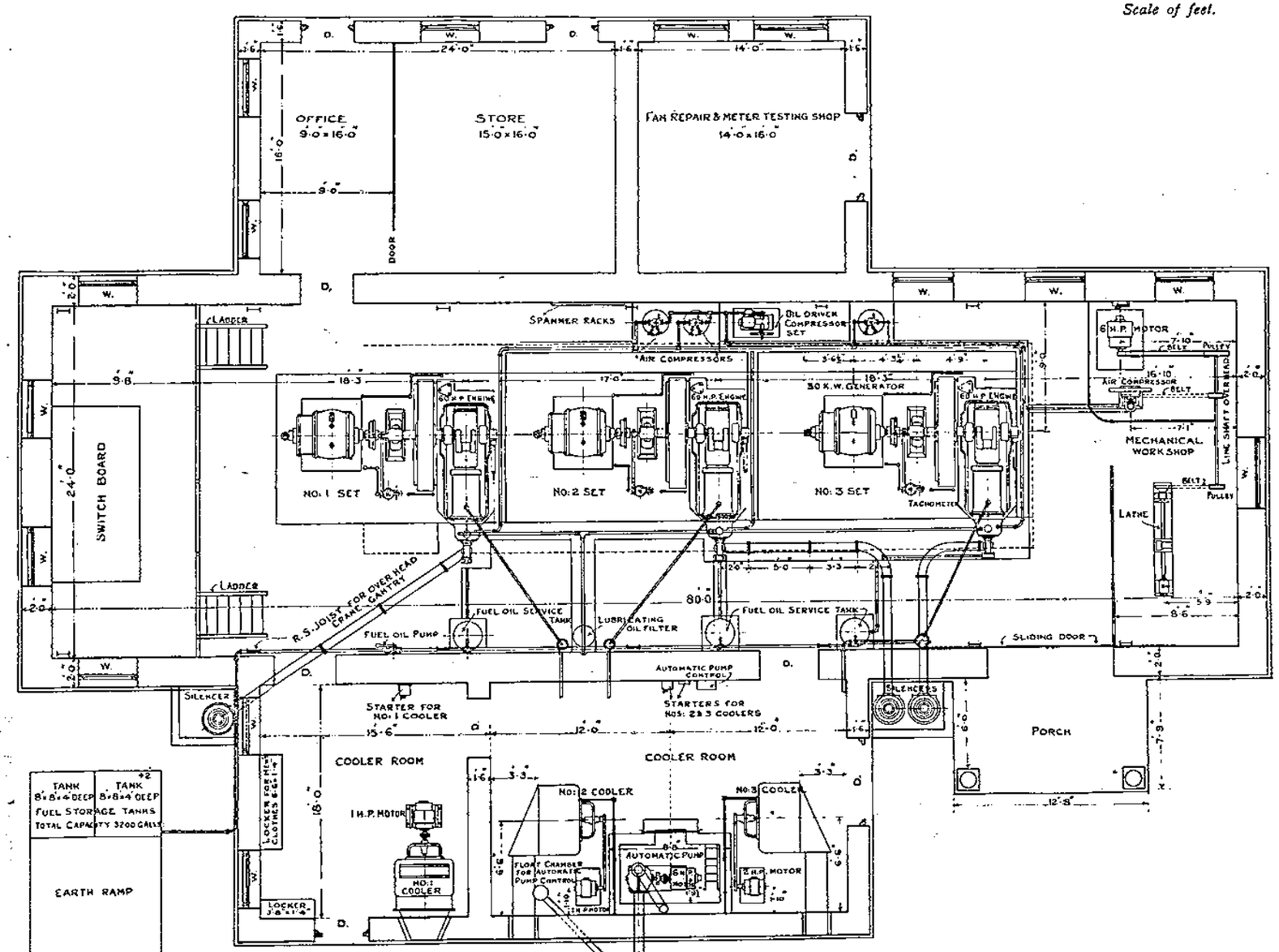
Power house building	Rs. 20,049
Machinery installed in power house	Rs. 78,618
Other buildings	Rs. 17,354
Total ..	Rs. 116,021
Total power installed	90 kw.
Cost of power house per kw. installed	Rs. 1,290
Original cost of distribution system	Rs. 22,113

NOTE.—A piped water supply from a deep well has been installed at St. Thomas's Mount. The pumps are electrically-driven and remote-controlled from the power station, from which they are about $2\frac{1}{2}$ miles distant.

POWER STATION
AT ST. THOMAS MOUNT (MADRAS)

PLAN

Scale of feet.



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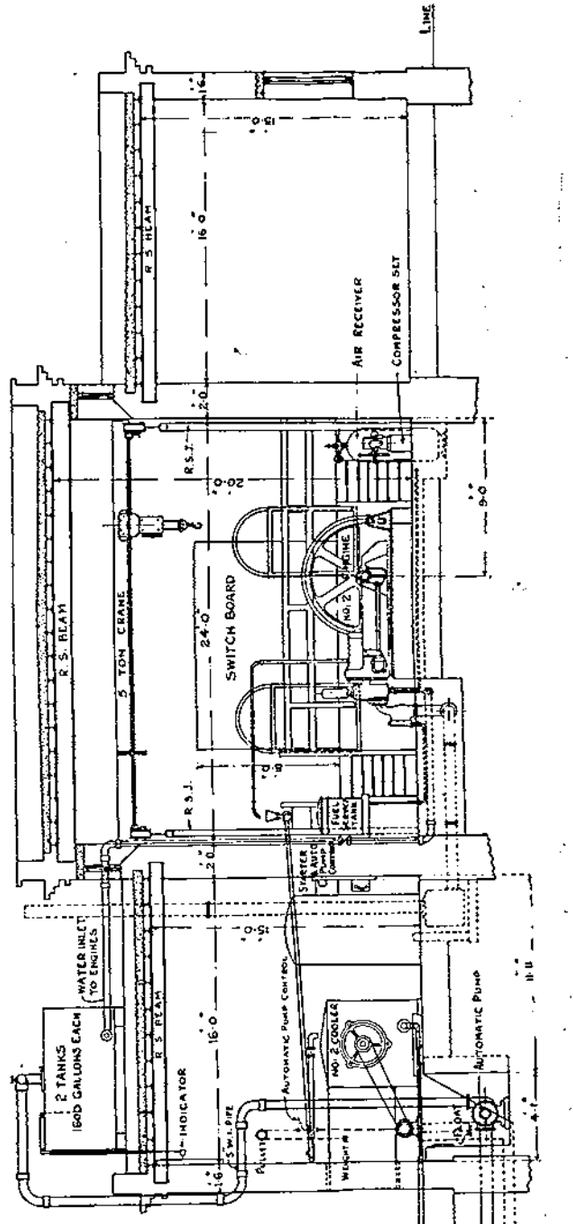


TEN DAYS IN JEHOL.

By ANON.

WHEN the Japanese assisted in the establishment of the independent Manchu State, they made it clear that the boundary between Manchuria and China was to be the Great Wall, which meant that the Province of Jehol, hitherto considered as part of Chinese Mongolia, and outside the Wall, was to be included in the new realm.

At the beginning of 1933, Tang Yu Lin, the Governor of Jehol, who for some time had been unable to decide on his future allegiance, was won over to the Chinese side by Marshal Chang Hsueh Liang, who filled his province with troops from within the Wall. Tang then issued a stirring manifesto, in which he declared that he and his army were ready to die "for the glory of Jehol and of China." Having already seen something of Chinese troops in action, I was anxious to watch the glory of Jehol being vindicated, and prepared to leave Peking for the front.

At this time I was joined by a war correspondent from Shanghai named, as far as this narrative is concerned, Lancaster. Having been in China for three and a half months, much of which had been spent in the society of native newspaper men, he believed that this great nation had at last been aroused, and was about to put up such a resistance in Jehol that Ypres and Thermopylæ would fade from the pages of history.

Our first problem was how to get there. There is a main road leading from Peking northwards over the pass of Kupeikou to Chengtefu, the capital of the disputed province; this route, though unmetalled, had had sufficient boulders removed from its surface to make it passable by motor traffic during the dry months of winter, and in normal times a willing but ramshackle "Dodge" may be hired for the trip, which is 150 miles and takes nearly two days. At the moment, however, there was a certain amount of panic among the natives of Peking, the northern gates of the city were closed at dusk, and it was impossible to obtain the use of any form of conveyance, horse-drawn or mechanical.

On the 24th of February the Japanese invaded Jehol, and there was no time to be lost. At the Mongolian Horse Market outside the Tartar Wall of Peking we purchased, on that very afternoon, the two most unlikely looking animals that one could imagine, herring-gutted, straight-shouldered, wild, fresh from starvation in the Gobi.

As most new arrivals from Mongolia are the same, they only cost the equivalent of £6 each, and there was a good chance of losing them during the course of the operations, we were quite satisfied, but found ourselves confronted by a second difficulty. No groom or "boy" was willing to accompany us, paid we never so dearly; a large proportion of the Pekingese are Manchu or Chinese Bannermen whose families have for generations regarded Peking as the only place where life is possible, and to them Jehol spelt battle, murder and sudden death. We were consequently bound to the principle of carrying what we could on our persons, and living on the country as far as possible, although it was not at all certain that the ice-bound hills beyond the border could provide subsistence for man or beast in time of war.

At sunrise on the 25th our ponies were ready. Mine, the chestnut, had never been approached by a white man, and hated me at first sight, especially as I presented a somewhat grotesque appearance in my fur cap, long sheepskin-lined coat, and Gilgit boots. It was soon apparent that the boots were far too big to fit into any ordinary stirrup, so I was compelled to have recourse to a pair of native ones, inlaid with silver and weighing some five pounds each, which had been doing the duty of door-stops in my house. Having mounted, to the accompaniment of the anticipated bucking and kicking, I found myself unable to dismount again, as the Gilgit boots, once forced into the stirrups, refused to come out. The pony refused to let anyone approach my feet, so that I had to remain mounted until I had accustomed him to forward body-bending to the right and left.

Lancaster's charger was a grey, but although it was far more placid than the other, his difficulties were no less. He had swathed himself in an immense sheepskin robe which hung to his feet, and, persuaded that the campaign would last for several months, carried on his back a rucksack under the weight of which he could scarcely walk. As two strong men hoisted him aloft, the pony's back visibly sagged, and its legs trembled, while his rider, carried away by the momentum of the enormous rucksack, with difficulty saved himself from falling on the off side.

To the accompaniment of loud cheers, not unmingled with derisive opposition laughter, we trotted out of the Legation Quarter and turned northwards up the Hatamen Street. Our chargers shied at everything they saw, especially rickshaws, and spent much of their time in backing into shop doorways; at length, however, we passed through the gate in the north-eastern corner of the Tartar Wall, one leaf of which had been closed in accordance with the habit in Chinese cities when there is the fear of a military disaster, and followed a sunken cart-road which led towards the Northern Hills. In the present condition of the ponies, we found that the best pace was a sort of hound-jog averaging some 4½ miles an hour, with a rest of

five minutes in every sixty. The chestnut was a slug, and only the tinkle of the metal balls in my ornamental stirrups kept him moving at all; he would go along with eyes half-closed, and then suddenly stumble right on to his head, when memories of Woolwich and "Now then, Mr. Yewston, are you sittin' on an 'orse or a feather bed?" would be aroused. The grey had a great heart, but his rider's unbalanced weight threatened to be too much for him, and once he came right down, Lancaster tumbling over his ears and having to be lifted on again in the manner of the White Knight.

For the whole of the first day the country was dead flat, mile upon mile of frozen sand stretching away towards the hills. There were about 20 degrees of frost, and not a sign of vegetation to be seen, while every now and then a cloud of grey dust would blow icily in our faces, the gritty Peking dust that creeps into the eyes and ears and lodges between the teeth.

At about 11 a.m. the grey appeared to be going lame in the near fore. There was nothing in the hoof and no heat in the leg, so we decided to carry on to the next village and see what could be done. At noon we reached the hamlet of Kuliushu, by which time Lancaster's mount had taken it into its ugly head to go perfectly sound again; this was a saving miracle, for if anything had really gone wrong with the ponies we should have been unable to obtain any other means of transport. At Kuliushu we made our two-hour mid-day halt, obtained water, kaoliang and bran for our beasts; and as we carried no food save an "iron ration" of chocolate and Oxo, made our luncheon of millet porridge and unleavened cakes at a caravanserai. This village was inhabited by one of the Moslem colonies which are scattered throughout North China, and the Ahung showed us round his mosque. Chinese Moslems wear nothing to distinguish them from their Buddhist or Taoist compatriots; only by their aversion to pork and their prominent noses can one readily tell them apart. Mosques in China are similar in outward appearance to any other temple in that country, having the usual tiled roof and upturned eaves, but within are to be found nothing but a few prayer-mats on the bare floor, a reading desk, and some ornamental inscriptions in Arabic; the Koran is read in the original tongue, which is not understood by the congregation.

Towards evening we rode into a wooded district, where there were a number of villages populated by wood-cutters and charcoal burners. At dusk we put up at an inn which consisted of two rooms, each measuring 15 feet by 12, one of which was occupied by the host's family and supplies, while the other accommodated a camel driver, two merchants who had just arrived in a cart, a muleteer, and ourselves. Our ponies shared an open shed with two donkeys, three mules and a camel, and I managed to obtain 3 lb. of kaoliang, 2 lb. of bran, and an unlimited quantity of chopped millet straw for each

feed. We gave three of such feeds every day, with variations where certain foods were unobtainable, and the daily cost of both animals rarely exceeded the equivalent of two shillings. It was necessary, however, to fill the mangers oneself, and to look into them at intervals while the beasts were feeding, in order to ensure that they received their full ration. We were not so fortunate, as the only food we were able to buy was a kind of macaroni and an old hen whose head was cut off in our presence, while we were forced to quench our thirst with native tea full of dust and twigs. At length the six of us huddled together on the brick stove-bed and fell loudly asleep, unperturbed by the smoke which filled the room from the brushwood fire under our sleeping place.

At dawn I shook the drowsy landlord until he produced forage, and we then devoured the remains of yesternight's chicken and macaroni, as nobody seemed either able or willing to kindle a fire. We were not long in getting away, as we had slept in a temperature scarcely above freezing point, and there was no dressing to be done, while mine host awoke in plenty of time to present his bill.

We jogged through the leafless woods under the blue sky and frosty sun of the northern winter, and during the forenoon struck the main Peking-Jehol road, which we had hitherto avoided in order to take a short cut. I suppose that in any other land such a road would have been crowded with streams of military traffic in both directions, but here the deserted stretch of dried mud showed that the Chinese Staff had studied at least that Napoleonic principle which advocates living on the country.

At mid-day we crossed a wide, sandy watercourse, on the far side of which rose the battlemented walls of Miyun, with its four gate-towers facing the four winds. Here were the first signs of war; as we entered the city we were challenged by a sheepskin-clad sentry with a Mauser pistol in his belt and a curved beheading sword slung on his back, and on producing our huge rice-paper passports covered with seals and Chinese characters were conducted to the headquarters of the garrison commander. The general, muffled in an enormous fur coat, was dismounting, as we arrived, from a pony almost as furry as himself, and received us with the hospitality which is the most valuable asset of the Chinese Army. Our animals were led off to be fed at the public expense, but the general could not refrain from asking how we had come on a journey without a native servant or groom. Being compelled to subsist on Chinese food, we looked forward to meals with a sense of adventure, and in view of the uncertainty as to when, or even whether, we should dine again, we ate heartily the dried prawns, pickled seaweeds, pork, wood-fungus, and other delicacies set before us by our host.

It is always difficult to break away from a hospitable Chinaman, and it was nearly three o'clock before we had bowed our way out and

made somebody understand that we wanted our ponies. Picking our way among the boulders of the river-bed, we reached Shih-Hsia at dusk, and got in just as they closed the city gates. The commander at Miyun had given us a letter of introduction to the general, who fed both ourselves and our chargers, and put us up for the night in a room heated by a bowl of charcoal and the paper windows of which admitted of no ventilation.

The morning found us unasphyxiated, and we made an excellent breakfast of boiled eggs floating in soup, but as we had to fish them out with chopsticks we did not consume quite as many as we otherwise might have done.

At Shih-Hsia we left the plain behind, and gradually climbed into the mountains towards the Great Wall, whose watch-towers we could already see upon the northern skyline. The road became steeper and more stony, and we passed several battalions of fur-capped, ragged soldiery on their way to the front, followed by their trains of requisitioned carts and camels; we also met an occasional motor lorry flying the three-cornered, dog-toothed flag of the Governor of Jehol, loaded with women and other baggage, its neglected engine struggling on to reach Peking. These were not signs of a Japanese reverse, yet the soldiers to whom I spoke all grinned and assured me that they were on their way to drive the "dwarf slaves" beyond the northern marches.

Shortly before 11 a.m. we rode into Kupeikou, the gateway of Jehol. It is an unfenced city, clinging to both sides of the Great Wall, which stretches over the hilltops like a twisting snake and guards the pass with its square stone towers. We rode up a steep slope to the local headquarters, which were aptly situated in the temple of the God of War, and were entertained to a full Mandarin dinner by the officer commanding. After the meal we were conducted to a terrace perched right on the Great Wall, whence we were able to view the snowcapped hills flanking the broad, sandy river-bed which led to our destination. Our departure was watched with some interest and amusement by the whole of the headquarters staff, who burst into loud laughter at a rending noise when Lancaster mounted; one officer, who had acquired somewhere a slight knowledge of English, exclaimed: "Sir, your bottom is broken."

Passing through the ruinous archway which leads out of China, and which was guarded by a sentry with a long, red-tasselled spear, we followed a winding course between the hills, every now and then having to dismount in order to cross a frozen stream. Some of these crossings were precarious, as the period of thaw was approaching, and there were many places where a wheel had broken clean through the ice. At one river we nearly lost the grey, but from another cause. I was leading my pony over the ice, followed by Lancaster and his animal; on reaching the far bank I thought it advisable to

continue leading for a little, as the ground was very rocky, but on looking round some minutes later I was surprised to see that my companion, who was of a contemplative nature, had let the reins slip from his hand and was walking on, blissfully unconscious of the fact that his mount was searching for something to eat half a mile away.

We had been unable to obtain any satisfactory large-scaled map of the country we were traversing, and topographical information was derived from the sparse local population which seemed to consist entirely of village idiots; in consequence we wandered from the main route, which in this region merely followed suitable watercourses between the mountains, and at dusk found ourselves at a small caravanserai in an otherwise deserted valley. We were at once surrounded by about six gaping natives in filthy sheepskins, and after the usual preliminary gossip were provided with a room and a meal of macaroni and unleavened cakes, which was the best that they could produce. There was no grain for the ponies, so I had to do what I could with wheat flour and black beans; it spoke well for the animals' digestions that they both continued to eat heartily and were none the worse in the morning. In winter, the Mongol pony's coat is so long that the only attention it gets is having the frost brushed off at sunrise. The people among whom we found ourselves knew nothing of clocks, and could not reckon time in hours; they had heard, however, of England and America, and described them as rich mercantile nations (an illusion which I strove to dispel from the mind of our host). The Russians, on the other hand, were locally considered as "stupid worms," while they knew nothing of Germany beyond the name.

We had the stove-bed to ourselves, but there was only enough brushwood available to fill the hovel with smoke. Our bedroom, therefore, remained at the same temperature as the Great Outdoors, about Zero Fahrenheit at this altitude, and it was almost impossible to sleep, even in sheepskins and Gilgit boots. Consequently there was no difficulty in rising before dawn and letting ourselves out of the palisade at the break of day, taking a local guide to show us the way back to the main route.

Our path led over a snow-covered pass at about 3,000 feet, and we had to lead the ponies. The whole world seemed filled with white peaks, and devoid of any animal life, while the hills themselves, like the few inhabitants we met, looked bony and ill-nourished. By 11 a.m. we had descended to the main route, which now followed a broad and sandy valley, and halted for two hours at the first inn we came to. It was quite a busy place; there was a train of camels kneeling in the yard, while boxes labelled "fire medicine" and "gun shells" were being adjusted on their backs, and outside was another of Tang Yu Lin's American motor-lorries laden with baggage for Peking. Round a brazier squatted a party of woolly-looking soldiers,

who told me that the Chinese had already slaughtered thousands of the " dwarf slaves " in the north. I found a tooth in my macaroni, and sought for information. A large crowd at once gathered, and soon divided itself into two schools of thought, some declaring that it was a dog's tooth, while others said it was obvious from the conformation that it could be no other than that of a pig. At length the cook, a particularly dirty old man, came forward and claimed it as his own, putting it carefully away in a cupboard and humming to himself a little song of which the chorus, " wo-ti ya, wo-ti ya " (my tooth, my tooth) was clearly audible.

During the afternoon we passed a column of about 600 infantry on their way to the front, and more camels carrying supplies ; these two-humped Bactrian camels, with their heavy, woolly coats, had been impressed by thousands for the winter campaign, and moved easily over the dry snow.

At 7 o'clock we rode into Luanping, which was occupied by a regiment of the Governor's bodyguard ; in consequence we found every inn and stable in the hands of the troops, and not a bite of food to be had. We accordingly called at the garrison commander's *yamen* and were courteously received, being lodged in the chamber of commerce and having our beasts once more made a charge on the public. The head of the chamber, with some other merchants, entertained us at dinner, and did his best to discover my political opinions with regard to Japan, Russia, and Communism. He was a good conversationalist, even for a Chinese, to whom talking comes naturally, and told us that the greatest cause of China's weakness was opium-smoking. At the time of speaking, he was lying on a couch in a robe of blue silk, drawing at an opium pipe, which he insisted on my trying. Placing a black plug of opium in a tiny ladle, he heated it over the small brass lamp which burned continually on a stool beside him ; when it had melted he collected a little on the end of a wire and inserted it into the minute bowl of the pipe, instructing me to inhale as deeply as possible. I found it very difficult to keep the pipe alight, as it is necessary to inhale far more forcibly than with tobacco ; the aroma is very sickly, and it must take a good deal of practice to become an habitué.

The poppy is the chief crop of Jehol, and the majority of the people smoke the " black earth," the Governor obtaining his revenue from taxes on the compulsory cultivation of the drug.

After a comparatively warm night in the company of a bowl of charcoal, we awoke to find it snowing hard, and waited with impatience until 9 a.m., for now that the Japanese invasion had begun we felt that any delay might make us too late. As the snow was too dry to ball in the hoofs, and as there was a telegraph line leading to Chengtefu, we pulled our fur collars up to our noses and pushed on. We were unable to say good-bye to our kind hosts, for nobody seemed

to be about save the servant who brought us gruel at 8 o'clock, and nothing is more difficult than to rouse a sleepy Chinaman.

At 1 p.m. on this day, March 1st, we entered the capital of Jehol. It is a small town of single-storied, grey-tiled houses, lying at the gates of the palace, and surrounded by a great amphitheatre of snow-capped hills. Like Kalgan and other towns on the Mongol border, it has no wall; the palace and park, however, built by the Manchu emperors and now the Governor's residence, are surrounded by a high wall some twelve miles in perimeter, which winds up and down hill like a miniature Great Wall of China. I carried a letter of introduction from the Belgian Legation to Father Conard of the Catholic Mission in Jehol, who received us most hospitably and gave us a room with the first live stove which we had seen since leaving Peking.

We found "One-armed" Sutton, Owen Lattimore the explorer, and an American newspaper reporter already installed in another room, while on the afternoon of our arrival we were joined by a cinematograph operator and a Russian officer belonging to the Young Marshal's new air force, which incidentally never left its aerodrome during the whole of the campaign. The good Father appeared not in the least perturbed, welcomed each arrival heartily, and disposed us about his diminutive Chinese house on bedsteads, sofas and floors while he produced excellent "1st and 2nd luncheons" from an apparently inexhaustible cupboard.

Father Conard, who had known Jehol for thirty years, told us that the population had been driven to the point of revolt by Tang Yu Lin's oppressive rule, and would appreciate the arrival of the Japanese if it entailed the overthrow of the old regime. As an instance he cited the case of the 1930 opium crop, on which the tax had been remitted because of its failure; this year, the Governor had decided to collect the tax not only on the current annual crop, but also, owing to his being short of funds, on the poppies which had failed to grow three years before. We learned that our arrival had been preceded by the news that "an Italian and his wife" had been seen riding into Chengtefu, but we found it hard to decide which of our costumes appeared the more ladylike.

Leaving our ponies in the Mission stables, where only bran and chop were available owing to the depredations of the army, we set off on foot to call on the Poppy King. Passing through the narrow streets, one noticed that the pigtail, which went out of fashion with the passing of the Manchus, was still worn by a large number of the people of Jehol; foot-binding also persists throughout North China, except in cities where missionaries and foreign-educated Chinese have decried the practice. The traffic consisted mostly of horsemen moving at a canter or amble, jostling one another dangerously, while every now and then we came upon a litter carried by two mules, one in front and the other behind.

1.—Traffic on the main Peking-Jehol road.

2.—Chinese ammunition column.

3.—Congestion in the Pass near Iyapeikou.

Ten days in Jehol 1-3

4.—The writer in Chinese dress.

5.—Types of Jehol soldiery.

6.—Embossed Chinese troops.

7.—Entrance to typical walled city.

Ten days in Jehol 4-7

On arrival at the Palace Gate, which was guarded by a pair of stone lions and a sentry equipped with a rifle and beheading sword, we were informed that everyone was too busy to see us until the morrow, as the troops were actually to be paid, an event which had not occurred for a number of months. T. V. Soong, the Minister of Finance, had arrived from Nanking a few days previously, and personally delivered the cash, and now the whole of the Headquarter Staff were occupied with this epoch-making affair. That night we were able to sleep without our overcoats, but the smallness of the stove and the absence of bedding made it impossible to undress more.

On the next morning it began to snow quite heavily, and Lancaster sent off a telegram to the effect that the spirit of the Chinese was excellent, most of the inhabitants had never heard the word "Manchukuo," and were therefore anti-Japanese, and that the invaders' advance would inevitably be held up by the weather. As we walked to the palace we saw no sign of troop movements either north or south, but an employee of the telegraph office confided to us that all communication had ceased between Chengtefu and Lingyuan, through which passed the main line of resistance. We were received by the Chief of the Governor's Household, a portly Manchu with a red moustache; this gentleman was said to have kept an establishment of singing girls in Mukden, and owed his promotion to the recommendation of a concubine whom he had procured for the Governor. As is usual in the case of a visit to an important mandarin, we were led through a number of courtyards to a chilly waiting-room and provided with cigarettes and tea. The courtyards were full of women, many of whom were dressed in rich silks and were doubtless some of Tang Yu Lin's numerous concubines. There was in the palace an atmosphere of packing; coolies ran across courtyards laden with bundles, while carts were being loaded with women, children and baggage. The rooms were singularly empty, most of the old Imperial treasures having already been packed up and removed.

Suddenly the noise of an aeroplane fell on our ears. Everyone ran out into the courtyards and gazed into the clear air, from which the snowstorm had passed. It was the first Japanese aeroplane, circling leisurely above the town at a height of 1,000 feet, the red circles of the Rising Sun distinctly visible on its planes. I asked a gazing official whether there was any local anti-aircraft defence; he replied that Chengtefu was defended by ten anti-aircraft guns. "Why do they not fire at the flying machine?" I enquired. "It flies too high," he answered. At that moment a regular *feu-de-joie* was fired by rifles and machine-guns all over the town, and several bullets fell into the courtyard where we were standing. The aircraft, having dropped leaflets urging the people to join their neighbours in the struggle for liberty, flew slowly away over the mountains.

At about two o'clock in the afternoon we were conducted to the

audience chamber and seated at either side of a long, lacquered table, at the head of which stood the Governor's chair, an old piece of furniture carved with a design of birds. About a quarter of an hour later, the curtains in the doorway were drawn apart, and the Governor of Jehol entered. He was a short, thick-set man, with the build of a gorilla and a grey, drooping moustache, wearing a fur cap and the uniform of a general. Tang Yu Lin was well known as a horseman as well as a tyrant, and an expert in the art of firing at a target with a rifle while at full gallop, an exercise in which the cavalry of Mongolia and of Jehol are trained, the reins being dropped and the body turned at right angles to the direction of movement. After a grave exchange of bows, he bade us be seated, and, without waiting for any questions, immediately began a long speech, in which he declared that he had done his best to resist the enemy but had been betrayed by politicians (how many generals have made that plaint !). I asked him whether he could give me the present dispositions of his forces, to which he replied that he would be delighted to, did he but know where they were ; he said his province had been filled with Peking troops, whose officers were taking all authority out of his hands, while the Nanking Minister of Finance had actually brought them pay.

Seeing that the old man was about at the end of his tether, I asked whether he would allow us to visit his park, to which he readily agreed, glad, no doubt, to be rid of us. We mounted the wall and walked along the top of it, whence we had, on the right, a view of the snowy ranges, and on the left, the prospect of the immense park with its tame deer, lakes, and ruined pagodas. The wall led us to the top of a ridge, where we found ourselves looking across the valley which so astonished Lord MacCartney when he brought his great yellow coach over the passes as a present for Chien Lung. On the far slope, in company with other minor temples, stood the two famous monasteries of Pootala and Tashilumpo, copies of the Pootala at Lhasa and the headquarters of the Tashi Lama in Tibet respectively. The former is characterized by its huge, square, red-washed, flat-roofed building, surrounded by chapels and the quarters of the monks ; the architecture is Tibetan. The style of Tashilumpo is more Chinese, with its roofs of coloured tiles and its strange pagoda growing out of a lower building, while the lamas at both places are Mongols.

As the sun set behind the weird sky-line of strange shaped rocks, the icy blast induced us to descend from the wall and walk back through the park, where the hardy deer were cropping the grass through the layer of snow which covered it. Taking a short cut across one of the frozen lakes, we made our way back to the Mission, where we found our party augmented by two members of the French Legation and two more newspaper men. Father Conard was undaunted, and ordered dinner to be served in three relays.

Information leaked out from the telegraph office that the Chinese in the north were falling back before Mongol cavalry under Japanese direction, while the southern flank was being pressed by tanks and armoured cars. Our companions at the Mission had all arrived in their cars, most of which had accomplished the journey in about 18 hours, as against 4½ days by pony. Having resolved to go forward on the morrow, I looked round our animals and decided that we must attach ourselves to some unit of the Chinese forces, as otherwise it would be impossible to obtain grain. The beasts had benefited by their day's rest, and we had four European meals inside us, so we prepared for an early start and a view of the front line next day.

Before dawn, information came in that Chinese troops were streaming through the town in full retreat, and that the Governor had fled. We ran out into the yard and found the motorists hastily filling their vehicles with the necessary liquids and burning little charcoal fires under their engines to facilitate starting. After giving the ponies a light feed, we put on our equipment and went out into the street. The panic was indescribable. Soldiers were removing every cart which they could lay hands on, and men were galloping hither and thither, shouting incoherently. The Government *yamens* were deserted, and their doors were no longer guarded by sentries with red-tasselled spears. In the hills could be heard the faint rumbling of guns.

A Chinese Principle of War came to my mind: "Flight means looting," and I determined to lead the retreat rather than follow it. We took leave of our genial host, who appeared quite unperturbed and was convinced that he could rely on the esteem in which he was locally held, saw the last motor-car and its chains rattle out of the yard, and mounted our ponies. The streets were full of camels, carts, mule-litters and ponies, but the noticeable feature was that the local inhabitants stood in their doorways and quietly looked on; only the troops and officials were leaving. On our way out we called in at the field hospital, but found that no wounded had ever come in there. In the pass which leads out of the valley in which stands Chengtefu, we came upon two of the correspondents, their car rolling slowly backwards down the hill and skidding when the brakes were applied. We saw them reach the bottom safely and start again, and then found that our own passage would be none too easy, for the pass was literally jammed with troops and transport, all trying to get through first. We had to dismount and lead our ponies over the mountain in order to get clear of this rabble, and returned to the main route as snow began to fall. At every turn we found the motor-cars or lorries of officials, some with wheels off, others having skidded over the edge of the road, while a number had fallen through the ice while crossing a stream. The drivers and passengers were in most cases sitting fatalistically by the roadside, hoping for something to happen.

One pathetic sight was that of an officer with one pony and two ladies, wondering how he was going to conduct his retreat. Some Jehol cavalry rode past at a gallop, shouting to us to beware of bandits (who always harry a retreat in China), and were soon hidden by the falling snow. I coveted the saddlecloths of these troops ; they were made of woven carpets in all colours of the rainbow, and added to the picturesque effect of their high-arched wooden saddles and ornamented stirrups. Soon more cavalry came by, driving before them the herds of ponies and cattle which they found grazing on the snow-covered hillsides.

At the most, we could not hope for more than five miles an hour from our mounts, and as dusk came on we began to be anxious as to how we should spend the night. We could hardly see the road, and the snow blew thickly into our faces ; having had no food since the morning, we felt justified in tampering with the " iron ration." All at once we were dazzled by a pair of headlights that rounded a corner in front, the ponies shied into a ditch, and a car pulled up. The owner proved to be, metaphorically speaking, our fairy godfather, in the shape of a Peking acquaintance who was the China correspondent of one of the most enterprising English newspapers. He was equipped, not only with Chinese servants and a portable wireless set, but with a motor-van stuffed with bedding and supplies. Having heard that he was too late to reach the capital, and that he ran a grave risk of having his property looted, Fairy Godfather turned rapidly round in the road, and bade us follow him to a caravanserai which he had recently passed. We accordingly pursued the slow-moving rearlights to Wangchiayingtzu, where we installed ourselves for the night, sleeping in the van and laughing at the snow through the steam from our mutton stew.

In the night we heard the rumbling of wheels and the grunting of camels as they poured past our camping place, but we barred the wooden gates of the yard and prepared to assert ourselves to the best of our ability should anyone try to billet himself in our enclosure. News was current that most of Tang Yu Lin's army had joined the Japanese, who were advancing up the valleys in motor-lorries, preceded by tanks and armoured cars, to brush away opposition. The countryside had been denuded of grain, and our ponies had to be content with black beans and bran.

In the morning we left Lancaster in charge of the camp, and motored forward to Luanping, which was only 12 miles from the capital. The place was in utter confusion ; the garrison was packing up and leaving, most of the officers had already fled, and the soldiers were going from house to house, looting anything, including doors, which they could lay hands on. A train of camels passed, led by an officer on a shaggy pony. " The Japanese are in Chengtefu," he said, but his camels seemed perfectly indifferent, strolling along in that supercilious manner which is so annoying to anyone in a hurry.

Seeing that we were attracting an unpleasantly inquisitive crowd, we started the car, and as we did so a Japanese aeroplane droned overhead and dropped a couple of bombs close by. Thinking that we might be mistaken for a Chinese A.F.V., we returned rapidly to Wangchiayingtzu and discussed plans for the future. It was evident that the only place where the Chinese could possibly rally would be in front of Kupeikou, where they might be induced to make a stand in view of the fact that they would be defending the gateway of China proper.

That evening our party, with ponies and cars, assembled at the temple of the God of War on the Great Wall. On the way we picked up an ex-bandit who had recently joined the irregular forces operating against the Japanese; this gentleman had decided that he would prefer a retired life within the Wall, and eagerly accepted my offer of a situation as groom. He proved an excellent servant, and later accompanied Lancaster to Shanghai as his number one boy.

The general at Kupeikou informed us he had been ordered to advance immediately and take up a position in order to bring the enemy to a standstill. He placed his late headquarters at our entire disposal, and left hurriedly with the parting advice to keep an eye on our motor-cars, as he was afraid his men might very likely steal them. A little later our new groom informed us that an officer would much like to borrow one of the cars "just for the night," so we immediately removed the appropriate parts of the magnetos. After the general had left, his orderly entered the temple and packed up his equipment. Laying a square of blue cotton cloth on the floor, the orderly placed in it about twelve training manuals (including *Instructions for the Use of Big Swords*, illustrated), a pretty painted calendar, a box of calling cards, a Thermos flask, and most of the letters which were lying on the table. He then tied the lot up into a bundle, bowed politely to us, and vanished.

Next day we drove northwards again as far as Chingshuiliang, a pass some 20 miles from Kupeikou, where our friend the general was personally disposing his division on the ground. The defensive arrangements were simple; one battalion was scattered in section posts on the skyline, while the remainder of the formation sat on the roadside in rear. Local inhabitants were impressed to hew shallow trenches out of the frozen ground, while machine-guns were sited on the highest peaks so as to give the most distant view possible. The road was blocked by piling felled telegraph poles upon it, and by building walls of loose stone. The infantry of this division were equipped with beheading swords (in addition to rifles), the weapons against which, to quote the Chinese newspapers, "the Japanese tanks and artillery could do nothing."

As we watched these preparations, and gazed across the hills for signs of the enemy, a Japanese aeroplane flew low over us, but

fortunately did not use its machine-gun. A few seconds later, however, there was a loud report on our left, and some bomb splinters struck a rock nearby. Being unwilling to become casualties in someone else's war, we made all speed back to our temple on the Wall, encountering *en route* a scene of almost indescribable confusion. In a narrow defile two divisions were trying to pass each other, one retreating in haste and the other pushing forward to support their comrades at Chingshuiliang. Since the pass was only wide enough for one-way traffic, they resembled nothing so much as two columns of ants meeting, each feverishly filtering through the other while ignoring each other completely. Camels with unopened ammunition boxes were sauntering southward, while similarly-loaded camels were sauntering in a northerly direction; jammed between the two was an ancient Ford car and a number of heavily-laden carts pushing in both directions. We took an hour to penetrate this inferno, but not without my having to constitute myself temporary Comptroller of Traffic.

Five miles outside Kupeikou we overtook Tang Yu Lin, mounted on a Mongol stallion and accompanied by his eleven-year-old son and 15 horsemen. We dismounted and exchanged courtesies, after which I asked the ex-Governor whether we could assist his retirement by giving him a lift in the car. "Thank you for expending thought on my account," answered the old man, "but I prefer to ride," and the whole retinue trotted on.

That evening the artillery, which had been kept "in reserve" and never used, started to come back, and the following day dawned on further chaos. The retiring army poured through the narrow gateway of Kupeikou, completely blocking the way of the troops who had been ordered up from Peking to defend it.

It was now clear that the Chinese army would fall back within the Great Wall, leaving Jehol to be incorporated in the new State of Manchuria. We therefore set off for home, and as the line of watch-towers faded on the skyline, the ponies seemed to trot out more freely, as if scenting the full mangers which awaited the thinnest yet stoutest little animals that ever left Mongolia.

BLASTING WORK ON THE SUEZ-ZAFARANA ROAD, CARRIED OUT BY THE 42nd FIELD COMPANY, R.E., 1933.

By LIEUTENANT A. G. WHITE, R.E.

HISTORY OF ROAD.

THE immediate purpose of this road is to enable the Egyptian Frontier Force to patrol the coast where the Attaka Mountains meet the sea. At certain points the cliffs were so sheer as to prevent even camels passing except at low tide. Naturally such a coast is ideal for smugglers, and accounts for a large proportion of the *hashish* that is brought into Egypt from Arabia.

With this aim in view a 35-mile coast route was started in March, 1932, and completed by the summer, 1933. The ultimate improvement of the road surface, which will eventually extend to Port Sudan, has started, but will take several years to complete.

In March and April, 1932, a detachment of the 42nd Field Company R.E. made a start on the blasting. The work then proceeded under the supervision of the Egyptian Army, during which time the route progressed from Sukhna, 30 miles south of Suez, to Abu Sandug, 25 miles farther south, where it was again taken over by the 42nd Field Company R.E. in March, 1933.

The camp then occupied was near a brackish water spring on the African coast. A party of 20 prisoners were camped nearby with their Frontier Force guards, to assist with the clearing and road building. Fresh water and rations were supplied from Suez by launch and desert cars.

TYPE OF DRILLING PLANT.

The plant used for the blasting work consisted of an Ingersoll Rand two-cylinder compressor working one pneumatic hammer (Photo 1). The same equipment had been in continuous use for twelve months. With the exception of shortage of drills, reduced to two long and three short, all the plant was in good condition and gave no trouble. The drill heads were cruciform chisel-ended, forming a hole of 1½-inch gauge. No reduction of diameter was found necessary for the full length of bore, in this case 7 feet 6 inches. The hammer when working satisfactorily rotated the drill automatically and cleared the bore by a jet of air forced up the centre of the steel.

ORGANIZATION OF PARTY.

The detachment consisted of one officer and 21 other ranks. By dividing the working numbers into two shifts the drilling was maintained for nine hours a day. The afternoon shift of one day continued as morning shift on the next, thereby only one handover was occasioned each 24 hours. During drilling, three men were employed on the hammer, one on the compressor, and four for clearing debris or making up charges.

While the construction of the road was in the hands of the detachment, it progressed five miles over a combination of rugged and undulating country. This afforded a variety of five or six different types of rock for blasting.

WORK ON SANDSTONE.

One week was spent in cutting back a sandstone wall 25 feet high to a depth of average 12 feet (Photos. 2, 3 and 4). This piece of sandstone was the easiest rock for boring and demolishing that was tackled. After trying several methods it was found that the best results were obtained by a series of full-length horizontal bore-holes at 4 to 5 feet centres at road-level. Each hole was filled with $2\frac{1}{2}$ lb. of explosive, and a series of 10 or 12 charges fired electrically. By this means a depth of eight feet or more would be cut out and the spoil that was not displaced by the force of the explosion could be brought down by crowbars. Eighty yards of this type of roadway was prepared in six days (Photo. 5). The clearing had to be done by the soldiers, as the prisoners were away on Bairam holiday.

TYPE OF EXPLOSIVE.

The explosive used was a proprietary brand of the Nobel Company known as Monobel. It was a brown powdery substance made up into 2-oz. cartridges $1\frac{1}{4}$ inches diameter, suitable for the $1\frac{1}{2}$-inch bore-holes. It combined a certain amount of lifting with a good shattering effect. When breaking up boulders, time could be saved by laying half a dozen sticks on the surface of the stone and merely covering with mud and stones before firing. The shattering effect was then similar to guncotton. When charging short vertical holes in hard rock, a more concentrated cartridge was obtained by breaking up the sticks and ramming in tight. Tamping was formed by puddling the red sand, which was abundant and proved very satisfactory.

WORK ON LIMESTONE AND SANDSTONE.

A different type of obstacle was met in the form of a promontory of sandstone on limestone layers (Photo. 6). It was decided

1.—The Ingersoll Rand compressor and drilling plant.

2.—Sandstone cliff before commencement of work.

3.—Clearing after firing a simultaneous line of charges.

4.—Dressing the face by means of several shallow bore-holes

Blasting work on the Suez-Zafarana road 1-4

5.—The route completed.

6.—The cutting completed.

7.—Conglomerate rock after a passage has been cleared.

8.—A section of the completed roadway traversing *wadis* and spurs

Blasting work on the Suez-Zafarana road 5-8

to make a cutting through the ridge. This entailed removing rock to the depth of 5 feet, width 15 feet, and 12 yards run. The task took five days, the prisoners being available to help to remove the spoil. The rates of drilling into the respective rocks were :—

Sandstone	..	15 feet per hour.
Limestone	..	8 „ „ „

The sandstone in places was fissured with seams of running sand, small stones or air cavities. When any of these were met the bore had to be abandoned.

Sharpening of Drill Steels.

After drilling 20 feet in sandstone or seven feet in limestone, the steel would lose its cutting edge. On occasions, owing to the shortage of drills, it was necessary to continue for longer periods. The rate of progress was then reduced to 75% of the above figures, and the result was to drill by pounding rather than cutting.

The sharpening of the steels was done by an Egyptian blacksmith, who had been enrolled in the Frontier Force. His methods were threefold :—

1. If the bit had its edges dulled but was still up to gauge, he would merely sharpen with a file, which took a matter of 20 minutes.

2. When the diameter of the head was reduced to 1¼ inches, the method was to heat the head and jump it up with the aid of a special forming tool. This tool was shaped with cross-channels, hence, in addition to making up the gauge, it gave a shape to the edges which could be finished by filing. Tempering was then done by cooling off ¾ inch, awaiting a dark straw colour, finally quenching in fresh clear water. This method of sharpening took 20 to 30 minutes.

3. In cases where the head was broken or after two or three goes of method 2, it became necessary to rehead. After cutting off the old head, a new piece was jumped up and shaped with a hot set. The result was to reduce the length by 5 inches, and the operation took 2½ to 3 hours, including tempering.

Cases of broken heads were met when drilling heterogeneous rocks such as conglomerate and saltstone. Incorrect drilling, such as bearing on the hammer, also broke the cutting edges.

Work on Conglomerate.

Conglomerate was met in one case (Photo. 7). This consisted of shingle and sea-shells cemented together by the action of the sea and spray. It proved to be like concrete, and was as difficult to deal with. The rate of drilling was reduced to 1 or 2 feet an hour,

while the effect of firing simultaneous charges was to split off big lumps. Saltstone was much the same, but was more formidable owing to the presence of red loam, which would jam the drill. The natives were able to break up these rocks by watering and picking. On the occasions where it was met we contented ourselves by clearing a passageway and leaving the dressing to the natives.

Two other places where blasting was required were both in soft sandstone. The one entailed making a cutting and forming ramps each side with the spoil. The other was a hollow which was made up by blasting alongside and above to obtain filling.

The remaining days of the four weeks were spent in digging and building up where the route traversed a hillside, and clearing the *wadis* of boulders on the level stretches (Photo. 8).

CONCLUSION.

The camp afforded a pleasant variety for the men, and was most beneficial to their health. Off-duty hours were mostly spent fishing in the boats that were taken for recreation purposes. Bathing had to be confined to specific hours, when a sentry was posted on the lookout for sharks.

In conclusion, the construction of the road was extended beyond the Abu Daraq Lighthouse, which had been our aim. The remaining obstacle between it and Zarafana is a rocky promontory which would entail four to six weeks' concentrated blasting. Owing to the policy of pushing on and leaving improvement till later, a winding route was surveyed inland. The ultimate improvement by blasting a sea-route would make an interesting task for 1934.

HOME THROUGH AFRICA.

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

I.

APPROACH.

AN invitation to stay in the Sudan on the way home did not look very promising when received in Shanghai, although optimism led me to enquire about the cost and time involved. However, a windfall two days before the troopship left induced me to cable for 80 days' leave, to commence at Colombo; and sanction from the War Office was received at Hong Kong. This account will give a sketch of the journey, and is intended to help others in the same direction. Shortage of time and money had to be continuously borne in mind.

At Colombo two passengers gladly left a crowded troopship on March 3rd, 1933, and proceeded to ask questions about Africa. Although the local Thomas Cook had speeded no clients thither, they knew that a branch had just been opened at Nairobi and that tours entering at Mombasa and leaving at Port Said were feasible during the season. When the season ended was vague, as were the fares, but there was a free luggage allowance of 50 kilos in the first class; immigration rules required every European to have fifty pounds and a certificate of vaccination less than three weeks old.

There were two ways of reaching Mombasa; either direct by the monthly Japanese steamer leaving five days later (fare £24, no second class) or *via* Bombay and a B.I. boat leaving the same day (fare from Bombay £28 first, or £17 second class); the latter meant leaving Colombo by train on the evening of the day we arrived, so we chose the former, which gave us time to be vaccinated and to enjoy the sea-bathing at the Galle Face (reduced rate Rs. 10 a day inclusive). We took one day in Kandy and saw the Botanical Gardens, but found it hotter there, in spite of its 1,500 feet elevation, than at Colombo, where a breeze blew day and night, and the highest temperature was 86° F. However, Colombo was expensive, and we were glad the *Arabia Maru* was only a day late.

Cooks feared that ship would be uncomfortably full of emigrants, but the latter were too well disciplined to worry us; there were 1,300 of them going to Brazil at their government's expense and with a promise of 50 yen each to help them to settle there. The *Arabia Maru* was comfortable and clean, and the food was good.

In spite of her 9,000 tons she rolled a little in the smoothest water, but there was no vibration, and she kept up 15 knots on a mixture of two-thirds oil and one-third coal. There were a dozen first-class passengers of all nationalities, no others being British.

The voyage was not dull; one day the emigrants gave a display of fencing, wrestling and jiu-jitsu; two days later sports were held, accompanied by an amateur mouth-organ band playing Japanese variations of "Auld Lang Syne," "John Brown's Body," and other Oriental tunes from nine to five without apparent rest; on March 14th we crossed the Line, and a Japanese-speaking Neptune inspected the ship with more than his usual retinue. The weather remained fine, the sea smooth, and the temperature below 86° F., except on the last day, when it rose to 89° F.

II.

KENYA.

We reached Mombasa at dawn on March 17th, and noticed that no one asked for vaccination certificates or our fifty pounds. In the Customs I had to license a 12-bore gun and pay a deposit of one-fifth of its value, recoverable in Uganda on leaving Butiaba.

We had to catch the fortnightly steamer at Namasagali on March 28th; this is 48 hours from Mombasa by train, so we had nine days. We decided not to spend any of this in Uganda as we did not intend to shoot big game, and preferred healthier neighbourhoods. It was the hottest time of the year at Mombasa, very sticky with a maximum temperature of 95° F., and the town has few attractions. Trains leave for Nairobi at 4.30 p.m. on Sundays, Wednesdays, Thursdays and Fridays—only the first two run on to Uganda—and this was a Friday, so we booked seats to Nairobi at once.

There is a half-fare concession for serving officers and their wives, which reduces the cost of the first-class ticket from Mombasa to Nimule (1,150 miles) to about £7; this officially requires a certificate signed by his C.O. that the applicant is on leave, but we found the display of passports to the District Superintendent was enough. Journeys on through tickets can be broken at intermediate stations; the first-class compartments are comfortable, and bedding can be hired. Second-class travel is recommended only for short, cool journeys, for there are no fans or wash-basins in the compartments. A restaurant car provided good meals, which had to be paid for in the usual way, but inclusive meal tickets obtainable in advance were promised shortly.

From Mombasa to Nairobi (330 miles) takes 18 hours, for the climb is 5,500 feet. At 6 a.m. we got a wonderful view of the sunrise on the snowy summit of Kilimanjaro (19,700 feet), 70 miles away; from then until reaching Nairobi at 10.30 a.m. we were constantly

spotting, not only horned game, but also giraffe, ostrich and bustard. Nairobi seemed a small, straggling place with good but expensive shops and several comfortable hotels (rates about 20s. a day). It was the hot season, yet we thought the weather perfect.

Though there are few " sights," money goes quickly ; when men with charming manners and large cars offer to show lion and rhinoceros within camera range, one should enquire the cost first, or one may afterwards find it high. It was not easy for us, limited in time and money, to choose excursions. As the guide-books say, game can be seen in every direction, and so can other interests, such as settling localities or native life. We were now four, having collected a British Army subaltern from India and an oil-engineer from Burma, and we decided to employ one of these " white hunters."

Off the main line the railway is slow and normally runs only one train daily ; the country is therefore best seen by car, and the cost, if shared, though greater than by rail, is not too ruinous (there is a 1s. a gallon tax on petrol). The roads are rough and, in the hot spring months, dusty, but the traffic is slight and the views everywhere magnificent. The hotels we found surprisingly good, more like private houses ; in the dairying district the food is excellent.

We did two half-day car trips ; one 30 miles westward through the coffee district and Limuru (7,400 feet) to the edge of the escarpment overlooking the Rift valley near the famous signpost—Cairo, 3148 miles, Cape Town, 4020 miles ; the other east to a ranch where game is preserved, to see at close quarters ostrich, zebra, pig, eland, hartebeest, impala and gazelle ; both trips gave glorious views. Then, one of us having departed for Kitale, the three survivors chose a four-day trip to the north and motored 100 miles to Nyeri (5,900 feet) partly through native reserve and partly through country planted with sisal, then running to seed as it was not worth marketing. We found a charming hotel facing the snow-streaked peak of Mount Kenya (17,400 feet), 25 miles away ; but had not time, unfortunately, to visit " Treetops." This is a two-roomed hut in a tree overlooking a water-hole and salt-lick in the forest ; dangerous game can be watched safely by day, and, with the aid of a searchlight, by night. However, when we were sitting in a *machan* over a nearer water-hole, we saw a rhinoceros emerging from the forest before dark.

On March 22nd we drove on N. and W. to Thomson's Falls (7,700 feet), across the plains where dairying is progressing. At a cattle ranch near Nanyuki we were driven through the scrub and shown sport on private land, and how easy it is to get lost without a compass when the sun is vertically overhead. During the afternoon we passed ostrich, zebra, hartebeest, three kinds of antelopes, two of gazelles and two smaller species within fifty yards of the road. A badly-needed evening shower caught us on a length of cotton soil road, and only luck in skids saved us being benighted. Thomson's

Falls are worth seeing, as there is a vertical drop of 250 feet; the hotel is opposite them, and there is good fishing.

The next day, skirting the sheep country of the Aberdare Range, we descended to the maize centre of Nakuru in the Rift Valley. This great geological fault, said to start at the Caspian and end at Beira, averages in Kenya about 60 miles wide and 2,000 to 3,000 feet deep, but contains many craters, mostly lakes, and the contours are very involved. Nakuru Lake is the haunt of flamingoes, estimated at from four to 40 million by different scientists; we found nothing else of interest there, and went on to Lake Naivasha, which is 12 miles in diameter and offers good sailing, fishing, shooting and bathing. Our companion caught the train here for Kampala to join the air mail home; we two spent the night at Naivasha and returned to Nairobi by an interesting road through natural and planted forest.

This tour gave us a superficial idea of settling conditions, which, after discussions with an agricultural expert, helped us to summarize the position. The depression has hit Kenya, and even professional farmers have difficulty in making ends meet; amateurs, therefore, who sink all their capital in land cannot hope to make money out of it, except possibly in coffee. On the other hand, land is now very cheap, and can be bought almost anywhere at from 10s. an acre upwards; now is the time to buy, therefore, for the man who has, in addition to a little capital, a pension upon which he can live. He will find a fair sunny climate, low taxation, and inexpensive sport.

On our return Nairobi soon palled. We saw a few captive animals and went round the Arboretum and the Agricultural Laboratories. We were also invited to a picnic in the Masai, or Southern, Game Reserve near the Ngong Hills, but saw little game until it was too late for photography; then, curiously enough outside the Reserve, one group of giraffe was trusting enough to let us get within fifty yards.

But we longed to get on with our journey; the next stage included the road from Nimule to Juba and we were warned that, unless we got through before the monsoon, we might have difficulty. Before leaving Nairobi, therefore, we paid the fare (£5 each) for the car to ensure that it was sent from Juba to meet us at Nimule.

On March 27th we left Nairobi at 1 p.m.; we had been warned of the dust between Mombasa and Nairobi, and noticed none, but the run to Nakuru, possibly owing to the exceptionally dry season, filled the carriage with it and it became impossible to keep clean. This part of our journey was not interesting; the climb out of the Rift to Timboroa (9,000 feet and the highest railway station in the British Empire), and the final crossing of the Equator, were done at night; thence the run became hotter and duller, the only game seen being guinea fowl. Probably we should have done better to take a day train to Kisumu and follow the route across Lake Victoria.

III.

UGANDA.

The train entered Uganda during the morning, and at 3.30 p.m. we changed at Mbulamuti for the connection from Jinja, which took us in less than an hour to Namasagali. This is a mere wharf 50 miles from the Ripon Falls, where the Nile leaves Lake Victoria. The Nile is already a mile wide, but very shallow, so the stern-wheeler *Grant* draws only three feet. She runs to Masindi Port every other Tuesday, and is clean and comfortable, with accommodation for 14 Europeans (first-class compulsory). We cast off about 6 p.m., pushing six lighters, and traversed Lake Kioga (3,376 feet) during the night. We were told there was nothing to see, but after a gorgeous sunrise we got "close-ups" in the papyrus of fish-eagles and flocks of egrets and went through a small locust swarm. The strange and vivid bird life is a great attraction of this journey; the insect life is unfortunately too teeming to interest any but an expert.

We landed at Masindi Port at 10 a.m., somewhat late, and 12 people with all their cabin baggage and some mail bags crammed into an elderly 12-seater Albion 'bus, which started off in haste for Butiaba. It had long lost its side curtains, and on the road we ran into a thunderstorm; we had optimistically packed our raincoats in a valise which was "booked" to Nimule, but those with raincoats seemed to get equally wet, so we all cheerfully consoled ourselves with the thought that we were seeing equatorial forest with its highly-coloured bird life in the correct atmosphere. After passing the clipped turf of Masindi Town we emerged at the edge of another escarpment, with Lake Albert (2,000 feet) below us, Butiaba at its edge, and the smoke of the waiting steamer. We arrived painted like savages by the fine red dust, the heat and the rain.

After collecting the deposit on my gun from the Customs *babu*—Uganda seems run by Indians even more than Kenya—we boarded the *Robert Coryndon* (900 tons) at 2 p.m. We started across the lake, and met the *Lugard* at 5 p.m. at the north end. The *Coryndon* makes fortnightly runs to the Belgian Congo ports, to connect with the Nile boats, and this Wednesday trip for tourists visiting the Murchison Falls, of which this was to be the last but one of the season. (Cost of excursion, £6 each, food 12s. 6d. daily.)

As we transferred to the *Lugard* she handed over a lighter-load of Congo natives entering Uganda for work. She is a newer edition of the *Grant*, also with 14 berths, every one of which was filled for this trip. She moved off at once up the Nile, eastwards, and anchored three hours later. After dinner we sat out forward listening to grunting hippo and leaping fish, and wishing we had brought fishing tackle, for the latter sounded as big as the giants of the Ripon Falls.

At dawn the ship moved on, and the early riser was amply rewarded —laggard crocodiles snoozing on the bank, waterbuck having their *chhota haziri*, colobus monkeys doing their "daily dozen" in the tree-tops, baboons out for a morning walk, families of hippo at their toilets—the hippos alone must have numbered thousands. Perhaps the most surprising picture was a black ibis with beak agape, looking like a young modern pterodactyl yawning from sudden awakening; while crossing our bows a few feet away he paused suddenly in mid flight, dropped his wings, and scratched his ear!

Below Lake Kioga the Nile is navigable as far as Atura; rapids then occur which culminate in the Murchison Falls, where the river drops over the escarpment to the level of Lake Albert. The foot of the Falls was reached at 8 a.m., and we landed after breakfast for the mile walk to the top; the ship displayed a somewhat alarming notice, that passengers would attempt the "arduous climb" on their own responsibility; actually, though the going is rough and sandy, the only trouble is the heat, which can, to some extent, be avoided by an early start. At the Falls the entire river bursts through a twenty-foot gap in a natural dam and falls 400 feet in three twisted cascades. It gives an unforgettable impression of tremendous momentum and is worth coming far to see. Doubtless some future Sapper will attempt to domesticate Nature even here; we found the animals tame enough, for there were several hippo above the falls obviously asking to have their photos taken. On returning to the ship at midday, very thirsty, we found her surrounded by thousands of black ibis. On the way downstream we got excellent views of three herds of elephant, about ten in each, by the water's edge; two kinds of buck were also seen, colobus monkey, and innumerable birds; the few natives appeared to be wet fly fishing.

At 5 p.m. we again met the *Coryndon* in Lake Albert, exchanged a few passengers and took back the lighter, now loaded with time-expired Congolese, whose clothes and boxes contrasted with the nakedness of the previous day's cargo. Our first stop on the northward run was at Pakwach at 8 p.m., where they landed, faced with a 200-mile walk home. The *Lugard* filled up with wood fuel and started again at 2 a.m., the lighter now loaded with cotton for the ginnery at Rhino Camp, which was reached at 9.30 a.m. The place is not much to look at, a shed on the quay, a row of pruned Kapok trees, one road, and the ginnery, which is worth a five-minute visit.

But there is one attraction, probably unrivalled in the world; this is one of the few remaining habitats of the rare "white rhinoceros." The ordinary rhino, notoriously bad-tempered, inhabits the Game Reserve on the east bank, but on the west bank only the rarer species is found; as only a few hundred survive, they are completely protected. The authorities are satisfied that they are not dangerous, some having proved personally that, though a parent will charge to protect

its young, the charge is not pushed home if firmly faced with orders to "Go away." Consequently heavy penalties are threatened for killing or wounding one, even in self-defence, or for conduct "tending to disturb, infuriate, or terrify" him.

We found it unnecessary to do any of these to take a photograph; we walked a mile and a half up the road, entered a village and uttered the word "Faro." A man put on a shirt, walked a mile into the bush, picked up a fresh track, followed it for another mile, and pointed. The animal looked like a rhino but was larger, about six feet high at the shoulder. He was the same mud colour as his cousin—not white—but did not behave like him; he heard us at 50 yards, peered short-sightedly with ears twitching, retired a few yards and continued his lunch with his back to us. We were told that another mile ahead a hundred were to be seen, but fear of delaying the boat and the threat of a thunderstorm deterred us.

We were under way again at 3 p.m., and after dropping the lighter, now loaded with cotton seed, at sunset, continued to Laropi and tied up at 10 p.m. The river had so far been two or three miles wide, but blocked by papyrus except for a few quarter-mile channels; here, however, a rocky peninsula on the right bank constricts the width to about half-a-mile, without apparently increasing the current.

At 9 a.m. next morning, April 1st, the voyage continued, and after light rain Nimule was reached towards midday.

IV.

The Sudan.

The southern gate into the Sudan is even less imposing than Rhino Camp; it has only a quay and a wall-less shelter. The Nile here enters rapids again, and one must proceed by road; two cars were waiting for the seven passengers and a lorry for luggage, so we transferred after an early lunch. The road to Juba had just been completed for all-weather traffic; we travelled at good speed on its wide, smooth, well-graded surface, and it was perhaps fortunate that no traffic was met, as the bridges are only single width. The country was Game Reserve, but we saw only one buck, a pair of Red Huzzar monkeys, a bustard and some guinea fowl. Shortly after passing, 100 miles from Nimule, a village incongruously labelled "Garbo," an oil-powered ferry took us across the Nile into Juba (1,500 feet), the fourth capital of Mongalla province, at 4.30 p.m.

It looked like a small new Indian cantonment (without the barracks) in its bareness, heat, and scattered unimposing buildings; but its hospitality was striking. H., to whose invitation the whole trip was due, had left word that he was unable to be at Juba, but that he would come to Amadi, 180 miles away, the next evening to

meet us; and there was a car for us. But he had taken steps that we should not arrive unintroduced, for nearly every inhabitant of Juba was waiting for us with either an invitation or advice. They said that the car he proposed would not carry us five miles, and offered us instead a brand-new Ford waiting at Terakekka to be driven up country; we could reach it in 12 hours by steamer on the morrow, unless it had already been taken (as afterwards we found was the case); since it would land us at Amadi a day late, we declined and decided that optimists were justified in accepting H.'s choice.

We were right and the car deserves a mention; she was, like most Southern Sudan cars, a Model A. Ford; no beauty, about four years old, with an obvious "past," she had been for sale for a year and no one wanted her except one man who took her to Entebbe and back. She obviously enjoyed our trip and carried us well over 1,000 miles with no serious trouble, and the day we returned she was taken immediately by another officer going on shooting leave. British cars have unfortunately failed, with a few exceptions in Nairobi, to satisfy Sudan and Kenya residents.

By the time the car had been inspected, spare tubes and tools borrowed, and luggage passed through the Customs, it was dark. A cocktail party, and dinner party with two Governors and the head of a Government Department from Khartoum, led up to a dance, which on the arrival of rain, gave place to "Murder"; bed at 2 a.m.

It is striking that in this Imperial Airways station the firm with the apparent monopoly of commerce and the contract for transport on the Juba-Nimule section of the "All-Red" Cape to Cairo route, should supply foreign vehicles and possess the un-British title of *Société du Haut Uele et du Nile*; possibly their abbreviation and nick-name "Shun" is sufficiently Imperial to compensate. The car, after standing all night in the deluge, started at the first kick; we found the "Shun" petrol pump out of action and the office closed as it was Sunday, so we had to search out the Greek in charge and collect fuel and oil from the main installation. This, loading up, collecting sandwiches and accepting a welcome gift of fruit from an ex-Sapper officer working for Imperial Airways, took until 10.30 a.m., which was very late for starting. We had 180 miles to do in an unknown car and country, not speaking the language, without a servant or a map, and over roads hardly yet made in some places.

However, all went well; we did sixty miles in two hours on the road, better than that to Nimule, running S.W. through Yei into the Belgian Congo at Aba. Short of the Loka mission we turned N.W. on to an inferior road; fortunately we kept ahead of the necessary average, for we suffered a petrol stoppage in the actual tap which could not be dismounted; manipulation with a wire cleared it and we lost only half an hour. The country was rolling and the roads devious and rocky, patched with ironstone which looks soft but is hard beyond

imagination, and torture to drive over. We saw a few hartebeest and oribi, but the vegetation was disappointing until we reached the striking geological formations near the Lui mission. At dusk we reached Amadi and found "H," who had arrived five minutes earlier, with the District Commissioner; the latter had been a contemporary of mine at Woolwich and offered shelter, which we gratefully accepted; at this height, 3,000 feet, the night was cool, and we slept soundly on the wide, thatched veranda.

Next morning we inspected the garden, shaded by mango trees in fruit and brightened by "Gold Mohurs," and the live stock, including a tame duiker in the house and a tame bush-buck in the garden; we also admired the local bridge, a fourteen-span crib-pier structure of which the D.C. as amateur builder was justly proud. At 10.30 a.m. we left for Meridi, 80 miles S.W. of Amadi, three of us with one servant, in two Fords. The road was the worst I have ever seen, but we had only one puncture. After lunch in an unfurnished mud rest-house, we were drenched by a tropical shower and had to shelter in a dispensary. These are now being established in every chief's area, under native dispensers who have had some years' experience and training in a hospital; judging by the number of natives who come for treatment, they are thoroughly appreciated.

A mile short of Meridi we walked up a rocky shoulder for the sunset on the hills of the Nile-Congo divide nearby. We stayed at the still partly furnished rest-house that had been the D.C's house before he moved to Amadi. Meridi contains a British agricultural officer, a Greek shop-keeper, and a Syrian doctor who runs the hospital and small leper settlement. We dined with the first and next morning walked round the hospital; the Greek obliged H. with a haircut.

The next day we continued westwards, leaving Mongalla province for the Bahr-el-Ghazal; the 120-mile drive was without incident and brought us to Li Rangu, a leper settlement and sleeping-sickness inspection centre opened less than four years ago.

Sleeping-sickness is controlled by making the whole population live along roads sited to avoid streams, in the banks of which the *tse-tse* fly breeds; where *khors* cannot be avoided at crossing or watering-places, the banks are cleared of cover for a distance greater than the range, fortunately short, of the fly. These precautions, combined with periodic inspection of the entire population and the removal to hospital of any "cases," stamped out the disease entirely by 1932 in an area as large as Wales. Recently, however, a few cases have been discovered, owing apparently to uncontrolled movement across the Congo border. Leprosy also was always prevalent in the district, and the sleeping-sickness inspections provided excellent opportunities to tackle it. All lepers are picked out and classified; "infectives" are moved into the settlement and given treatment; those in whom the disease is quiescent may choose either to enter the

settlement or stay in their villages under observation. Whether or not the disease can ever be stamped out, the first step has been taken, and 4,000 lepers registered. The staff for all this is one British and two Syrian doctors, who are also administrators and engineers. The settlement has its brick kilns and saw-pits; the hospital is being converted from mud to burnt-brick; 60 miles of road have been made; and a swimming bath is now being attempted. All by the unskilled labour of the mild leprosy cases, under amateur supervision.

The concentration of the people on the roadsides means that the traveller sees no game; instead he suffers some of the pains of royalty by having perpetually to smile and salute. Everyone rushes out to speed the passing car; the men in their bark aprons throw down spears or bows and arrows, take off their headgear, if any, and salute; the women in their sporrans of leaves wave and cheer with the children. This tribe, or nation, the Azande, which number half a million with the Congo branches, actually defeated the slave-raiders with heavy casualties, and it is a pleasure to see their fine physique and general healthiness, happiness and trustfulness. They do not understand the use of money; *bakhshish* or *cumshaw* has no local equivalent, and a sheet of newspaper is a handsome present.

We had a week in their country; we spent a night with the D.C. at Yambio and inspected with him a new road to Saruti on the actual Congo border; here sites were chosen for a rest-house and a new Court for international cases; on the way we passed over a locust swarm in the hopper stage, a thick, reddish-brown, loathsome moving carpet. One day was spent driving through the districts of several chiefs. For the week-end we went to Myambara, a shooting and fishing camp in a clearing in the bush on the bank of a rapid in the River Sueh, to which, to save a 12-mile walk, a 17-mile road had been cut. We were misled as to its condition and length, and night overtook us half-way there; we had the utmost difficulty in following the road, for grass and thornbushes growing in it had already made it unnoticeable. Nature avenges lack of traffic, and it will soon be invisible; the game had returned, and we nearly ran over a leopard in the dark. Instead of tents, we slept in grass huts, and instead of the drums of native dances, we heard at night lion close by. During a stroll before breakfast we were watching Uganda cob (antelope), when giraffe unexpectedly passed fifty yards away; a hippo spent the day in the pool above the rapids, and in the evening H. got in easy shots at cob and waterbuck; we also saw that rare giant, the whale-headed stork, seldom found so far south, but taken as the provincial emblem for the Bahr-el-Ghazal, as is the rhinoceros for Mongalla. The curious ant-hills like giant two-foot mushrooms, mentioned by Schweinfurth, are evident in this neighbourhood.

On Wednesday, April 12th, we turned back to catch the mail-boat which leaves Juba every other Sunday. At Meridi we watched a

funeral dance on the village green, but found it half-hearted and disappointing. At Amadi we found B., a naval officer, who, during three months' leave had acquired fifteen different heads, culminating in a giant eland, of which less than one a year is shot on the average, and a hunter is allowed one in his lifetime. After Amadi we called at the Lui medical mission and were regaled with tea and tales of surgery grave and gay; then we inspected a little-known spring of the clearest boiling sulphur water, emphasizing the recent volcanic origin of the locality. We spent Friday night at Lalya, with lovely evening and morning views of conical peaks. Several showers fell during these days, showing that the short rains had begun.

We found Juba on Saturday as hospitable as before, and the previous programme was repeated with invitations to lunch and tea added. We tried unsuccessfully to discover whether, as in Kenya, concession fares were granted; eventually we telegraphed to Khartoum and wrote an air-mail letter to the General Manager, Sudan Railways. It was important, as, compared with the fare from Mombasa of about £7 each, we must pay about £50 each to reach the Mediterranean, even by the recently reduced tourist tickets (Juba to Shellal £40 including meals). Accompanied by H., we boarded the *Rejaf* during the afternoon and slept on board her after the festivities were over; she is provided with two mosquito-proofed sleeping houses on deck, and had two lighters and two 2-story barges grouped round her; on one of them various Belgians occupied a kind of second class. She sailed at 8 a.m., about half-full.

After passing Lado, where the Belgian graves, a reminder of the *Enclave* of 30 years ago, are visible from the river, we were hailed about 11 a.m. from Mongalla, the last capital of the province; a shout about a man gored by a buffalo sent us alongside. A rescue party was soon organized, and, entering the long grass across the river, found, after an hour's search, tragedy. An officer of the Sudan Defence Force on shooting leave had arrived at Mongalla to meet a friend from Juba in our "late" car. Hearing of a herd of buffalo, neglecting warnings, and without waiting for another European, he started off after them before dawn, accompanied only by a few natives. According to the evidence, he probably killed one and the herd charged; in self-defence he then wounded two others and, when following one into long grass, was again charged at close range; his last shot grazed the animal's skull, and both man and beast were found dead, the latter on the broken rifle. Another grave was added to the cemetery, and the *Rejaf* continued her journey four hours late.

At sunset, at Terakekka, B. came aboard with the best of his heads; the rest-house here is noted for the wall-decorations by Millais; these are now very dilapidated and will not last much longer unless protected. The next afternoon we rounded a corner so suddenly that a hippo thirty yards away, its entire black and pink

body out of the water, forgot to submerge. An hour later we caught a herd of elephant in an open patch less than 100 yards away; an old Sudan official remarked that he had never seen either so well.

The navigation in the Southern Sudd is very difficult owing to the unwieldy tow, the strong current and the narrow winding channel; each corner is only rounded by colliding with first one bank and then the other; at one we struck both banks simultaneously and had to break tow and continue backwards for some distance before resuming normal positions. As we had been warned, the Sudd gradually became boring, and we three did not enjoy it, for we suffered in turn from malaria. I started it the day before returning to Juba, H. retired three days later, and, when we had recovered, at Malakal E. followed suit. The fact that all three succumbed ruled out all argument about the best preventive measures; I took no precautions, H. wore mosquito boots on some evenings; while E. preferred the Chinese mosquito stockings. At Adok in the Sudd we were interested in one of the few present instances of adaptation to environment in human beings; many men of these Nilotic tribes are over seven feet high, the extra foot being almost entirely in leg length; they are very lightly built and can traverse swamps which would drown men of ordinary physique; they have also the striking habit of standing for long periods with one foot resting on the other knee.

We reached Malakal, which has little attraction besides a small swimming bath, on April 20th; here we heard that our application for concession fares had been refused. That evening we stopped at Kodok, once famous as Fashoda, a very unassuming stage for drama. On the evening of April 22nd we passed through Kosti bridge by a swing span and found a real train-de-luxe awaiting us; this, skirting the Makwar dam during the night, arrived at Khartoum early the next morning. There was business to be done about steamer passages and a missing letter-of-credit, but telegrams had brought those concerned to the station, although it was Sunday. This, and the transfer to the next train, left us under ten minutes, but we hastily borrowed another Ford for a drive round; on our return the train had started, but we leapt on it as it left the platform. As the connections run once a fortnight, we were thankful not to have been later.

V.

EGYPT AND EUROPE.

After a day and night of dust and heat we reached Wadi Halfa and transferred *via* a sketchy Customs examination to the *Ibis* and her tender, which had a lighter alongside. Starting at midday we stopped at sunset at the temples of Abu Simbel, said to be the best preserved in Egypt. From there on the effect of the Aswan dam

became noticeable for vegetation disappeared below the surface; when the 20 feet additional height takes effect the water will rise almost to the entrance of Abu Simbel, and the river will become a lake nearly as far as Wadi Halfa. It is fine sailing water even at present.

We moored for the next night just short of Shellal, and a high wind covered everything with sand. We reached Shellal about 10 a.m. after a glimpse of the dam and passing within a stone's throw of the Philæ ruins, so soon to be further submerged. There were three hours before the train left, and the dam was only two miles away, so we went to inspect it, preferring walking to hiring a boat. Only the finishing touches of the heightening work remain to be done; the completed structure is impressive and the organization of work interesting. Back at Shellal by noon, we lunched and sought our *wagons-lit* (fare to Cairo, first class sleeping car, £4 10s.); these would not normally have been necessary, but when suffering from malarial headaches and full of quinine, one prefers not to share a compartment with Egyptians. Unfortunately we passed Luxor too late to catch a glimpse of the temples; Cairo was reached at 7 a.m. on April 27th. We had 48 hours here, some of which went in long-delayed shopping; but we found time to go round the Zoological Gardens, have an afternoon at the Pyramids and see the Tut-an-Khamen treasures, the last of which had just been displayed in the Museum.

We caught the early train on Saturday, 29th, for Alexandria (first-class fare £1 5s.), breakfasting from baskets thrust in at a stop, and reached our ship, the Lloyd-Triestino *Tevere*, about noon, having booked second-class berths. The Cairo hotel, however, had mislaid E.'s most important suitcase, so we complained to the Purser that the necessary repacking was impossible when sharing a 4-berth cabin, and he gave us a spare 2-berth first-class one. The missing suitcase arrived five minutes before sailing, the hotel porter having followed in the next train, so the voyage was spent in comfort; the food, even in the second class, was excellent.

Strictly speaking, this article should end when leaving Africa; but the rest of the trip was so enjoyable that others should know about it. We went from Alexandria to Venice *via* Rhodes, the Piræus, the Corinth canal, Brindisi and Bari for £17 odd. At Rhodes, which is a small town, one can see in two hours ashore a great deal, either separately or on a conducted tour by car (40 lire); it is a treasure house of mediæval architecture, and, as a home of the Knights of Malta, has a considerable history. Two hours at the Piræus is different, and on a first visit one should undoubtedly take the 40-lire trip arranged by the ship; one can then "do" the Acropolis and at least get an inkling of "The Glory that was Greece." We had perfect weather for both these visits, and the memory of the Acropolis in the early morning sun is unforgettable.

Passports took up most of the time at Brindisi and at Bari the ship

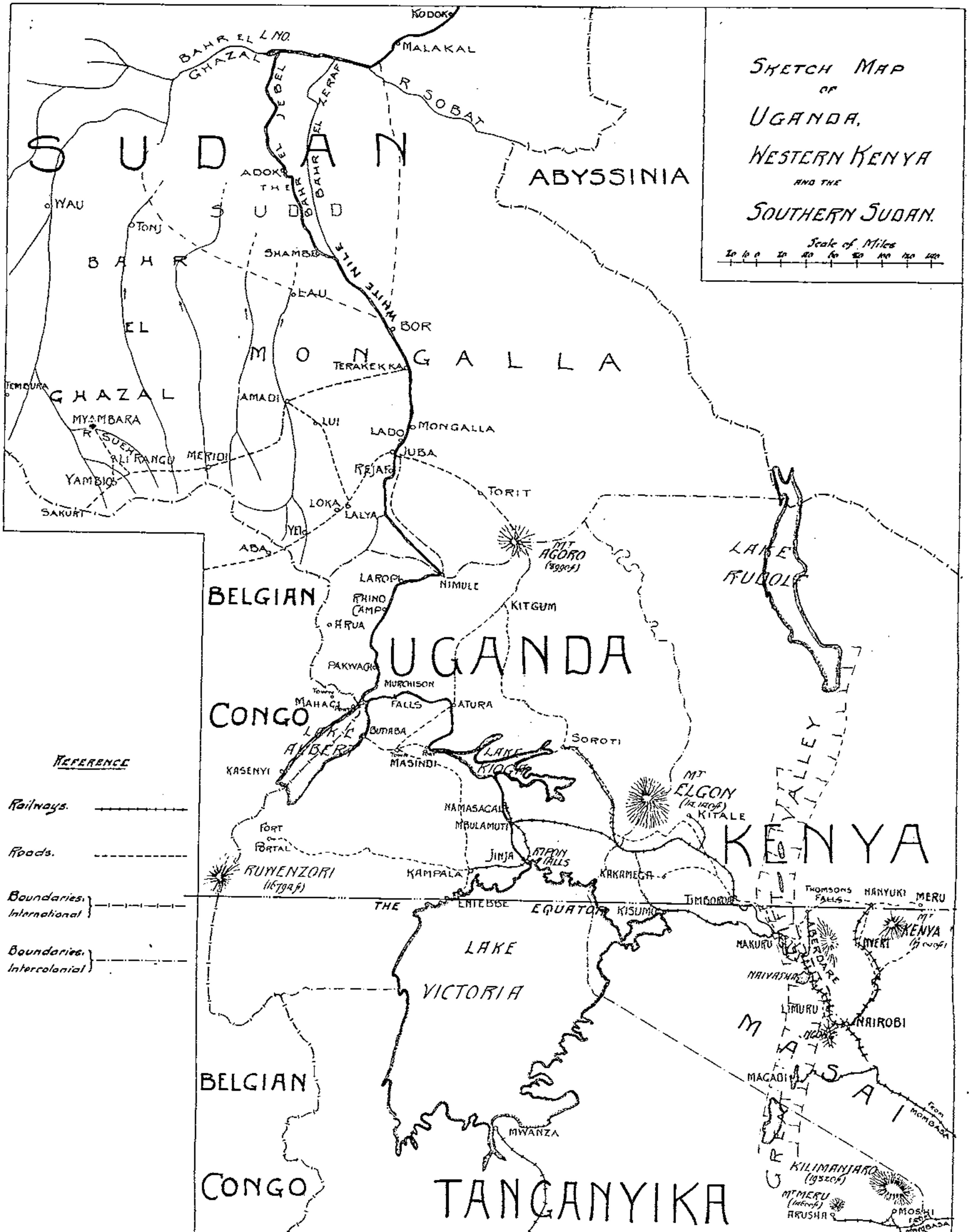
neither went alongside nor waited long enough for passengers to go ashore. Venice was reached at 3 p.m. on May 3rd, but our three-day stay can only form the foundation of a future long visit; the courtesy and efficiency there are noticeable after hotter countries. From Venice to London a special cheap second-class through ticket costs about £6 10s., and one with a large choice of routes less than £10. We chose the latter, and fulfilled a long-held ambition to see Switzerland in summer; entering through the Italian Lakes and St. Gothard, we passed Lake Lucerne and stayed on the slopes overlooking Lake Constance, where it was blossom-time; thence westwards to the Lake of Neufchatel and home to England on May 12th, with the chestnuts and bluebells at their best.

VI.

CONCLUSION.

This description should have made it clear that the trip is easy, comfortable, and extraordinarily interesting; a maiden lady could have made it without shock. Kenya in particular encourages visitors, for rail travel is cheap, cars can go almost anywhere across country, hotels are adequate and the climate is good for camping. Uganda will appeal more to those looking for big game, although the new roads in the extreme west are opening up country for others. In the Southern Sudan a departure from the Nile route requires official permission, and cannot be recommended unless the traveller has friends there; impossibility of obtaining stores, absence of furnished accommodation, and lack of transport and maps, mean that he must be self-supporting and take a lorry. But once one has the entrée, the scarcity of European society makes one welcomed everywhere, while the native population are most attractive and the climate not as bad as one expects. At no time on our trip did we experience climatic conditions nearly as bad as the summer in Shanghai.

The long steamer journey through the Sudd can be avoided by one day's flight with Imperial Airways at increased cost. It should be possible to reach England from Khartoum at less expense via Port Sudan, travelling second-class from there home. The cost of the full journey from Colombo to England through Africa may be taken not to exceed £200 a head; for those with less to spend, a circular tour in Kenya, Uganda and Tanganyika might be suitable.


SKETCH MAP OF UGANDA, WESTERN KENYA AND THE SOUTHERN SUDAN.
Scale of Miles
REFERENCE
Railways.
Roads.
Boundaries. International
Boundaries. Intercolonial
SUDAN
ABYSSINIA
BAHR EL GHAZAL
MONGALLA
THE SUDD
BELGIAN CONGO
UGANDA
KENYA
TANGANYIKA
MASAI
GREAT RIFT VALLEY
LAKE RUDOLF
LAKE ALBERT
LAKE KIOGA
LAKE VICTORIA
THE EQUATOR
BAHR EL GHAZAL
BAHR EL JEBEL
BAHR EL ZERAF
WHITE NILE
R. SOBAT
R. SUEH
KODOK
MALAKAL
ADOK
WAU
TONJ
SHAMBE
LAU
BOR
TERAKEKKA
TEMBURA
AMADI
LUI
MYAMBARA
LI RANGU
MERIDI
YAMBIO
SAKURE
LADO
MONGALLA
JUBA
REJAF
TORIT
LOKA
LALYA
YEI
ABA
MT AGORO (8990 ft)
LAROPI
NIMULE
RHINO CAMP
ARUA
KITGUM
PAKWACH
MURCHISON FALLS
ATURA
MAHAGI
BUTIABA
MASINDI
SOROTI
KASENYI
MT ELGON (14,140 ft)
KITALE
NAMASAGALI
MBULAMUTI
FORT PORTAL
JINJA
RIPON FALLS
RUWENZORI (16,794 ft)
KAMPALA
KAKAMEGA
ENTEBBE
KISUMU
TIMBOROA
THOMSONS FALLS
NANYUKI
MERU
MT KENYA
NYERI
NAKURU
ABERDARE
NAIVASHA
LIMURU
NAIROBI
NGONG
MAGADI
MWANZA
KILIMANJARO (19,320 ft)
MT MERU
ARUSHA
MOSHI
from MOMBASA

THE CROSSING OF THE VARDAR NEAR PARDOVICA.

24th September, 1918.

By LIEUTENANT DONALD MCBRIDE, *late R.E.*

ON the morning of the 15th September, 1918, the Allied offensive was launched in Macedonia, when two French and one Serbian divisions attacked the Bulgarian front on the mountain range between the Sokol and the Vetrenik. As a result of their success, Serbian and French troops were let through on a front of 16 miles, and by the evening of the 17th had advanced to an average depth of 10 miles and already seriously threatened the enemy's communications in the valley of the Vardar.

The Commander-in-Chief of the Allied Armies of the East, General Franchet d'Espèrey, had instructed the British Commander-in-Chief, General Milne, to carry out an attack east of the Vardar, between the river and Lake Dojran, on the 18th, in the event of the Franco-Serbian attack being successful. The object of this attack was to pin down the Bulgarian troops on the left or east bank of the Vardar, and subsequently to take advantage of any weakening shown by him, to drive him beyond the mountain range known as the Belasica Planina, and thus assure for the Allies the communications in the Vardar valley. The attack was launched by the British 22nd Division and Greek troops under General Milne's command at dawn. The Greek attack was in the main successful, but that of the 22nd Division, which had to face the strongest defensive position on the Macedonian front, the notorious Pip Ridge, gained little ground and suffered very heavy losses. On the 19th the attack was renewed with fresh troops, but with not much greater success.

Meanwhile the Serbian troops were pressing onward towards the Vardar. In the early hours of the 22nd the enemy evacuated his trenches along the whole front from Lake Dojran to west of the Vardar, leaving only small rearguards to cover his retreat, and before it was light the British were advancing on both banks of the Vardar.

The 27th Division was the only British division west of the Vardar. Following upon the withdrawal of the Bulgar, the 501st (2nd Wessex) Field Company, Royal Engineers, forming part of the 27th Division, were ordered forward to construct a bridge over the River Vardar, near the village of Pardovica. This was to enable the 27th Division to take up the pursuit of the retreating Bulgar on that flank.

The actual site of the proposed bridge had been decided upon for some time from aerial photographs taken by low-flying planes over the river between Pardovica and Guevgueli. These photographs were taken at such close range as to enable sandbanks and shallows to be clearly identified in the river bed and, by devising a rough scale of measurement, it was found possible to decide the length of the bridge to be supported on pontoons and the length of the portion to be carried on improvised trestles and piles over the shallows and obstructions. The extra bridging materials were therefore constructed and loaded up; the additional pontoon wagons were parked and ready at Pont Dreveno when the order to move forward was given before midnight the 22nd September, 1918.

The route lay through Mayadagh and Kara Sinanci to Guevgueli and thence to Pardovica. The country in this sector of the Balkan front was particularly hilly and tortuous and the roads, where they existed at all, were primitive and too narrow for the broad, heavy pontoon wagons. When rounding some of the more acute bluffs very often only a few inches of margin separated the outer wheels from the crumbling edge of the gorge, which fell away steeply for several hundred feet below. On one occasion, in fact, the rear end of a pontoon wagon did actually slither over the edge; and only the magnificent horsemanship of the drivers, who remained mounted and urged their animals forward until an additional six teams of six horses each were hooked in to the rescue, saved the wagon from crashing with its team to the foot of the gorge.

Now and again at stream and dry *nullah* crossings rough bridges were met with which were either inadequate or had been destroyed by shell fire. These were strengthened or rebuilt, or avoided altogether by making a detour to a more convenient crossing.

There were other, and all too frequent and irritating stoppages, due to the snapping of harness or the breakdown of vehicles, or to the exhaustion of the draught animals, whose condition became well-nigh hopeless after twenty-four hours of gruelling work on an appalling road. When a breakdown occurred at any part of the column the drivers immediately behind had orders to pull to the side and drive forward; but, as often as not, the nature of the ground forbade this, and much valuable time was lost by these oft-recurring delays. The entire column of bridge transport was over a mile in length, and there were very few and brief periods when the whole moved forward at even the slowest pace.

Despite the fact that an order had been passed along giving the bridging unit priority of passage over all other transport, the wounded included, there were many occasions when traffic was unavoidably met with head-on and in narrow defiles; and only after drastic remedies had been resorted to was the way once again made clear.

At the end of twenty-four hours, during which no man had rested,

or eaten except frugally and on the move from haversack rations, a complete halt was called in the village of Guevgueli. The plight of the worn and badly galled animals was pitiful in the extreme, and both men and officers were thoroughly exhausted.

The situation was considerably relieved by an Artillery Brigade Commander offering to hook in his horses to the bridge wagons and continue the march. This offer was gratefully accepted, and the remaining portion of the journey was accomplished.

The wagons were drawn up at the bridge site about 4 a.m. on the morning of the 24th September and, without a moment's delay, the task of erecting the bridge was put in hand by men who had been for two nights and a day without rest.

Speed was the great essential!

Artillery and transport units were coming rapidly forward and massing on the west bank of the river, eager and impatient to cross.

As a preliminary, many of the sappers and their officers walked into the river to freshen themselves for the task ahead. While the work of unloading the wagons was in progress a helpful battalion commander came forward and offered the services of his men to undertake whatever fatigue work they could usefully perform. After a short discussion amongst the bridging officers, a method was devised of utilizing to the utmost the services of these excellent men.

Under their officers and N.C.O's, the infantrymen were lined out across the river and close to the bridge, and remained in position to act as a very efficient human conveyor, floating bridging material forward from hand to hand to the position of assembly.

This somewhat unorthodox method of bridging was particularly successful during the crossing of the shallows, as the low water would have prevented boats being used with any economy; and as this stretch, which was carried on piles, was the slowest and most difficult part of the bridge to erect, it was necessary to tackle it immediately and hurry the work forward. To this end the human conveyor largely contributed.

A word about the ingenious box piles. Each pile was constructed of four random lengths of 10-inch by 1¼-inch planking. These were nailed together to form a long rectangular box, and a sole piece of heavier section timber was nailed to one end. These light and hollow piles were floated out and placed upright in their approximate positions. After being properly set for line and distance, the hollow was filled with stones and sand and cut off at the requisite height above water.

The work was carried through expeditiously and without a hitch by a very competent company of sappers who had been carefully rehearsed in their part and knew exactly what was required of them. It is a tribute to the indomitable spirit of these men that, despite their extreme bodily fatigue, they continued at their task without

halt and in the remarkable period of eight hours had coupled the east and west banks of the River Vardar with a bridge over five hundred feet in length. This made a period of thirty-six hours which the company had spent in marching and working, with practically no rest and very little food. Even at its termination, certain of the officers and men had to be detailed to remain on the bridge while all the transport and troops crossed, in case of any breakdowns.

When the last deck plank had been laid, and before the side curtains had been erected, an impatient but excellent artillery brigade commander rode forward and, declaring that his units were capable of crossing the naked bridge, commenced to lead the first battery over.

Some of the horse teams behaved quite well, but others, becoming frightened by the sinuous motion of the structure and the movement of the water flowing underneath, commenced to stall and shoulder each other, until one team complete with drivers and ammunition limbers crashed into the river. Fortunately they fell between the pontoons, doing little or no damage to the frail canvas craft, and men and animals were extricated quickly without loss. The screens were then erected by request, and the crossing was continued and completed without further mishap.

The R.E. Company was commanded by Major R. B. Pitt, M.C., with Capt. M. C. M. Wills, M.C., second-in-command, and Lieuts. Kean, Lockett and D. McBride in charge of sections.

From the commencement of the march at Dreveno until the bridge was constructed at Pardovica, two days later, officers and men had worked at high pressure and without rest or halt for food: one officer, who had been out on night reconnaissances for the two nights previous to the commencement of the march, putting in a period of eighty hours without sleep.

ENGINEER TROOPS, SUDAN DEFENCE FORCE.

By LIEUTENANT A. J. KNOTT, R.E.

THE Engineer Troops, Sudan Defence Force, date only from 1925, but they have grown out of the old Sudanese Sapper Section of the Egyptian Army. As early as 1912 there is a record of some Nuba boys being attached to one of the Sudanese Battalions and being trained in trades and military engineering. All work of that sort was then under the Military Works Department, which numbered among its personnel many R.E. officers, though it was mainly a civilian organization.

Minor wars and patrols were common at that time, and the arming and clothing of the Sapper Section as soldiers had already been decided upon. Within a year the military element showed itself again in the Works Department by the institution of a regimental guard at Headquarters in place of the previous system of watchmen, and soon after this precedence in the Army immediately after the Artillery was granted to the Sapper Section, with permission to wear a blue and white hackle and red and blue flash. The flash now worn by all ranks of the Engineer Troops is of the same colours, but slightly different pattern, but the hackle now in use is also of the Corps colours, red and blue.

No provision was yet made for the Sapper Section in the budget, but an officer from the Military School who had been through the Engineering Section of the Gordon College was posted to it, and the men were given some training in Fieldworks under Mr. Hart, an ex-serjeant R.E. in the Military Works Department. At the same time efforts were made to collect from experienced officers information as to what sort of work would be required of the unit in war, and experimental lists of tools were got out.

In this original conception it was apparently intended that the Sappers should be responsible for work in close touch with the fighting troops only; Line of Communication work was still to be carried out directly by the M.W.D., who visualized the use of Egyptian conscripts for it, and planned to give some of them some elementary Fieldworks training—to turn them, in fact, into a sort of pioneers. Units for this purpose were organized by the M.W.D. as and when required. The desirability of making the Sapper Section a separate unit on its own was fully recognized, but various difficulties were encountered. Discipline, too, was difficult; the

men were mostly Nuba prisoners of war who had been drafted for army service as a measure of tribal pacification. They had left their wives behind in the mountains, and not unnaturally men were always deserting to go back to their homes and families.

In 1916 the Sapper Section saw service as such in operations in Darfur. Mr. Hart was given a commission as Saghkolaghasi (a rank between Captain and Major) to command it, and thus gained the distinction of being the only British Sagh. in the Sudan, as officers seconded for service there are normally gazetted Bimbashi immediately on joining. Hitherto any units accompanying the army for engineer work had been unarmed and had, therefore, required an escort. The Sapper Section was armed, and therefore independent of escort, though they had with them a permanent working-party of Egyptian conscripts.

For the next seven years the Sappers were employed at intervals on road work, building blockhouses to protect wells, making barbed wire enclosures, and so on. On patrol they were usually commanded by Hart, who was soon promoted Bimbashi. He left the Sudan in 1924 after 16 years' service in the country, having played a considerable part in the early training of what is now the Engineer Troops. The next big step forward took place in 1920, when a scheme was approved for the establishment of a school to train military artisans—the forerunner of the present Boys' Company and Training School.

After the departure of the Egyptian Battalions from the Sudan in the latter part of 1924 the Sapper Section, though still weak in numbers, took over the greater part of the work of the M.W.D., and were completely armed, equipped and trained as infantry. The following year saw the beginnings of the present régime; the proposed establishment of the new Engineer Troops was one Field Company of four platoons and a Boys' Training Company. The Field Company was to be based on the Indian pattern, and was to be trained and equipped to undertake all engineer work on patrol and to be employed on Military Works Services in peace. Actually an establishment of two platoons was immediately authorized, and this was increased to three in 1930. The boys were to undergo a five-years course of trade and military training, and were to provide all the necessary recruits for the Sapper Company. On May 1st, 1925, 60 men and 12 boys moved to their new quarters in Wood Pasha Barracks, Omdurman—the present home of the Engineer Troops. The first Commandant was El Kaimakam F. E. Fowle Bey, and he had under him four British and seven native officers. It was not anticipated that any work outside Omdurman would be undertaken for at least a year, and it was therefore decided to send certain officers to the Public Works Department to gain experience of Works Service. Two British and three native officers were seconded

in accordance with this plan. By the end of that year transfers from other units and direct enlistment of boys had raised the strength of the unit to 92 men and 83 boys.

Later that year a detachment was sent off to tackle the first building job of the new unit, a house for the District Commissioner at Akobo. On paper they had sufficient skilled builders to carry out the job, but it was found that trade rates previously granted were practically valueless, and the men definitely could not turn out work of the required standard. The Commandant, therefore, reluctantly declined to take on any other constructive work for a year, by which time it was hoped to have raised the general standard of trade proficiency.

In the following year the new organization was well tested, orders being received to send a platoon at two days' notice to join a patrol at El Obeid. The detachment left within the prescribed time and were employed on road work, blasting and construction of blockhouses. Shortly after their departure from Omdurman an urgent request was received from the patrol for a searchlight and men to work it. Some old equipment was got out and reconditioned and a detachment rapidly trained in this new branch of Sapper work, and within seven days of the receipt of the original orders they left to join the patrol. The light was used to illuminate selected waterholes, to prevent their use by the enemy—a practice which has since become standard. This platoon also carried out the clearing of an aerodrome at Talodi, a task which involved the blowing up of a large number of trees. The actual number demolished was quoted in various reports as anything from three to thirty thousand.

Next year, 1927, the Engineer Troops took part in two patrols. Their main work in the first was the blowing up of the Deng Kurs Pyramid (*R.E. Journal*, June, 1929), the removal of which was required to facilitate the subjugation of recalcitrant tribesmen. The demolition was accomplished in February, after the detachment had been employed on the construction of various improvised rafts and on road work, including the making of a slab road. The other detachment again took with it a searchlight party, which worked for the most part from a steamer. This detachment also had the now common task of teaching the infantry to carry out rapid wiring, usually in the form of sections of portable fence.

Certain Works Services were carried out in the same year at Singa, including a reinforced concrete rifle range, minor barrack repairs and the construction of a well. This last task presented considerable difficulty, and was only completed as the result of a good deal of patience, skill and ingenuity on the part of the detachment and of its commander, Abdulla Effendi Khalil, who has since had the distinction of being the first Saghkolaghasi in the Engineer Troops, being promoted to that rank on 15th August, 1931.

The navigation of certain parts of the Nile has always been somewhat precarious for native boats, and in 1927 the assistance of the Engineer Troops was called for to improve a section near Wadi Halfa. The current there, as in most parts, is very fast, and the date boats on their way to Egypt had always suffered heavy casualties from boats being carried on to the rocks or capsized by local rapids. Some thousands of cubic metres of rock were removed with explosives from this reach, the work being extended over three years. As a result, in 1932 the date fleet of very unmanageable native boats got through with only one wreck, as against anything up to fifty in previous years. This improvement was not only appreciated by the owners of the boats, but was also of benefit to the country, as the date trade increased considerably with the greater safety, and with it the amount collected in taxes on exported dates.

In the same year a comprehensive course of instruction in Field-works was carried out by the unit, particular attention being paid to the rapid wiring which had been the task of many detachments on patrol. The portable fence was the design most favoured, and the record achievement was the construction of 25 yards of this by 7 men in 4 minutes 45 seconds. A small building programme was also carried out in Nyala, including a hospital block, and British and native officers' quarters, the total cost being about £2,500.

During the following year a detachment made two trips in connection with the Nuer Settlement. At first they were employed on road-making and later on clearing landing-grounds for aeroplanes and constructing mosquito houses. The commander of the detachment, El Bimbashi Kavanagh, acted as advisory Roads Engineer to the Governor of the Province.

During the operations of 1928-30 the Engineer Troops received their share of recognition, 4 British officers, 2 native officers and 13 other ranks being mentioned in dispatches. Fowle Bey reverted to the British Army in May, 1929, and was succeeded in command by El Kaimakam C. C. Duchesne Bey. He in turn handed over command to Kavanagh Bey in December, 1930.

The year 1929 saw the beginning of the biggest building programme the Engineer Troops have yet undertaken. New quarters were required for the Equatorial Corps at Torit (H.Q. and 2 Companies) and Kapoeta (1 Company), and the whole were to be built by Sappers employing direct unskilled labour. For three successive years a large detachment was in the south on this work from about October till June each year. Plans, specifications and estimates were prepared at Headquarters in Omdurman, and joinery was made and steel works prepared for erection in the workshops there. On the site, the entire work, from the making and burning of the actual bricks to the painting of the finished houses, was carried out by Sapper labour and supervision. The buildings erected included

7 British officers' quarters, 5 offices, 7 stores, 1 guardroom and magazine, 2 wells, and 3 large steel buildings for mechanical transport. The total cost was about £16,000—not a bad undertaking for one Field Company with no Engineer Services personnel to do the specialized work for them.

During the time that the Torit building scheme was in progress very little real training was possible. Ninety or more men were away from Omdurman, and there were always other small jobs which, with the necessary duties in barracks, absorbed the whole of the Sapper Company. In 1932-33 a full and extensive course of military and engineer training was organized for the whole Company, including Infantry Field Training, Musketry and Fieldworks.

The Boys' Company has seen several changes since its inception. In 1929 it was decided that the Engineer Troops, in addition to enlisting and training all their own boys, should train those destined to become drivers and artificers in the Mechanical Transport. At first a separate establishment was carried on for this purpose at Khartoum North, where the M.T. are located and have their own workshops. The running of two separate shows some five miles apart presented certain difficulties, and in 1932 the dual establishment was done away with. The fitter boys now do their training in the Engineer Troops Workshops at Omdurman with the remainder of the boys. They are transferred to the M.T. when they have about one year more to do as boys before joining the ranks. The elementary bench work is done in Omdurman, and they also learn there the parts of the various vehicles in use in the M.T., so that when they go to Khartoum North on transfer they can get on to more specialized work, which will be of more direct use to them as men in the ranks of the M.T. The other trades taught in Omdurman are builders, blacksmiths, carpenters and painters, and an additional small outlet for trained boys and men is provided by the other Corps of S.D.F. who require a few artisans on their strength. Many of these jobs have hitherto been held by relatively highly-paid civilians, and it is hoped gradually to replace them all by soldiers trained in the Engineer Troops.

In December, 1932, the first review of the S.D.F. was held in Khartoum. As only troops within easy reach of Khartoum were on parade, the Engineer Troops were the largest unit present. They also staged a display at the close of the review in which the boys, dressed as savages, attacked and burnt down a post office, being afterwards themselves attacked by a section of Sappers representing the Government Troops. Though acting is not included in the syllabus of the Boys' Training School, their natural aptitude in this direction was well shown, and the display was very popular. The final item in the programme was a parade of the S.D.F. of the past and future, the past being represented by retired native officers, and the future

by a composite detachment of enlisted boys. These boys were drawn largely from the Engineer Troops, and were commanded on parade by the Engineer Troops Boy Serjeant-Major. Their drill and steadiness on parade would have done credit to many a unit of fully-trained men.

The present establishment of the unit is 3 British officers, 1 British N.C.O., 6 native officers, 162 men and 160 boys. The men are organized in Headquarters and three platoons, the fourth platoon originally proposed not having materialized. Of the boys, 60 are earmarked for transfer to the M.T. General financial stringency in the Sudan, as elsewhere, has resulted in the cessation of all but essential building work, and the Engineer Troops have not been employed lately on any big work of this nature. They have carried out many small jobs, have been able to put in plenty of training, both military and engineer, and took part in 1933 in manœuvres in Darfur.

Apart from the use of the Engineer Troops as Sappers in operations and in peace, the training of the boys and men is of great service to the country ; the men leave the unit after their nine years' service far more useful members of the community than they were when they came in. That this is fully appreciated is shown by the fact that there is already a more than sufficient supply of boys wanting to enlist in this branch of the S.D.F. Further expansion is not required for the moment, nor would it be possible for financial reasons, but it is to be hoped that retrenchment has reached its limit as far as the Engineer Troops are concerned. The combined educational and military value of the organization is too great to be allowed to be whittled away, even by economies. Any Sapper or other officer who happens to find himself in or near Khartoum should not fail to pay a visit to Omdurman, where he will always be welcomed and shown all there is to see of this most interesting offshoot of the Corps.

THE FASTNET RACE, 1933.

By LIEUTENANT L. R. E. FAYLE, R.E.

ON the evening of Friday, 21st July, 1933, six yachts between 20 and 46 tons, three British and three American, lay at anchor off Cowes. They were the smallest, but perhaps the most formidable, field, ever assembled for the Fastnet Race. The two smallest, *Dorade* and *Ilex*, had each won a Fastnet Race previously. *Flame*, Mr. Charles Nicholson's Bermudan cutter, was the only other old boat besides *Ilex*, but her modern and efficient rig made her a formidable competitor for light weather and head winds. *Lexia*, the other British entry, a fine new 40-ton gaff cutter, had been well up with the leaders in the hard race of 1931, and would be hard to beat in heavy weather. Besides *Dorade*, the Americans had brought over two new schooners, *Brilliant* and *Grenadier*. The former, a fine husky boat of 46 tons with short overhangs, solidly built of teak, had just crossed the Atlantic in 16 days, including a wonderful week's work of 1,445 sea miles. The latter, an Alden-designed Bermudan schooner, very like *Water Gypsy*, which was 2nd in 1931, was a smart and efficient-looking ship.

We had arrived in *Ilex* that afternoon, the crew having joined up in full strength at Pompey the previous morning. As we had anchored, a boat had drawn alongside with an encouraging cable to the skipper from Dennis Hunt at Landi Kotal. One sad change, however, had been made from the usual arrangements. Carter had not been very fit for three weeks or so preceding the race, and we had decided that it would be too much to expect him to cook for us under normal Fastnet conditions. Accordingly T. P. Watkins came as his amateur substitute, while Carter remained on board till just before the start of the race to help us put the finishing touches to our preparations and to impart instruction to our new cook on the art of mastering the wily Primus.

There was to be a change in the course this year. From the start we were to go down the Solent and so direct to the Fastnet instead of round the Isle of Wight as in former years, but the homeward run, instead of finishing at Plymouth, led round St. Catherine's, and the finishing line was between the Horse and No Man's Forts in Spithead. This made the course some 100 miles longer. The handicaps for the Fastnet Cup were to be based on the usual R.O.R.C. rating rule, but

this year, in addition, a second cup called the Jolie Brise Cup, presented by Mr. Robert Somerset, was to be given, the handicaps for this being decided by the entrants themselves.

The crew was made up as follows :—

Skipper and Navigator : H. S. Francis.

Port Watch.	*Starboard Watch.*
P. L. Wilkinson (mate).	J. de V. Hunt (mate).
J. M. Guyon.	K. N. Wylie (bos'n).
L. R. E. Fayle.	P. N. M. Moore.

Cook : T. P. Watkins.

On Friday evening the skipper went ashore to a meeting of owners and returned on board with the handicaps : they were hardly cheering ; by the R.O.R.C. rule we had to allow *Grenadier* two hours and *Dorade* over eight. *Lexia* was scratch boat and had to allow us 11 hours. By the Jolie Brise handicap we were long handicap boat, and gained some advantage over the R.O.R.C. handicaps on all the others except on *Lexia*, who on this was allowing us only about nine hours.

Saturday, July 22nd. The morning of the race dawned, showing us a clear sky and little prospect of a breeze. Carter went ashore after breakfast, and very sorry we were to see him go. Meanwhile, however, we had to prepare to get under way. The start was at 11 a.m. B.S.T., and soon after 10 sails were being hoisted, anchors weighed, and the ocean racing fleet got ready for the start. Of wind, however, there was none, and we, like most of the others, got a pluck from a motor-boat to the starting-line. With slack water and the prospect of a light air coming over from the mainland in time to reach us before the gun, we chose the northern end of the line. We were unlucky, however—no wind came—and as the starting-gun went the inshore boats got the first of the ebb, and not until 12 minutes after the gun, just after *Brilliant*, did *Ilex* cross the line. *Dorade* and *Grenadier* were well ahead with *Flame* close behind.

We stood inshore and got an air which pulled us up : we passed *Brilliant* and *Lexia* (who was having trouble with her kedge), but off Egypt Point we bumped a ledge of rock ; the tide swept us clear, but steerageway had been lost and we dropped back into last place. Soon a breeze came up from the W.S.W. ; it reached *Ilex* last of the fleet, but soon it freshened, and we were beating down the Solent at six knots under main, jackyarder, longhoisted jib topsail, and working headsails.

We were gradually overhauling *Brilliant*, and soon after Hurst Castle was passed there was great excitement on board as we passed ahead of her on the starboard tack. When we next met her we were on the port tack and had to pass astern of her : John Hunt

FASTNET RACE 1933

THE STARTERS

Scale

BRILLIANT, 96 tons
Owner:- Mr Wm Burnum. (U.S.A.)
Built in 1932.
Length (over all) 61.6' Beam 19.7' Draught 8.8

LEXIA, 40 tons
Owners:- Major T.P. Ross-Richards
Built in 1931
Length (over all) 68-0" Beam 13'4". Draught 8'3"

GRENADIER 39 tons.
Owners:- Messrs H.A. & S. Morris. (U.S.A.)
Built in 1930.
Length (over all) 59'4" Beam 13'8" Draught 11'2"

FLAME, 33 tons
Owners:- Mr. C.E. Nicholson
Built in 1900.
Length (over all) 63'5"; Beam 12'1" Draught 8'2

ORRADE 21 tons
Owners:- Messrs A. & J. Stevenson (U.S.A.)
Built in 1930
Length (over all) 52'2" Beam 10'3" Draught 7'7"

ILEX. 20 tons
Owners:- Royal Engineer Yacht Club.
Built in 1899
Length (over all) 50'0" Beam 10'4" Draught 7'5"

at the helm, however, was determined to lose as little ground as possible, for *Ilex's* bowsprit only missed *Brilliant's* main boom by a matter of inches. So the two of us continued down the Solent, passing and repassing each other, jolly sailing, six knots, a bright sun and a clear sky. Soon we were down to the Needles, now ahead of *Brilliant* on both tacks, and the opening phase of the race was over.

We were working in our normal watches now, having put the clock back to Greenwich time. We stood in towards Old Harry, the breeze continuing fresh, and then made a leg out, passing two cables astern of *Lexia* and well ahead of *Brilliant*. At 4.30 we went about on the port tack and the breeze, which had been sending us along at seven knots, started to ease: at 6 p.m. G.M.T. we were 25 minutes behind *Grenadier* and only four minutes ahead of *Brilliant*, and scarcely doing three knots, having set the big jib in place of the other headsails. *Flame* and *Dorade* were now well ahead of us all.

Supper proved to be a good meal, for which the cook was duly commended. The feeling of well-being, however, which the port watch experienced as they emerged on deck afterwards, was rather rudely dispelled when the skipper, deciding that the contrary tide was pushing us back, dropped a kedge in 20 fathoms. That was a simple matter, but a minute later, when it was found that the tide was less strong than expected, it had to come up again. Little did the unfortunates who hauled it up know that they were in for another dose of it the next day.

At 9 p.m. a breeze came up from the N.W. and for the next three hours we progressed at two or three knots. We thought we could see the starboard light of *Brilliant* creeping up on us. So ended the first day.

Sunday, July 23rd. By 2 a.m. Portland was abeam, and at dawn two sails were in sight ahead, which we optimistically hoped were *Flame* and *Dorade*, while, astern, *Grenadier* was sighted. All the morning we sailed close-hauled, making one and a half to four knots, and gradually dropped *Grenadier* out of sight. At noon the day's run was 74 miles. The coast of Devon near Start Point soon became visible, and we sighted *Lexia* and *Brilliant* ahead; the breeze freshened, and as we neared the Start we were doing five and a half knots, with dolphins diving across our bows.

Inshore we went about on the starboard tack, and settled down to make up on *Lexia*, *Brilliant* having now drawn out of sight. At 4 p.m. we went about on the port tack, standing inshore again towards the Prawle, and half an hour later crossed a mile ahead of *Lexia*. The latter, however, stood out to sea, while we seemed to lose the wind as we stood inshore. Soon we scarcely had steerage way, and the tide turned against us; down went the kedge in 32 fathoms.

Ten minutes later we had it up again, as another light air came up from the W.S.W., and we set the big jib again, but it was no good, and before 7 p.m. the kedge was down again. Meanwhile *Grenadier* appeared from behind Start Point. She, too, lost the wind, and the two of us stayed there waiting for a breeze or for the tide to turn: an exasperating time it seemed, for *Lexia* out to sea was getting a breeze.

The tide turned in our favour soon after 9 p.m., and the kedge (at the end of 70 fathoms of warp !) was weighed by the unfortunates on deck. Then a light breeze came, and after coming from all quarters—first spinnaker was set and handed, then the same with the reaching staysail—it went ahead and we lay close-hauled on our course for the Lizard; not for long, however, for the breeze died again before midnight.

Monday, July 24th.—A light air came from the N.N.W. and improved. By 2 a.m. we were making about six knots with sheets eased a little, and set the working staysail to help the big jib. At 3.10 a.m. G.M.T. the Eddystone was abeam to starboard, but the wind eased afterwards, and by 8 a.m. we were down to about three knots with the wind starting to head us. Finally we were broken off and had to go about.

Shortly after 9 a.m. we had a little comic relief. Watkins, after washing up the breakfast, passed up a bucket of slops for Guyon to empty overboard. The latter, in carrying out this operation, fell overboard complete with bucket owing to the life-line breaking. We were sailing slowly so he came aboard again abaft the dinghy, still complete with bucket. He was so inordinately proud of having retained the bucket, that he was fully compensated for his wetting.

The day was cloudy, but there was hardly any wind. We ghosted along at two knots or so during the morning, going about from time to time as the wind headed us. We were nearing the Lizard, and we sighted *Grenadier, Lexia* and *Brilliant* ahead. The two former quickly disappeared round the point, but *Brilliant* remained in sight for some time. At noon the second day's run was 77 miles.

At 1.30 p.m. we were close in to the Lizard, and the big jib having been torn, was replaced by the yankee and working staysail and came down for repairs by the bosun. At 2 p.m., close inshore, we stood out to sea on the starboard tack. The afternoon was much like the morning, and the only cheering thing was the sight of *Brilliant*, apparently becalmed in Mounts Bay. *Lexia* and *Grenadier* had disappeared ahead, and where were *Flame* and *Dorade ?*—probably half-way across to the Fastnet, we thought. Spirits on board were at rather low ebb: the Fastnet weather about which we had heard so much seemed to have gone from one extreme to the other; moreover, two joints of meat had gone bad and had been consigned to the deep. Towards nightfall the wind was very light and fluky and

caused us to go about frequently. We were now between the Wolf and the Runnelstone, and the Longships was in sight; *Brilliant*, abeam of us inshore, seemed to be making little progress.

Night fell, and the last we saw of *Brilliant* was her port light under our lee bow.

Tuesday, July 25th. Until 3 a.m. we did little more than drift with the tide, till a fitful and variable westerly breeze gave us two knots again. At 4 a.m. the Seven Stones Lightship was abeam and we found ourselves able to set our course for the Fastnet. Dawn showed none of our competitors in sight, a calm sea with a slight swell and an overcast sky. Our speed improved a little during the morning and at noon our third day's run was 64 miles. After lunch the old ship was doing six knots for a time, but by 6 p.m. we were down to three again, though still able to lay our course. By 7 p.m., however, a moderate W.S.W. wind had come up, and we settled down to a steady 6½ under main, jackyarder, big jib, and reaching staysail. Midnight saw us doing over seven.

Wednesday, July 26th. The wind had eased slightly and headed us a little at times, but it freshened again at 2 a.m. and at 2.10 the big jib, which had been pulling us along grandly, blew out. The skipper on the bowsprit end, ably assisted by John Hunt, got it out of the ditch, not without difficulty, and replaced it with the yankee. Their efforts were somewhat hampered by the helmsman letting the ship get aback, but in a few minutes the mess was straightened out and the ship again moving at her former gait.

Soon after 6 a.m. G.M.T. we sighted *Lexia* returning from the Fastnet and another yacht which we thought was *Flame* but was probably *Grenadier*, and at 7.10 a.m. *Brilliant* passed. The latter we took for *Grenadier*, all three yachts being very distant, and we still hoped we were ahead of *Brilliant*. By 8 the wind started to ease and head us, and drizzle began: we were soon broken off to N. by W. This meant a beat up to the Fastnet, and must have lost us quite four hours. Meanwhile, conditions in the fo'c'sle were unpleasant for the first time in the race, but the cook gallantly produced an excellent breakfast.

The weather soon cleared, and the sun came out, giving us our first view of the Irish coast. At noon the day's run was 121 miles, and the Fastnet lighthouse was visible over the horizon. In the long swell we beat up to the rock at four knots, and as we neared it the lighthouse-keeper stood out on a ledge of rock and started to semaphore. Wilks, our signal expert, was aroused from sleep to interpret. "You are . . ." came the signal—breathless moment—were we ahead of *Brilliant*?—". . . SIXTH" it went on: moans of disgust. More news was signalled and it became apparent that *Flame* and little *Dorade* had rounded the previous evening. Though we did not know it, we were even 12 hours behind the 5th boat.

1.—The start—a light air.

2.—*Brilliant* passing astern of us in the Solent.

3.—The boom mending sails.

4.—The Fastnet Rock, 26th July, 1933.

The Fastnet Race, 1933 1-4

5.—The starboard watch.

6.—Thursday morning—7½ knots.

7.—Spinnaker boom drill.

The Fastnet Race, 1933 5-7

By 3 p.m. G.M.T. we had rounded, spinnaker was set, and the lonely rock with the long Atlantic swell breaking on it dropped astern, as at six knots, with a light breeze from the N.W., we started on our run home. The swell was long and comfortable, and in the evening we passed an outward-bound cargo steamer of about 4,000 tons: she was pitching horribly into it, and the sight was a striking example of how in a long sea a small vessel may be more comfortable than a large one. For four hours we ran at six knots, but before sunset the wind died and left us slatting about in the swell. At 9.30 p.m. a light air from the N.E. arrived, and we took in the spinnaker: it improved and by midnight we were doing six knots again with wind abeam.

Thursday, July 27th. The wind held and increased, and by 3 a.m. we were doing 7½ knots for the first time in the race: the jackyarder had to come down, to be replaced by the jib header, and soon afterwards the first jib replaced the yankee. It was a grey dawn, a lumpy sea had got up across the old swell, and spray was coming aboard. *Ilex*, however, was enjoying herself, and reached along steadily at 7¾ knots hour after hour. Soon after 9 the wind had eased slightly and the medium jib topsail was hoisted to be replaced an hour later by the yankee. The day was rather cold, and the picturesque sun-bathing kit used by the crew by day on the outward passage had now been definitely replaced by the sober blue jersey—though a dash of colour was lent to this garment by one of the crew who wore, on his, a piece of embroidery worthy of a high-class tattoo artist: it depicted a peroxide blonde encircled by a lifebuoy on which his initials and those of the Royal Engineer Yacht Club were displayed.

During the morning a feeble sun was occasionally visible through clouds and gave the skipper the opportunity to get a few sights, on which, however, he was placing little reliance. We were hoping to make our landfall at about 1 p.m., but the poor visibility would not make the task very easy. At noon our day's run was 135 miles.

The port watch came on deck at 1 p.m. G.M.T., and shortly afterwards we got our first sight of land—the Scillies—dead ahead, putting us somewhat to the south of our observed position and proving the unreliability of sights taken through cloud. We altered course to pass between the Scillies and the Seven Stones, running almost dead before the wind, and at 2 p.m. Wilks on relinquishing the helm found he had broken the hourly record for the race by doing 8·1. The next hour, during which we altered course for the Lizard, was not quite so good—7·75. The skipper then took the helm and did 8·35, the sea being moderate and occasionally rather steep. The next hour Guyon did 8·3, claiming that he was equal with the skipper on account of the rotator of the log having jumped out of the water once! By this time the Wolf was abeam to star-

board about half a mile distant, and the sea was easier: in the next two hours we ran 8·1 and 7·8. This six hours' watch had been grand sailing; we had run 48·4 miles, for which the port watch duly congratulated themselves.

At 7.30 p.m. G.M.T. the wind had eased sufficiently for us to hoist the jackyarder in place of the jib header, and 10 minutes later the Lizard was abeam. We were still doing over 7½ knots—not quite so good as the afternoon's sailing, but very satisfactory none the less, and we held on thus until midnight. This had been a day to be remembered; we had been doing over seven knots since 2 a.m., and the run from midnight to midnight worked out at 184 sea miles, an average of 7·67 knots, a topsail having been carried throughout.

Friday, July 28th. At a quarter to one we passed the Eddystone, but as dawn came with Start Point in sight ahead the breeze began to die: tide was against us and we made slow progress, until an air came out of the S.W., and with spinnaker set we began at last to leave the Start astern. All through the sunny morning the breeze improved.

At noon our day's run was 154 miles, and soon afterwards, as the breeze increased, the spinnaker boom started to lift from time to time with the puffs. Accordingly the skipper devised a brutal but effective method of restraining it: one hand sat on the boom hanging on to the end of a rope made fast to the kedge. If the spinnaker boom wanted to lift, it therefore had to lift an anchor and a man as well. This was very amusing for the rest of the crew, but not so jolly for the man sitting on the boom: the position was, to say the least of it, cramping, and once, as the boom gave an exceptionally vicious jerk, Wylie was lifted from his perch and shot half-way down the fore hatch.

Lunch was a somewhat frugal meal, for our cook was beginning to show signs of Bolsheviki tendencies. A further blow fell in the afternoon, when we heard on the wireless that *Dorade* had again won the race, with *Grenadier* second.

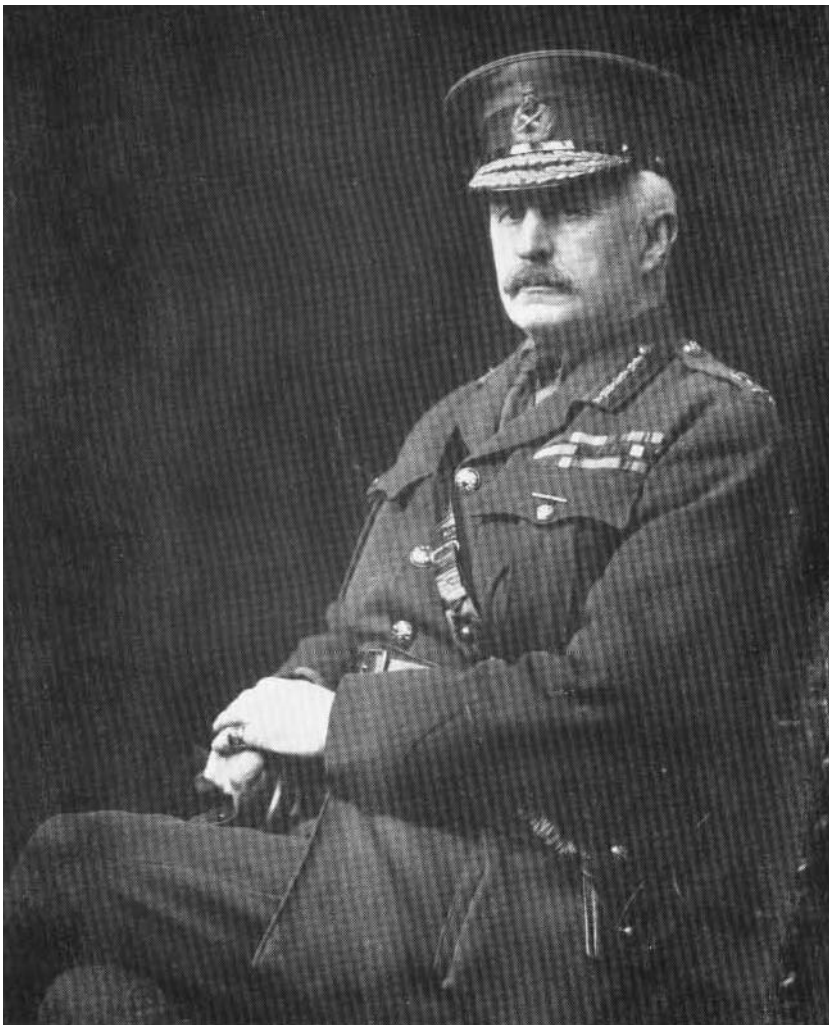
Between 6 and 7 p.m. John Hunt broke the hourly record with an 8·5 under mainsail, jackyarder, yankee, reaching staysail and spinnaker. Steering, however, had become very difficult, as the sea was getting up and wind freshening, and before we reached St. Catherine's the spinnaker was handed, followed an hour or so later by the jackyarder, and the working headsails replaced the yankee and reaching staysail. For the first time in the race the topmast was bare and we could dismantle the preventers. At 9 p.m. Dunnose was abeam, and an hour later we gybed and made for the Nab Tower, which we passed at 10.30 p.m., the wind still freshening, and much spray coming aboard. Away to starboard a vessel, apparently stationary and wearing either two or three foremasthead lights, had been sighted, and had occasioned some wild discussion as to her

nature. Shortly afterwards the skipper called for green Very lights in order to announce our arrival in the prescribed manner. The mate, who had served in a defended port, was convinced that the mysterious vessel was a target-boat or guard-boat for night firing by the Royal Artillery: he also knew that a green Very light was the signal from the guard-boat to the battery that the range was clear. Determined to prevent an unfortunate accident, he slipped below, and pocketed all the green lights he could find before suggesting calling up the vessel with the Aldis lamp. He easily explained away the lack of response by pointing out that the signallers' attention was riveted to the shore, but the skipper put an end to all argument by demanding a light, and saying he was not going to be frightened by a tug towing a hopper of spoil out to the dumping grounds! Lights were therefore fired—no bombardment ensued—and by their radiance we were able to admire *Ilex*, doing eight knots under plain sail with lee rail awash. With sheets hardened in slightly we tore up Spithead, and at 11·44 p.m. G.M.T. we crossed the finishing line, having averaged 6·61 knots from the Fastnet, 12 minutes behind *Lexia* on corrected time, and last in the race, but a good second best to *Brilliant* on our time for the homeward passage. Half an hour later we were at anchor in Portsmouth Harbour.

It had been a peculiar race in many ways: for the first time on record all the starters had finished the course, but the weather had been exceptionally easy, as we had carried a topsail for over six days on end, and no one had been seasick! On the other hand, *Ilex* has only once—in 1928—done a faster homeward passage. Even in 1926, when she won, her homeward average was under 6½ knots, and this year the glorious sailing on the 27th July had, at any rate, been some compensation for the exasperating days of beating against light airs on the way out.

For the sake of clearness, the finishing times and handicaps, which have been previously published in the *Supplement*, are given on the following page.

NAME.	*Finishing Time (B.S.T.).*	FASTNET CUP.			JOLIE BRISE CUP.		
		Handicap.	*Corrected Time.*	*Order.*	*Handicap.*	*Corrected Time.*	*Order.*
		H. M. S.			H. M. S.		
Flame ...	28 July 5-15- 6	2-24- 0	28 July 2-51- 6	3rd	Scratch.	28 July 5-15- 6	3rd
Dorade	,, ,, 11-23-15	19-24- 0	27 July 15-59-15	1st	10-20- 0	,, ,, 1-20-15	1st
Brilliant	,, ,, 12-12-23	8-24- 0	28 July 3-48-23	4th	4- 6- 0	,, ,, 8- 6-23	5th
Grenadier	,, ,, 12-14-37	13- 0- 0	27 July 23-14-37	2nd	7-27- 0	,, ,, 4-47-37	2nd
Lexia ...	,, ,, 13-31-56	Scratch.	28 July 13-31-56	5th	5-36- 0	,, ,, 7-55-56	4th
Ilex ...	29 July 0-44- 0	11- 0- 0	,, ,, 13-44- 0	6th	14-24- 0	,, ,, 10-20 -0	6th



Lieut-General Sir Henry Mcrrick Lawson KCB.
Colonel Commandant RE.

MEMOIRS.

LIEUTENANT-GENERAL SIR HENRY MERRICK LAWSON, K.C.B., COLONEL COMMANDANT R.E.

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LIEUT.-GENERAL SIR HENRY MERRICK LAWSON died on November 2nd, 1933, in a nursing home at the age of 74. " Wise Bob " to his contemporaries in the army, he was an officer of outstanding character and ability, who saw much active service and held a great variety of important appointments and commands during his long career.

The fourth son of the Right Hon. James A. Lawson, a judge of the Court of Queen's Bench, Ireland, he was born in Dublin on January 30th, 1859, and was at Cheltenham College before passing into the Royal Military Academy. He was gazetted Lieutenant in the Royal Engineers in June, 1877, and saw his first active service as a subaltern in the Sudan. After being present with Graham's force, which advanced from Suakin and repulsed Osman Digna at El Teb in February, 1884, he was in Wolseley's Nile expedition for the relief of Gordon in Khartoum. Being with the Desert Column he saw the actions of Abu Klea, El Gubat, and Metemneh, his services being mentioned in dispatches.

After graduating from the Staff College at the beginning of 1888 he was promoted Captain, and received his brevet majority in April. He obtained his first staff appointment in August, 1889, when he went to Ireland as Deputy Assistant Adjutant-General, Dublin District, remaining there four years. In September, 1893, he went to the War Office as a D.A. and Q.M.G., getting his Corps majority two years later. In March, 1898, he obtained employment with the Egyptian Army, commanding native levies during the operations against the dervishes on the Blue Nile after the fall of Khartoum. He was at the capture and subsequent defence of Gedaref, when he was dangerously wounded, his services being mentioned in dispatches and bringing him the brevet of Lieutenant-Colonel.

At the outbreak of the South African War he joined the staff of Sir George White's force in Natal as A.A.G., and went through the siege of Ladysmith. After the relief of the town he was similarly employed—as D.A.G. from October, 1900—in the field; first in Natal, where he was present at the Laing's Nek action, and later in the Transvaal and Orange River Colony and on the Zululand border of Natal until the end of the war in May, 1902. He was present at the actions of Belfast and Lydenburg, August and September, 1900, received five " mentions " and gained his brevet colonelcy.

In June, 1902, he was appointed *A.D.C.* to His Majesty and promoted Substantive Colonel.

He remained in South Africa as Brigadier-General and Chief of the Staff to the Commander-in-Chief until December, 1903, when he was brought home to fill the newly-created post of Director of Works —as distinct from the Inspectorate-General of Fortifications and Works—at the War Office. Before he took up the work, however, the Directorship was made a civilian appointment—an experiment which soon failed—and Colonel Lawson became instead, in April, 1904, Director of Movements and Quarterings. He was created a C.B. in that year.

In June, 1906, he was appointed to command the 13th Brigade in Ireland, but was promoted Major-General in the following February, and went to Aldershot as Major-General in charge of Administration in October, 1907. In February, 1910, he was appointed G.O.C. 2nd Division, his tenure of command being notable for the mobilization of the division at war strength by borrowing men and vehicles from the 1st Division. It was the first time that a division of the British Expeditionary Force had been seen practically ready to take the field. General Lawson was regarded as remarkable for the strategical insight he exhibited in the conduct of divisional operations. Many best qualified to judge had seen in him a future Quartermaster-General, but when he left Aldershot at the beginning of 1914 Sir John Cowans had been in the saddle in Whitehall since January, 1912, and Lawson was appointed Lieutenant-Governor of Guernsey.

Some months after the outbreak of the Great War he was called to the War Office to act, for several weeks, as assistant to the Chief of the Imperial General Staff, Sir James Wolfe-Murray, but in January, 1915, took over the Northern Command. At the end of 1916, having been promoted Lieutenant-General in November, he was sent to France to assist in solving the question of our waning man-power by advising upon the withdrawal of fit men employed in the back areas for posting to combatant units. In November, 1917, he was appointed Inspector-General of Communications in Italy, where he organized the "Taranto Line"—that is, the rail and sea communications through France and Italy with our forces based on Salonika. He returned to his duties in France in July, 1918, and remained there until the end of the war. He was promoted to be a K.C.B. in 1918, and retired from the army in January, 1921, being appointed Colonel Commandant Royal Engineers, in November, 1922.

General Lawson married in 1912 Lady Wilma, daughter of the fifth Earl of Radnor and widow of the second Earl of Lathom. His wife, who was created C.B.E. in 1920, died in 1931. He leaves no children.

**Major-General Sir Reginald Ulick Henry Buckland,
KCMG CB Colonel Commandant RE.**

MAJOR-GENERAL SIR REGINALD ULICK HENRY BUCKLAND, K.C.M.G., C.B., COLONEL COMMANDANT R.E.

MAJOR-GENERAL SIR REGINALD ULICK HENRY BUCKLAND, K.C.M.G., C.B., was knocked down by a motor on the evening of the 4th November, suffering severe injuries to his head, and he died three days later without regaining consciousness.

With that thought for others which was one of his characteristics, Buckland left instructions, written some years ago, that when he died there should be no memorial service and no memoir in *The R.E. Journal*. But a man who was Chief Engineer of the Fourth Army on the Western Front from first to last, a Colonel Commandant of the Corps, and a Vice-President of the Institution, whose example and words had such a strong influence on most of those who were associated with him in the army, cannot be allowed to pass from the Corps without a few words. To those who knew him personally a printed record is unnecessary, they will not forget him; but to review his career briefly may be helpful to others who knew him not on his path through life.

Youngest of the five sons of Mr. C. T. Buckland, Bengal Civil Service, who was a first cousin of Frank Buckland, the great zoologist, he was born at Surbiton on the 20th January, 1864. He went to Eton, passed into Woolwich, and was commissioned in July, 1883, eighth in a batch of eleven, of which he was to become the most distinguished member.

His early service was in Egypt, with the 24th Field Company, from February, 1885, until the last day of 1889, including the Suakim Expedition of 1885, and a few months' duty with the Egyptian Army. After a short spell at Southampton, he was, in 1890–1, on survey duty in Lagos, returning to the Ordnance Survey for nearly four years. From October, 1895, he was adjutant S.M.E. for four years, but in the autumn of 1899 was sent on special service to South Africa, becoming assistant to the C.R.E. 5th Infantry Division; and he remained there until the close of hostilities. He then went to Gibraltar for a couple of years, commanded the 11th Field Company at Shorncliffe for eighteen months, and was on the Ordnance Survey in Ireland for three years. In May, 1908, on being promoted to Lieutenant-Colonel, he was sent as C.R.E. to the Salisbury Command. In October, 1909, he was selected to be *A.D.C.* to His Majesty, thus obtaining the brevet of Colonel.

In February, 1911, he went back to Egypt as C.R.E., becoming Chief Engineer in 1913, but he was brought back home at the end

of August, 1914, and soon afterwards appointed Chief Engineer of the newly-formed IV Corps (7th Division and 3rd Cavalry Division), which, under Sir Henry Rawlinson, was landed at Zeebrugge and Ostend in time to take part in the First Battle of Ypres.

When the Fourth Army was formed in February, 1916, Rawlinson, who was selected to command it, insisted on taking with him most of his IV Corps Staff, including Buckland and the present C.I.G.S., Sir Archibald Montgomery-Massingberd, and henceforward Buckland's fate was bound up with that very happy and successful "family," Fourth Army Headquarters, whose motto might well have been "courtesy and efficiency." These qualities, coupled with absolute loyalty, an infinite capacity for taking pains and a gift for looking ahead, were the distinguishing features of all Buckland's work. A fitting crown to his war career was his tenure of the post of Chief Engineer of the victorious British Army of the Rhine from January to September, 1919. He retired in 1920.

All who came into intimate contact with Buckland by serving with or under him quickly recognized his flair for seizing essentials, his disinterestedness in assuring to them and not assuming for himself credit for work done; realizing his sincerity and single-mindedness, they soon felt and always retained for him real affection. On occasion he would assume gruffness, but those who experienced it knew only too well it was assumed and was put on as a matter of duty.

The writer recalls that long ago, in 1891, when he was about to take up an instructional appointment at the R.M.A., Woolwich, Buckland came to congratulate him, and said, "May I give you a word of advice? Don't treat the boys like board-school children as we were treated. Don't forget they will one day be your brother officers, and treat them as human beings and future comrades." He has tried to bear that advice and all it includes in mind ever since.

No one was prouder of belonging to the Corps than Buckland. After becoming a Major-General on transfer to the Fourth Army, he still continued to wear a disreputable old overcoat because it had R.E. shoulder-straps, and he regarded his selection to be a Colonel Commandant as the highest honour which the army could give him.

J.E.E.

All Reviews of Books on military subjects are included in the provisions of K.R. 522c.

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

HISTORY OF THE GREAT WAR.

MILITARY OPERATIONS: FRANCE AND BELGIUM, 1914.

Compiled by BRIGADIER-GENERAL SIR JAMES E. EDMONDS, C.B., C.M.G., R.E. (retired), *p.s.c.* Maps and Sketches compiled by MAJOR A. F. BECKE, R.A. (retired), Hon. M.A. (Oxon).

(MacMillan & Co., Ltd., London. Vol. I. Third Edition, 1933. Price, with case of (revised) maps: Text 12s. 6d., Maps 5s. 6d.)

The first edition of Vol. I was published in 1922 from such material as was then available. An amended second edition appeared in 1925, and was reprinted in 1928. Meanwhile, in 1926, the German Official Account completing the history up to the end of the Battle of the Marne had been issued, but it was decided to wait for the French Official Account before undertaking the revision necessary to embody all the new information thus available. The French volume dealing with the Marne only appeared in the spring of 1933. Hence the third edition, which appeared at the end of the year. No such revision of the other published volumes will, the compiler hopes, be necessary.

The " List of Books to which most frequent reference is made " has been amplified by the inclusion of the following :—

I.—*The French Official Account.* The first three volumes of *Tome I* cover the period from the outbreak of war to September 14th, 1914, the first volume commencing with the pre-war plans, including Plan XVII. It is a severely technical record, reinforced by a mass of documents, there being seven volumes of these to three of text in the *Tome.* Both text and maps are inaccurate as regards the B.E.F. at the Battle of the Marne.

II.—*The German Official Account.* A number of volumes of this have now appeared. Those dealing with the Western Front up to the end of October, 1914, are the first, third, fourth and fifth.

III.—Vol. I of *Kriegsrüstung und Kriegswirthschaft,* published in 1930. This is a separate part of the German Official Account dealing with the " Preparations for War." That dealing with military preparations traces the growth of the German Army from 1875 to 1914, and gives the increase necessary from 1905 onwards—and especially after 1912—for the execution of the Schlieffen Plan. Incidentally it contains the statement that the first step in financial mobilization for the war was taken as early as June 18th, 1914, when the President of the Reichsbank, " with special emphasis," recommended the directors of the leading Berlin banks to increase the cover of their foreign securities by 10 per cent.

IV.—*Das Marnedrama,* 1914. One of the Great General Staff monographs published in 1928 in five volumes. It treats of the Battle of the Marne in much more detail than in the Official Account, but as its manifest purpose is to glorify the officers and men of the old German Army, its comments and claims will hardly bear investigation. The sketch maps are, however, of considerable value.

V.—*War Histories of German Regiments.* Most of these are in the series *Erinnerungsblätter deutscher Regimenter*, published by Gerhard Stalling, Oldenburg. Some of them give detailed and personal accounts of the fighting; others merely reproduce the official war diaries.

VI.—*Belgian Official Account.* This has been published so far only in the *Bulletin Belge des Sciences Militaires*, but will probably appear later in book form. Included in it are *La Bataille de Liège* and *La Défense de la Position Fortifiée de Namur*, both valuable to the historian.

Sir James Edmonds takes the opportunity to state in a footnote on p. 14 the facts as to the studies pursued, from 1906 onwards, by General Grierson and his successors, with the authority of the Prime Ministers, Sir H. Campbell-Bannerman and Mr. Asquith, in the elaboration of the plans for the landing of the "Expeditionary Force" in France in the event of war, under the reserve that in no case should they constitute an engagement for the British Government. Although there was an "obligation of honour," there was no definite undertaking to send the whole or any part of this force to any particular point, or, in fact, anywhere at all. There was no arrangement with Belgium of any kind, her Government having made it quite clear that they would maintain strict neutrality, opposing with all the Belgian forces France or Germany, if either violated the frontier, or any third power interested who might land troops in Belgium, or try to use Belgium as a base of operations. In a later Note it is stated that why Germany did not violate the Dutch frontier, as was intended in the Schlieffen Plan, was because she hoped thereby to keep open her communications with the outside world and obtain supplies through a neutral Holland.

On p. 16 a useful paragraph has been inserted recording the arming of the British, French and German armies. While the British and Germans had a clip-loading (five cartridges) rifle, the French had a magazine rifle with eight cartridges in the butt; these fired, it became a single-loader. On the other hand, the French field-gun was a true quick-firer with a rate of fire almost double that of the British or German. The French corps and divisions had, however, no howitzers or heavy guns, and only a few groups of heavy guns, of small range, under army control. While a French Active corps had 28 battalions and 120 field-guns, the German had 24 battalions, 108 field-guns and 52 howitzers (4·2 or 5·9 in.).

On p. 21 revised figures are given of the strength of the German Army. The number of trained officers and men, 4,300,000, which the British Intelligence Branch had estimated before the war would be available, proves to have been under the mark; the actual number was 5,020,700. The number of untrained men available was approximately correct, 5,474,000 actual, as against 5,500,000 estimated.

The "Introduction" ends with a Note recording the uniforms adopted by the belligerents. On the outbreak of war the French infantry wore blue with red trousers and *kepi*; it was not till 1915 that "horizon-blue" was adopted. The officers were conspicuous by reason of their shorter coats. The Germans wore field-grey from the start. The Belgians wore dark blue with grey trousers till they adopted khaki in 1915.

Chapter I begins with a revised reference to the events leading up to the outbreak of war. Sir James Edmonds refers the reader to certain publications from which it is abundantly clear that the British Government made every effort to bring about mediation and took no step that would contribute to precipitate war.

On pp. 38–41 there is some more detailed information as to the precautions taken by the French to ensure that no French troops violated the German or Belgian frontiers and as to the first movements of the French troops on the declaration of war. On p. 39 there is an important statement: "On the 13th August, General "Joffre came to the conclusion that the enemy was wheeling south towards the "(French) Third, Fourth, and Fifth Armies on the upper Meuse, and it was too "late for them (the French) to seek battle beyond the river 'under good conditions.'

" He paid no heed to the view of General Lanrezac (Fifth Army) that the enemy " wheel was of a much wider nature." On p. 40 the changes in General Joffre's original orders are briefly enumerated.

Sir James Edmonds refers to the fact that when the Schlieffen Plan was first drafted the possible effect of air observation was not, and naturally, taken into account. There is no hint, he goes on to say, that subsequently either Moltke or his assistants ever took into consideration the fact that their foes might obtain information from the air which would enable them to recognize and stultify the German plan.

In this connection, attention is drawn to one of the principal new features in this edition, as regards the British operations generally, the inclusion at some length of the air reports and the deductions made from them.

In describing the fog of war which surrounded General von Kluck at this juncture, Sir James Edmonds records that the German Navy had not been helpful in the matter of information as to the advent of the B.E.F., and since the 1st August had been unable to shed any light whatever as to the embarkation or movements of the British. In fact, the only information it supplied was incorrect. On August 8th, the naval command reported that " they had definite information that the transport " of the B.E.F. to Calais and eastwards (Dunkirk, Ostend and Zeebrugge) was in " full swing." It is now definitely known that nothing was heard in Germany of the mass of the Expeditionary Force crossing the Channel in the middle of August.

Another new feature is the use which the official historian has made of the valuable information collected by the late Major-General Sir Reginald Buckland, and published in his article in *The R.E. Journal* of March, 1933, under the title, " Demolitions Carried Out at Mons and During the Retreat of 1914."

On p. 95 there is an addition quoted from the German Official Account of the Battle of Mons, which ends : " A decision had seemingly not been obtained. Only " the envelopment of the British by the German right wing could lead to this. " Whether the German leaders could manage to carry out the manœuvre, in time, " against the left wing and left flank of the British was now of vital importance for " the result of the great battle, not only to the First Army, but to the whole German " front." The attempt, General Edmonds sums up, was to fail on the 24th August, and fail again on the 26th at Le Cateau, and the final result was to be the envelopment of the German right wing itself by the Allied left wing. He recalls here that it was on the 23rd August that the eight-day Battle of Tannenberg commenced ; and also the Battle of Krasnic, which ended on 11th September with the retreat of the Austro-Hungarians before the Russian armies on the south-west front.

The narrative, pp. 96–116, describing the fighting on 24th August has only been slightly revised. The Note on the German movements on that day has, however, been amplified from the German Official Account. It ends with an extract from von Kluck's orders for the 25th August, in which it is recorded that he was " of the " opinion that he had so far only had to deal with advanced portions of the British " Army—two or three divisions—which had now withdrawn on what appeared to " be their main position."

One has heard a good deal, when discussing the fighting in the early days of the war, of the failure in liaison between commands and units. There is no doubt now that the arrangements for intercommunication were inadequate ; it was remedied later in the war. On p. 129 Sir James Edmonds cites an example. In a new paragraph he quotes the evening summary of such air reports as had been received on 25th August at G.H.Q., and writes :—

" This information was passed on to the two corps and to the Cavalry Division. " . . . A later summary made up at night showed subsequent and important changes " in the positions of the advancing German troops. This very accurate picture of " the situation does not seem to have been communicated to the corps or divisions, " or to the cavalry."

In his book, *The Fifth Army*, General Sir Hubert Gough refers repeatedly to the way in which he was hampered by not receiving orders and information from the Cavalry Division during the period under review. The fact is that it was impossible to ensure proper liaison when, owing to inexperience of war, there were few if any officers charged with this important duty during operations.

It is interesting to note that Sir James Edmonds, when quoting the corresponding summary of the reports of the German airmen on the evening of the 25th August from the German Official Account, describes the German picture as "incomplete." It was, however, sufficient to make the Germans realize that the First Army had failed to get on as fast as was intended and that "the British appeared to have "managed to extricate themselves from the threatening envelopment of the First "Army."

The reasons which led to the change in direction of the retreat of the I. Corps (Haig) on the 26th August have always been somewhat obscure to the military student. On p. 135 there is an important reference to this in describing what occurred during the night of the 25th/26th August. It would seem that originally it was intended at G.H.Q. that the I. Corps should retreat in a south-westerly direction from the south-east and east of the Forêt de Mormal. It appears now that the change of direction was apparently ordered by Sir John French himself. Sir James Edmonds writes: "There is at this point a gap in the records, but it would appear from what "followed that General Haig must have been told by Sir John French that, in view "of what he had reported as to the direction of the enemy's attack at Landrecies, "he must retire southwards, not south-west. At 8.45 a.m. the C.-in-C. "repeated General Haig's information to General Smith-Dorrien, 'Enemy appears "to be working round south of Landrecies, G.O.C. 4th Brigade doubts if he can "move south,'" and then (vide Appendix 14) gave the II. Corps the Le Cateau–Busigny road, previously allotted to the I. Corps, thus directing the latter more south than south-west. He had already, at 5.0 a.m., informed General Lanrezac, commanding the French Fifth Army, General Sordet (Cavalry Corps), and General d'Amade, commanding the French troops on the left of the British, that the I. Corps was retiring south, if not south-eastward, and called on them for help. In his message to General Lanrezac, he asked him "to help him by receiving the I. Corps "until it can rejoin the main body of the British forces."

On pp. 145–147 the narrative, describing the movements of the 4th Division during the night of the 25th/26th August in its retirement as rearguard from the high ground south of Solesmes and the River Selle to the line Ligny–Esnes, has been amplified and corrected as regards the topography of the position it took up. It was not till 5.0 a.m. on the 26th August that all the infantry of the Division reached the end of their march. At 5.30 a.m. they received orders to occupy the previously ordered battle positions, on which to all intents and purposes they were then lying exhausted after a very trying night. Instead of continuing the retirement, as ordered, at 7.0 a.m., they were now directed to get into touch with the 3rd Division, 2,000 yards to their right about Caudry and be prepared to protect the left flank of the II. Corps in the ensuing battle.

It has not been found necessary materially to revise the account (pp. 152–191) of the Battle of Le Cateau. On p. 192, Sir James Edmonds deals with certain criticisms which have appeared as to the failure of the C.-in-C. to over-ride General Smith-Dorrien's decision to stand when he was first apprised of it early on the morning of August 26th, and as to whether General Smith-Dorrien should not have himself ordered a retirement later in the day, during the lull in the fighting about 1p.m. The official historian, who was G.S.O.1 of the 4th Division at the time, is in no doubt about the answer to the first suggestion. There is, he writes, a very general consensus of opinion among the officers of the 4th Division that, had not the II. Corps stayed to fight, the newly-arrived 4th Division—still without its cavalry, heavy battery, cyclists, engineers and signal company—would have been unable to carry out a step-

by-step retirement (whether appointed as rear guard to the left of the B.E.F., or not) in the face of the three German cavalry divisions and the IV. Corps which were immediately available to deal with any opposition, and would have been destroyed. As regards the second suggestion, he replies that withdrawal might have been begun with the greatest ease about 1 p.m., but in view of the hours of daylight remaining, the enemy would have soon discovered the real direction of the retirement, and in all probability there would have been a close and disastrous pursuit. He states with authority: "In the circumstances, General Smith-Dorrien was fully justified in his "decision to fight, and he was wise in delaying his retirement to the latest moment "compatible with the safety of his force." He adds: "Could the 5th Division have "stood till dusk, or had the I. Corps given some assistance, there might have been "fewer losses; for the missing were largely made up of wounded left on the ground, "and of parties which did not get the order to retire."

On p. 193 the air reports received during the day are summarized. They were of the greatest possible value to General Smith-Dorrien, but unfortunately no summary of the whole was made at G.H.Q., owing probably to its retirement from St. Quentin to Noyon at 3.30 p.m. Had the information available by the evening been summarized it should have given G.H.Q. a fairly clear picture of the situation.

Chapter VIII is practically unchanged. The Note at the end on the movements of the First and Second German Armies after Le Cateau has been supplemented by a lengthy extract from the German Official Account. On p. 217 reference is made to the pessimism which apparently existed at G.H.Q. after the battle, and led to Colonel Huguet sending an alarmist message to General Joffre as to the state of the B.E.F. In the following Chapter Sir James Edmonds summarizes on pp. 244–6 the effect of this report and the interchange of messages which it caused between the C.-in-C. and General Joffre, and the intervention of Lord Kitchener, who was gravely concerned as to the effect on the French mind if the B.E.F. was withdrawn from the line, as Sir John French proposed that it should be, to a position behind the Seine west of Paris. General Joffre pointed out that such a move would entail crossing the communications of the Sixth French Army, whereupon Sir John French agreed to its withdrawal to a point behind the Marne east of Paris, where it could rest and reorganize. Later, amended orders were issued by G.H.Q. for the B.E.F. to retire south.

On pp. 252–4 a comprehensive Note has been inserted at the end of Chapter XI, on the Battle of Guise, from the French and German Official Accounts. It is to be noted that the Germans refer to it as the Battle of St. Quentin.

In Chapter XII there is an addition to the Note on the German movements on September 1st, quotations being given from the German Official Account and the information that was available from air reports. There is also a Note on the organization of the Army of Paris, based on the French Official Account.

It was on September 1st that General Joffre advised the Government to leave Paris, which they did, for Bordeaux on September 2nd. On the 3rd and 4th September, the writer of this review, on his way by motor from Le Hâvre to open the British Base at Marseilles, *via* Le Mans (headquarters of G.O.C., L.-of-C.), Tours and Lyons, crossed the main roads leading from Paris to the west, south-west and south of France. There was on every road a continuous stream of motor vehicles of all kinds, loaded with passengers, luggage and tins of *essence*. It was difficult to get through Tours at all. Over a million people are said to have left Paris by road, rail and river on these two days. At Moulins, he and his staff officer were greeted as Russians! A British officer in uniform had never been seen there before, but the rumour of the coming of the Russians (*via* Archangel and Aberdeen) had evidently spread!

In Chapter XII, on p. 274, there is a valuable addition, as to the information then available on 3rd September to enable the respective Commanders-in-Chief to visualize the movements of the Germans and decide on the action to be taken thereon. It is

now known from German sources that von Kluck's divisions (his move eastward was already known) by making marches of 25–28 miles secured all the bridges over the Marne between Chezy and La Ferté-sous-Jouarre (exclusive) before or by midnight on the 3rd/4th September. It will be remembered that it was only at 11.50 p.m. on the 3rd September that Sir John French issued orders for the remaining bridges over the Marne in the British section to be destroyed.

On pp. 278–81, Sir James Edmonds endeavours to straighten out what actually transpired on September 4th between the two Commanders-in-Chief, their staff officers, and Generals Lanrezac, Franchet d'Esperey and Gallieni as to the movements to be carried out on the 5th September, especially as regards the further retirement (if any) of the B.E.F. Sir John French solved all doubts by deciding to retire a few miles south, in view of the gap which existed between the B.E.F. and the Fifth Army, and his conviction that General Joffre wished the B.E.F. to be withdrawn further to make room for the Army of Paris south of the Marne.

On p. 293 there is a new Note on "The Genesis of the Battle of the Marne," and a Note on the sequence of events on the 4th September, 1914, based on the *Mémoires du Général Gallieni*; also a book by his Chief-of-Staff, General Clergerie, and on *Joffre et la Marne*.

In Chapter XIV, on p. 296, Sir James Edmonds has in the second paragraph interpolated two words: "*Fortunately or* unfortunately, these orders not having "reached Sir John French," the B.E.F. was allowed to continue their marches southward on the 3rd September. His amendment of the end of the paragraph explains the reason. "Thus on the night of the 5th/6th September, the B.E.F. was, on the "right, 10 miles, and on the left 20 miles in rear of the position, *actually in occupation "of the Germans*, in which the French C.-in-C. expected it to be." The words in italics are new.

On p. 297 reference is made to General Joffre's visit to Sir John French at G.H.Q., at 2 p.m., on 5th September, "to beg in the name of France the intervention of the "British Army in a battle in which he had decided to throw his last man." (The scene is described in *Joffre et la Marne* and in Brig.-General Spear's book, *Liaison*.) "Visibly moved by the appeal of the French C.-in-C., Sir John French gave his word "that his army would do all that it was possible for men to do."

On p. 313 the movements of the French on 7th September are summarized from the Official Account, and this is followed by a long Note on the movements of the German right wing on the same day.

It was on the evening of the 7th that the C.-in-C. issued orders for the British advance to be continued against the line of the Marne from Nogent l'Artand to La Ferté-sous-Jouarre.

On pp. 324–5 (Chapter XVI) a summary of the air reports of the 8th September is given, which showed that the greater part of the German IV and IX Corps was opposite the British on the north bank of the Marne, quite enough, comments Sir James Edmonds, to make Sir John French feel cautious when forcing the passage of a wide river.

On p. 326, he refers to the Special Instruction No. 19, issued by General Joffre at 8.7 p.m. on the 8th September, in which *inter alia* the Fifth Army was directed to cover the right flank of the British Army by sending a strong detachment against Château Thierry–Azy, which, he now points out, it failed to do (see p. 333), and thereby caused the I. Corps (Haig's) to be halted till the situation in this direction was cleared up.

The movements of the German divisions during the Battle of the Marne are now given at greater length. Sir James Edmonds has made it even clearer than before that it was the advance of the columns of the B.E.F. across the Marne on the morning of September 9th which led to the orders being issued for the German retirement, for no French troops crossed the river until these orders had been issued.

Chapter XVII, p. 332. Throughout this chapter there are numerous additions

from French and German sources which make the progress of the battle much clearer. In a note at the end, reference is made to the second Belgian sortie from Antwerp (9th–10th September). Though the delay of the IX. Reserve Corps and 30th Division in reaching the front did not actually affect the Battle of the Marne, as Kluck and Bulow retreated on the 9th before these reinforcements could have reached them, the three divisions might otherwise have well been in time to have prepared a position on the Aisne for the retreating armies, or to have made a flank attack on the advancing Allies.

Chapter XVII describes the pursuit to the Aisne. On p. 371, Sir James Edmonds suggests that as there were many indications that the enemy intended to make some kind of a stand on the line of the Aisne, which offered great facilities for defence, there was good reason for attempting an enveloping operation round the German right flank, if only with Bridoux's cavalry corps. He also notes that the movement (actually known then) of large bodies of German troops eastward from Soissons on Neufchatel (15 miles north of Reims) during the previous three days indicated that the enemy feared his centre might be broken and was making efforts to concentrate more troops in front of the Fifth French Army and the British. A gap had existed in the German line. Was it realized by the Allied Higher Command? Why did they not take advantage of it? Was it the fog of war merely? And must the same explanation be offered for the Germans who failed to realize the gap that existed before and after the Battle of the Marne between the Fifth (French) Army and the B.E.F.? The absence of unified command may have been the cause of such opportunities being missed by the Allies, but can the same excuse be offered for the Germans?

Chapter XIX, p. 379 *et seq.* The narrative remains practically unchanged but a comprehensive Note is added as to the French movements on the 13th September. As regards the Germans, it is noted that on this day the First Army did no more than improve and hold its defences and swing back its right flank in view of the reported advance of French forces. As the IX. Reserve Corps (from Antwerp) and the 7th Cavalry Division had been ordered to this flank, there seemed no reason for alarm. The Third and Fourth (German) Armies continued their retreat and on the 13th reached the new positions assigned to them; but it was not till the next day that the Fifth (German) Army arrived there.

In Chapter XX there is nothing added of much importance. A new sketch map (No. 20) gives a very clear idea of the stabilization of the line on the Aisne, and it may be mentioned here that all the situation maps have been revised as to the position of the French troops.

Chapter XXI is unchanged except for a Note on the German strategy during the Battle of the Aisne, culled from the German Official Account. The concluding paragraph is interesting: "The 26th September was the bloodiest battle-day of the "whole of this period. . . . Nowhere had the armies won any ground worth mention-"ing, far less beaten the enemy. . . . A great part of the German armies suffered "irreparable loss of officers and men in these battles; but what was more serious "was the disappearance of the hitherto unshaken faith in the irresistible might of "the German attack, which the Marne had destroyed. . . . The result of the fighting "from the 15th to the 27th September did not come up to expectation. The German "Army had not succeeded in beating the ever-lengthening western wing of the "enemy. Indeed, the Sixth Army (which had been brought up from Lorraine) was "compelled to form front to a flank."

There was cause for disappointment on both sides! In Chapter XXII, Sir James Edmonds adds, on p. 465, to his review of the fighting on the Aisne the following: "The disappointing results of the operations on the 12th–14th September seem to "have been due to a failure of the Allied High Command to appreciate the situation, "and exploit the still existing gap in the enemy's line. It was at any rate partly "due to the neglect to exercise control and issue orders which could have made the

" essential requirements of the situation clear to subordinate commanders." He goes on to trace the loss of " the race to the sea " to the failure to make a resolute effort even to reconnoitre the enemy's dispositions on the river, and, except in the 4th Division, " to push forward parties to seize the bridges on the night of the " 13th/14th September. In the G.H.Q. orders there was no hint of the importance " of time. By the evening of the 13th the situation had completely changed. " German reinforcements were known to have arrived and serious resistance was to be " expected on the 14th, yet the G.H.Q. orders merely repeated the formula that ' the " Army will continue the pursuit . . . and act vigorously against the retreating " enemy.' They gave no more tactical direction than to allot roads. There was " no plan, no objective, no arrangement for co-operation, and the divisions blundered " into battle."

Appendices 1 to 8 do not appear to have been altered. At the end of Appendix 9 (p. 507), General Edmonds discusses the point as to what extent Marshal Foch was responsible for the French Plan XVII. He has ascertained that there is in existence a study prepared by the Marshal in 1911, two years before Plan XVII was elaborated, the main lines of which are hardly distinguishable from Plan XVII. In that document Marshal Foch discounts the value of fortifications and enunciates his doctrine in the following words: " There is only one way of defending ourselves, that is by " attack—to attack as soon as we are ready."

On pp. 516-7, Appendix 14 reprints Sir John French's Operation Order No. 8 of the 25th August, given in the original edition. Para. 7 of that Order says: " The " I. Corps can use the Le Cateau–Busigny road and roads to the east. Billeting Area " in Busigny and to the north and east." The allotment of this road to the I. Corps has already been referred to in this review. It would be interesting to know why the I. Corps did not use it? Might not General Haig have been in closer touch with the II. Corps fighting at Le Cateau if he had had troops on it, and might he not have then been in a better position to know what was going on on his left and perhaps able to lend a helping hand?

In a note to this Operation Order, General Edmonds, in the original edition and in this, clears up a point as to the actual time at which it was issued and proves conclusively that it was not issued at 4 p.m., as stated on the G.H.Q. copy quoted, but at 7.30 p.m. It was received at II. Corps H.Q. at " about 9 p.m." General Edmonds also prints an autograph letter which General Henry Wilson wrote to General Smith-Dorrien at 3.45 p.m., informing him in advance of Sir John French's intention to continue the retirement on the 26th, and stating that orders (*i.e.*, Operation Order No. 8) " will follow as soon as the details have been worked out." It would be interesting to know at what hour General Smith-Dorrien received this letter?

There are practically no alterations in Appendices 14 to 37 (new edition). On p. 555, Appendix 38 gives Operation Order No. 19, issued by Sir John French, at 7.30 p.m., on 8th September, 1914. The same evening General Joffre issued his Special Instruction No. 19 (summarized on p. 326 of the new edition), timed 8.7 p.m. This must have been received at G.H.Q. some time after Sir John French's Operation Order No. 19 was issued. There is nothing to show whether any action was taken on it, or whether any order or message was sent out from G.H.Q. subsequently, embodying the information given by General Joffre and the intentions of the Generalissimo, which were that the Sixth Army was to hold the troops opposing it on the right bank of the Ourcq, whilst the British forces, crossing the Marne between Nogent l'Artaud and La Ferté-sous-Jouarre, were to advance against the left and rear of the enemy on the Ourcq? Operation Order No. 19 merely says: " 2. The " Army will continue the advance north to-morrow at 5.0 p.m., attacking rear-guards " of the enemy wherever met."

The Official Historian is to be congratulated on the Third Edition. He has cleared up many doubtful points, and filled up the gaps in the narrative. His skilful use of

the mass of new information at his disposal has added only 48 pages to the book. The new and revised sketches and maps are invaluable. Any officer who is preparing for an examination, or who has to lecture on the operations, must use the new edition, and the object of the reviewer has been to make it easier for him to find the new material.

H.B-W.

FOUR-SCORE YEARS AND TEN.

By General Sir BINDON BLOOD, G.C.B., G.C.V.O.

(G. Bell & Sons, Ltd. Price 16s.)

It is indeed fortunate that Sir Bindon Blood was persuaded to write this book, and so give us some of his varied experiences covering the period of his life up to 1906, the date of the termination of his military service on the active list. The writing of it alone, compiled as it is very largely from memory, is in itself a notable achievement, and the lightness of touch and breeziness with which it is written make it delightful reading and give it a vivid interest.

To refer to its contents in any detail would spoil it for those members of the Corps, and others, who it is hoped will take the earliest opportunity of reading it

It is interesting to note the combination of fortuitous circumstances that decided the author's theatre of service from time to time, with the clear determination on his part to make the most of every opportunity, both professionally and in the field of sport.

Sir Bindon's prowess as a tiger shot is still recalled with pride by the local inhabitants in the Roorkee district, and no one is more pleased than himself to know that the number of tigers that fall to the rifles of the R.E. Mess is being well maintained. *Shikar* in India can still be enjoyed by those who take the trouble to find it.

The chapters dealing with the North-West Frontier are of particular interest in view of the situation in the Mohmand and Bajaur area last year, and the fact that the bridging of the River Panjkora was again involved.

Sir Bindon gives his reasons for not extending the scope of his narrative beyond the year 1906, but those of us who have had the privilege of being closely associated with him at any time since then realize and appreciate only too well the inestimable value and benefit of the helpful advice and guidance that he has given in all Corps matters.

C.A.B.

SCHNEIDER TROPHY.

By Wing-Commander A. H. ORLEBAR, A.F.C., *p.s.a.*, R.A.F.

(Seeley Service & Co., Ltd. Price 12s. 6d. net.)

A badly-written book about a subject on which the author is well informed is always preferable to a well-written book on a subject about which the writer is ignorant. But when an author is one of the world's authorities on a subject and can write in a style that satisfies both expert and tyro, that book should be regarded as a masterpiece.

Such a book is *Schneider Trophy*, by Wing-Commander A. H. Orlebar, and it certainly deserves a place on the bookshelf of anyone who has any interest, however slight, in aviation.

In spite of its title, this book does not pretend to be a history of the Schneider Trophy, although a small history of the earlier contests is given. Rather is it an account of the pleasures, trials and tragedy of the Royal Air Force High Speed Flight whilst that unit was commanded by the author from 1929 to 1931.

To those who knew and had the pleasure of serving under him, every page conjures up memories of happy days which will be just as apparent to those to whom even flying is unknown.

Considerable technical information is given, but at the same time it can be read like a novel Not like a thriller, however, because for the first time, in print, perhaps, the general public is told that the pilots who flew these high-speed seaplanes enjoyed it for the sheer joy of real flying rather than that they flew them with gritted teeth and thoughts of hospital.

Thrills, or rather incidents, not unnaturally crept into such work, and the author's description of the time when he encountered rudder flutter at about three hundred and fifty miles an hour, whilst making the initial test flight on the S6A deserves perpetuation as an example of how briefly a critical incident can be discussed in print.

Incidentally, it is a great pity that he did not go further with that adventure and give a pen picture of what happened when the motor-boat, whilst endeavouring to tow in his crippled seaplane, caught the tow-line round its (the motor-boat's) propeller. The author's remarks to the coxswain that morning will always remain a cherished memory.

The reader is taken right through the testing and practice periods for both the 1929 and the 1931 Schneider Trophy Contests, and the successful attacks on the straightaway World's Speed Records.

Even the most complicated technical problem encountered is understandable to the non-technical reader.

The book is largely made up from notes written at various times throughout the three years, with frequent excerpts from the pilots' reports that were made directly after the flights described, in what was called the "Doomsday Book." Appendixes amplify the main work, giving details of all flights on the Supermarine racing machines in both 1929 and 1931, the dimensions and weights, etc., of the seaplanes and engines, together with a table of the Schneider Trophy Contests from 1913 to 1931.

The last main chapter is headed "Reflections," and everybody, whether they suffer from speed fever or not, will think seriously after reading it. The author makes no absurd claims for the present, and rightly puts the 400-miles-an-hour aeroplane into the commercially useless class. At the same time, however, he draws some very pertinent comparisons in the speed of travel to-day with that of a few years ago.

The end of the chapter sums up the High Speed Flight pilots' points of view in two sentences No one could have put this view in better words. They are: "The credit belongs to the brains which conceive, not to the hands that hold. But the hands had very good fun."

A postscript contains a very pleasant compliment to the Italian High Speed Flight for shattering every speed record that had been set up by the High Speed Flight under Wing-Commander Orlebar's command.

This book breathes the wonderful personality of the author, and should be read, if only because it gives the story of a section of a fighting force that was especially organized to meet a section of a foreign fighting force in friendly competition instead of in war.

J.N.B.

THE CAMPAIGN IN IRAQ.

By Commandant M. MOUQBIL BEY.

(Berger Levrault, Paris. Price 20 francs.)

Mouqbil Bey was one of those who (at least as far as Iraq is concerned) were lucky enough to have taken part only in operations which had a successful ending, and can write therefore in a mood not soured or depressed by failure and defeat.

I met him during our march as prisoners of war from Baghdad to Mosul.

He had been some years with the Turkish Embassy in Paris, and was leaving Iraq after the death of Marshal Von der Goltz, on whose staff he had been.

I asked him if he remembered the day when the Marshal and his staff had

approached Kut rather too closely, and had come under fire. He did indeed, for as they all galloped away one of our shells killed his charger, for which, but shortly before, he had paid a stiff price in Baghdad.

He caught us up on our march once again, near Mosul, and at a rather critical moment. A certain young Iraqi Turkish under-officer had been behaving harshly to the prisoners, and had struck some of our officers just as Mouqbil Bey appeared on the scene; he was appealed to, I think, by Sir Walter Delamain, and made very short work of the offender, whom we never saw again.

We were very grateful for his prompt and humane interference.

He is evidently of the opinion that Turkey was manœuvred into the war by Germany, and, in common with nearly every Turk I met, thoroughly disliked his German allies. He comments on the impossibility of stirring up Holy Wars in these days and the absurdity of the Utopian scheme of Germany for a great Mohammedan crescentade which should sweep eastwards to Afghanistan and India. His reasoning is not very clear when he complains that the mobilization scheme of Liman Von Sanders and the German Military Commission, and the directives of the German Great General Staff led to an offensive dispersal of the Turkish armies towards Egypt and the East. According to him the Armies of Turkey were hardly equal to the task of defending her territorial integrity.

Turkey's leaders, and most certainly Enver Pasha, can have had no illusions, *defence* could not be the policy of a nation joining another in a great *offensive*.

Liman Von Sanders constantly complained of Enver's wildcat offensives.

He says, too, that the rich soil of Iraq and its oil wells were sufficient reasons for England to consider it necessary to secure possession of these regions.

The triviality of our effort—two divisions—during 1914-15, is a sufficient answer.

In his description of events before the investment of Kut he is not very reliable.

He rather leaves the reader to infer that the British always outnumbered the Turks. At Shaiba we had roughly about 5,000 against Suleiman Askeri's 10 battalions infantry, 24 field, 12 mountain guns and 2 howitzers, and 10 to 15 thousand tribesmen—his own figures. And these troops were not all Iraqis; besides other details there were two battalions of the fire brigade and the Osmanjik battalion of ruffians from Constantinople.

At the first battle of Kut el Amara in September, 1915, and at Ctesiphon we were considerably—at Ctesiphon *heavily*—outnumbered.

On page 30 the author explains *l'avance foudroyante* of the British up to Kut el Amara, briefly, as due to science *versus* the lack thereof, and preparation *versus* slackness and improvidence.

This is a fine tribute to the old VIth and XIIth Indian Divisions.

He is certainly correct about the careful preparation of the VIth Division by Sir Arthur Barrett, one brigade, indeed, the 16th Poona Brigade, had been trained to the pitch of perfection by the late Sir Charles Barter, who for three years submitted it to a truly gruelling course. Whatever mistakes the leaders may have made the brigades and other units made none.

As for the siege of Kut el Amara, the author expresses wonder that a sortie was never made. Indeed, such action might well have changed the whole course of affairs.

Kut was so encircled by the Tigris that sorties were not easy to carry out.

Then, too, for the first month and a half the garrison was worked to death completing cover not only against fire but also against water. Finally, on 21st January, all but some 800 yards on the N.E. of our front line was flooded right back to the second line 500 yards away. So was the Turkish line, and the opponents henceforth were far apart except on a very limited front, leaving the enemy only a space of 800 yards or so to guard against a sortie by land. A sortie across the flooded Tigris in face of gunfire and snipers was a difficult undertaking. However, I can remember two occasions on which the garrison was ready to break out, once on the

22nd February to the N.E. along the left bank, and once again when preparations were made to cross the Tigris with two brigades, of which I commanded one, under Sir Charles Mellis.

This sortie was to co-operate with Aylmer's enterprise of the 9th of March against Dujaila and Es Sinn.

On neither occasion did General Sir Charles Townshend consider the information given him by the relieving force sufficiently definite to warrant action.

I think that had the supreme command co-ordinated the actions of both besieged and relieving force a sortie would have been made and succeeded.

The author is in agreement with Mehemet Emin Pasha (writer of *Selman Pak* and *The Siege of Kut*), in disapproving of the operations in Persia, which weakened the force opposing General Maude, though he does not make violent charges of incapacity and worse against Khalil Pasha, as does Mehemet Emin.

The Anatolian soldiers, who did all the fighting, after the date of the investment of Kut, till the end of the war in Iraq, certainly deserve the praise which Mouqbil Bey awards them. In spite of their weakness in numbers and penury of munitions, they put up a wonderful resistance, and cost us millions in money and men.

U. W. EVANS.

MODERN ROAD EMULSIONS.

(The Carriers Publishing Co., Ltd. Price 12s. 6d.)

Cold bituminous emulsions form an important class of material used in road making. The attention of military engineers has of late been drawn to their use in the mix-in-place method of rapid road construction, in which connection much experimental work is being done. The appearance of an authoritative book on these emulsions is thus particularly welcome at the present time.

This book is a collection of lectures by experts of the Road Emulsion and Cold Bituminous Roads Association of Great Britain, a body whose membership includes all the principal firms supplying bitumen and tar in this country. The information contained in it is thus reliable and up-to-date.

While the book is chiefly concerned with the use of emulsions in the ordinary processes of road making, such as surface dressing, grouting, and cold asphalt surfacing, much of the earlier chapters is of wider application. The description, for example, of the development and manufacture of asphaltic bitumens and coal tar will enable readers unfamiliar with these materials to get a clear picture of their properties.

The account given in Chapters III to V of the physical chemistry and behaviour of emulsions is excellent, and easy to follow. The fundamental requisites of road emulsions are stability during storage and transport, and satisfactory "breaking" of the emulsion when applied to the road. Stability, for a period of at least six months, can now be assured by careful manufacture: it is explained that the slight sediment of bitumen often present at the bottom of a drum can be readily rectified by rolling the drum. The breaking of the emulsion on the road is brought about mainly by the evaporation of the water beyond a certain point, combined with the mechanical disturbance caused by rolling. In ordinary road work it is desirable that this breaking should take place soon after the application of the emulsion to the road. In mix-in-place work, slower breaking emulsions are required, but the breaking must not be delayed indefinitely in bad weather. Such emulsions are unfortunately not dealt with in detail, though the problems to be solved in their manufacture are indicated, and we are told that "these matters have been worked out individually by many "research departments connected with various manufacturing concerns, but no "general technique has yet been devised."

Typical specifications are given for the use of emulsions in normal road work,

with many practical hints as to their application. Details of standard tests of asphaltic bitumens and bituminous emulsions, and table of data, are given at the end of the book.

There is an interesting chapter on modern plant available for the carriage and spraying of emulsions, with photographs of the machines described.

This should form a valuable reference book, whose usefulness is enhanced by an excellent index. A vast amount of information is packed into its 200 pages.

C.M.S.

THE GHOST OF NAPOLEON.

By CAPTAIN B. H. LIDDELL HART.

(Faber & Faber. Price, 7s. 6d. net.)

" General Bonaparte applied a theory which created an empire for him. The Emperor Napoleon developed a practice which wrecked his empire. And, a century later, evolved by Clausewitz into a system, it brought down three other empires in collapse."

This quotation really summarizes the main thesis of the author. The mobility of " organized dispersion " succumbed to the doctrine of mass, with disastrous results. As in previous writings of this author, Saxe is taken as the man who ultimately cleared the way for Bonaparte, while Bourcet, the " greatest of chiefs of staff " and the " organizer of dispersion," and Guibert, the " prophet of mobility," paved that way. The analysis of the operations and writings of these last two is very interesting, and the writer puts up a strong case for them as the guides to Bonaparte's conceptions, particularly that of 1796. The decay of mobility began, however, when Napoleon the Emperor forgot the lessons of Bonaparte, the general, and substituted mass tactics and strategy for organized dispersion. Though Jomini attempted to bring back some sense of mobility, his writings were too geometric to bear any real influence, and it was left to Clausewitz—" the Mahdi of Mass "—to preach to a listening world the doctrine of war to the end and of mass.

The author considers that all the continental leaders were obsessed by this Clausewitz doctrine, elaborated by Grandmaison, and that we had committed ourselves to it when we agreed to come in on the flank of the French armies.

This study is of great interest, but one cannot help feeling that the author exaggerates the influence of the written word and is looking at the picture too academically. It is true that Napoleon deserted his dispersion for mass, but the author ignores the influence on the Emperor of the somewhat rapid decline of the machine he was employing. Was that organized dispersion possible with the armies at his disposal in his later period ?

Was, too, the influence of Clausewitz so overwhelming ? Could von Schlieffen be called a disciple of this solid mass, without mobility ?

Capt. Liddell Hart has nearly always shown himself a supporter of the " anti-western front " school in the last war, and possibly his outlook is a little coloured by this. Historically, one can make out a good case for either side.

Excellent as his historical criticisms are, however, one wonders whether he knows the younger officers of to-day.

" Despite all its peace-time drawbacks," he writes, " a military career attracts a sprinkling at least of men who compare not unfavourably with those drawn to other careers "—" but so many of the ' alpha ' class drop out while still young." Do other careers really contain such a large percentage of brilliant men ? The experience of the author must be different from that of the reviewer. " Loyalty to truth," he ends, " coincides with true loyalty to Army in compelling a new honesty in examining and facing the facts of history. And a new humility."

With due humility, the reviewer recommends very strongly this analysis, which should certainly interest any student of history or psychology.

THE WAR MEMOIRS OF DAVID LLOYD GEORGE.

VOL. II.

(Ivor Nicholson & Watson. Price, 21s.)

Vol. II of Mr. Lloyd George's *War Memoirs* opens with a chapter discussing the merits of a more vigorous Balkan campaign instead of the Somme battle. The author accuses Joffre of making a show of supporting the Salonika enterprise while denying it the guns and ammunition necessary to success. Joffre's plea for Salonika at the Conference in London, in June, 1916, is described by Mr. Lloyd George as "one of the most cynical performances he had ever listened to" (p. 536). But those who have read Joffre's memoirs will remember that he urged an offensive by Sarrail at Salonika because it was contrary to all his ideas of sound strategy that an Allied force of some 300,000 men should remain inactive while the French, British and Russians were attacking. As for withholding the heavy guns from Salonika, that barren region, without roads, and covered with swamps where it was not mountainous, was no country for heavy artillery on the Western scale. To say that Joffre was deliberately adopting the method of urging an offensive at Salonika and then denying it the means of success in order to ensure the British Cabinet turning down the project and reverting to his Western strategy is wholly unjust. Joffre was far above such methods. It was he who saw the need for lending aid to Serbia, and French troops were the first to be sent there. "Neither the British Cabinet, the "General Staff nor the Admiralty ever favoured the Salonika venture" (*vide Military Operations, Macedonia*, Vol. I, p. 50); they pined to be rid of it. "We "had engaged ourselves," says the official historian, "in a venture which at the "moment had scarcely a friend among our statesmen, our soldiers or our sailors." Mr. Lloyd George was the only member of the Cabinet who pictured success at Salonika. At the Rome Conference in January, 1917, he advocated "an offensive "in Italy through the Julian Alps with the aid of British and French troops, above "all of heavy artillery" (*Military Operations, Macedonia*, Vol. I, p. 254). Yet Mr. Lloyd George himself writes: "No wise civilian would ever dream of embarking "upon strategy. A man who did that would be fit for no post in any ministry. He "would be a danger" (p. 763).

But we must credit Mr. Lloyd George with a very genuine and sincere desire to leave no stone unturned to obtain victory. What appeared to him to be obstinate resistance to his projects was the higher conviction of trained experts who had been brought up to examine more deeply into the problems of moving and equipping large forces in difficult countries.

Mr. Lloyd George blames Lord Kitchener for neglecting to construct roads, double the railways and build new ones in Macedonia and Serbia in 1915, but he does not explain how this could be done without Allied occupation, nor what the Germans and Austrians were likely to do upon discovery of these very informative preparations. The Greeks were uncertain Allies to say the least; the Bulgarians, who were not over-keen on their campaign on the Serbo-Greek frontier, would have been much tougher foes in their own country, and the Turks would have been in our rear. As to equipping the Salonika army with heavy guns, the first thing that army did was to ask for pack animals to re-equip itself lightly for operations in the barren mountainous country.

Mr. Lloyd George denies that the Somme was a successful battle, and says that, as far as attrition went, we lost 50% more than the Germans did; but a little farther on, he quotes from German records to show how terrible the German losses were. "The Somme was the muddy grave of the German Field Army and of the faith in "the infallibility of the German leadership, dug by British industry and its shells" quotes Mr. Lloyd George (p. 652).

Another chapter on munitions carries the story to July, 1916. It makes good reading, and shows some striking contrasts. But here again the author is not always

fair. It must be remembered that once the production plant had been set going, the output went on growing like an ever-increasing snowball and thereafter almost any figures of comparison could be made to represent the first steps as ludicrous. In his continuous attacks on Lord Kitchener, Mr. Lloyd George remains unfair. Here is a specimen attack: Sir Eric Geddes was sent to Lord Kitchener to ascertain the proportion of machine-guns to rifles, for manufacturing purposes. Lord Kitchener told him that he wanted as much of both as Geddes could produce. Not satisfied with this answer, Geddes extracted from Lord Kitchener that he wanted a maximum of four machine-guns per battalion—" anything above four was a " luxury," was the note made by Geddes. " That was the opinion of the Secretary " of State, generally accepted as our greatest soldier, on June 26th, 1915," added Sir Eric Geddes. Geddes got Lord Kitchener to initial his note, and carried it off to Mr. Lloyd George. The latter was " so indignant with this miserable estimate that he " would have torn it up if Geddes had not rescued it from him." Geddes was told to " take Kitchener's maximum; square it; multiply that result by two; and " when you are in sight of that, double it again for good luck." " Nor do I think " that the Army ever had cause to regret that the supply proposed by Lord Kitchener " in June, 1915, was increased sixteenfold," says the author.

The reader is thus given the impression that Mr. Lloyd George speedily equipped the troops with 64 machine-guns per battalion. *No such thing occurred.* The maximum proportion, reached in 1918, was 64 per *division* (then of 10 battalions), giving an average of 6·4 per battalion, or 50% more than Lord Kitchener's figure of 1915. Having thus treated Lord Kitchener's " miserable estimate," Mr. Lloyd George, a little farther on, lamely says that all the machine-guns eventually turned out, including those for the Machine-Gun Corps and the Royal Air Force and *those kept in reserve*, exceeded a figure equivalent to an average of 64 per battalion! Lord Kitchener dealt with the establishment to be maintained in the field; Mr. Lloyd George was dealing with the scale for manufacture; as any layman knows, two totally different things. The author's record of the great munition achievement is spoilt by this kind of thing.

Another example of the misrepresentation of Lord Kitchener is given on p. 643, on the occasion when he deliberately feigned lack of interest at a demonstration of the experimental tanks. He considered that too much publicity was being given to them and he wished to counter this. Lord Kitchener knew what he was about. But here Mr. Lloyd George carries the story through to its correct explanation; although it is not clear why the story was inserted, seeing that it had such explanation.

In connection with the tanks, Mr. Lloyd George blames Sir Douglas Haig for their premature use on the Somme in September, 1916, and says, " so the great secret " was sold for the battered ruins of a little hamlet on the Somme which was not " worth capturing." But the secret was already out. General Charteris, in his *Life of Earl Haig*, says: " There was leakage at home. A demonstration of tanks had " been given in England, at which a very large number of unofficial spectators, " including members of the House of Commons, had been present. Letters taken " by the Censorship had shown that full information was being sent by one at least " of the spectators to neutral countries, whence it would inevitably reach Germany " (f.n. to p. 222). So Sir Douglas Haig decided to use the first batch of tanks before the Germans could devise counter-measures.

A well-deserved tribute is paid to the women-workers in the national shell factories: their work is too often passed over.

Mr. Lloyd George tells us that when Sir William Robertson was appointed Chief of the General Staff, it was with exceptional powers all carved out of Lord Kitchener's authority. Later on, after Lord Kitchener's death, when Mr. Asquith asked Mr. Lloyd George to take over the War Office, the latter was very reluctant to accept it, " because the post had declined very much in real influence "!

Mr. Lloyd George harps on the " Too Late " tragedy of so many of the Allied

projects. Was this not due to the growing habit of referring every strategic problem to a committee? The Allies throughout suffered from too much advice and consultation. The Germans had the advantage of almost unified control from the outset. Our own War Committee was continually being re-cast. War cannot be conducted by committee. The period of greatest success on the Allied side was that during which a Generalissimo controlled the whole, but he was not called in until the situation had become desperate.

One of the best and most statesmanlike memoranda quoted at length in this volume was the work of Sir William Robertson. The book also winds up with a quotation from another of Sir William Robertson's papers, reviewing the situation at the end of 1916, which must have found ready sympathy from Mr. Lloyd George.

The author makes a good deal of the failure to help Russia in time; but all the information about the widespread corruption in Russia at that time, which has now been learnt, points to the probability that all our efforts to give her guns and shells would have met with the same fate; corruption and disorganization would have prevented their distribution to the fighting forces.

Some of the most interesting passages in the book are the memoranda on the problems of a peace in 1916, especially the contribution of Mr. Balfour. Mr. Lloyd George describes how there was a danger that a peace based on the stalemate might have been too attractive for the war-weary peoples, and how such a peace would have been even more catastrophic than the continuation of the war could possibly have been.

The author has very little good to say of our military leaders; his praise is confined to one General (who had never commanded troops in the field). Many of Mr. Lloyd George's readers will wish that he had written these *Memoirs* with less personal bias.

W.H.K.

FROM CAIRO TO SIWA.

By Major T. I. DUN, D.S.O., M.C., R.A.M.C.

(Messrs. E. & R. Schindler, 41, Sharia Madabegh, Cairo, Egypt; Messrs. John Smith & Sons, Ltd., 57/61, St. Vincent Street, Glasgow. Price, standard 18s. 6d., *de luxe* 26s. 6d.)

This book fulfils the promises held out in the preliminary notice referred to in *The R.E. Journal*, September, 1933, page 518. Starting with the modest object of giving an account for the general public of the reconnaissance made by a squadron of the XII Royal Lancers with armoured cars from Cairo to the oasis of Siwa, the author has been led on to write something also of the history and customs of Siwa Oasis. He has not contented himself with writing, but has enlisted in his service a band of artists whose work is almost unfailingly a delight. Every page is decorated with wood-cuts, the subjects of which, both modern and ancient, are suggested by the letterpress, and there is in addition a section of reproductions from photographs, some of them taken by foremost photographic artists. These photographs cover the whole course of the reconnaissance from Cairo at one end to Siwa at the other, and many gems are contained amongst them.

The vehicles used on the reconnaissance consisted of "ten Rolls Royce armoured cars, one wireless Leyland, three Austin Seven cars and six motor-cycles. A total of six lorries of the unit and attached R.A.S.C. carried the supplies and water reserve. Two R.A.O.C. workshop lorries . . . accompanied the column." One of the vehicles was an ambulance, the author being the Medical Officer in charge. In addition, two armoured cars and some transport vehicles proceeded through the desert direct to Siwa. The itinerary of the main column was Cairo-Burg el Arab-Mersa Matruh (on the coast)-Sollum (on the coast and near the Italian Tripoli frontier)-Siwa. On the return journey the column proceeded direct from Siwa to Matruh.

The Rolls Royces were all very ancient cars, and gave their crews plenty of experience in repairs. Water had to be conserved carefully, as the consumption per car, on a day's run, reached seven gallons, in spite of pipes fitted to condense the steam. Each car carried a reserve tank of 12½ gals., and a Thornycroft lorry carried 25 tanks holding a total of about 425 gallons in reserve. The water was replenished at Matruh, Sollum and Siwa. Communication with Cairo was kept up by wireless and the R.A.F. aeroplanes, which enabled various senior officers to visit the column from Cairo. The trip lasted from October 26th to November 14th, 1932, the distance covered was 1,136 miles, and the day's journey varied from 136 miles to 42.

For the details of the trip and an account of Siwa as it is now and its past history, the reader must be referred to the racy narrative in the book itself. With its unusual covers, designed by the author, its artistic get-up, and its mass of delightful illustrations, it forms an ideal "gift book." Not the least striking thing about this most interesting undertaking is that the book has been entirely produced in Cairo, from imported materials.

P.H.K.

GORDON IN CHINA.

By Bernard M. Allen.

(MacMillan & Co. Price 7s. 6d. net.)

The author is continuing the task of at last giving the world the true picture of Gordon. In this short volume, he produces a clear and vivid account of Gordon in China, from the time when he arrived in Shanghai in 1860, to the capture of Changchow and the complete collapse of the Taiping rebellion. The "Ever-victorious Army" had been raised and commanded by the intrepid American leader, Ward, whose death at Ningpo opened the way to Gordon's career in China. The story of his campaign is an amazing one. Not only was he the born leader of men, but he also showed himself at once a master of minor tactics. The surprises he achieved and the masterly way in which he used his river steamers to co-operate with all his moves and attacks make the operations a model of their type; and the influence he exercised over the Chinese themselves was only equalled by that later in Egypt and the Sudan. His handling, too, of recalcitrant Chinese Generals and Governors was as firm and direct as that shown later in his career. Luckily, in China, he was given more or less a free hand as the man on the spot, and China and Shanghai in particular owe him a great debt.

This is a very interesting and well-produced study, which should be read by anyone interested in Gordon or in the history of China and the Treaty Ports in particular.

VADE-MECUM DE L'OFFICIER DU GÉNIE SAPEUR-MINEUR.

By Colonel Baills.

(Paris: Charles-Lavauzelle & Cie. 1934.)

Books which aim at containing "what every Sapper wants to know" have appeared from time to time in many languages. Sometimes it is under the guise of an Aide-mémoire; sometimes it is a collection of useful data, facts and formulæ; sometimes it is a handbook. We ourselves had at one time a much-appreciated *Royal Engineers Field-Service Pocket Book*. And now a most distinguished and prolific French author has entered the field with a "vade-mecum."

Which, if any, of all these various forms of *multum in parvo* meets a real need? This is a matter we would do well to consider, because a need clearly defined is a need half-met. Without a clearly defined need it is futile to try to decide which details should be included in such a book and which omitted.

The old *R.E.F.S.P.B.* aimed (in its own words) at supplying "a want which has

long existed, viz., of having in one small volume the cream of the information contained in the official textbooks on field engineering." Colonel Bailis does not define the object of his *vade-mecum*, but the title of the first section gives us a hint. " L'Officier de réserve au moment de la mobilisation. . . . Concentration. Organisation. Administration." There is a fund of good advice here, including several delightful touches that would probably be crowded out of an official publication. For example, the author stresses the value of *liaison par le ventre* : " No opportunity for this should ever be missed ; it gives the best results of all. A meal together, or the timely offer of a cup of coffee, are worth—as a means of liaison—more than reams of paper and hours of talk." Then follow summaries of the composition of the principal formations and units and of the equipment carried by divisional, corps and army engineers. In short, the reserve officer is put rapidly into the military picture.

Section II is " Communications," *i.e.*, generally their significance and the responsibilities of the engineers in establishing, improving and maintaining them. Under " River-Crossings " is given a full discussion of the relative advantages of boats, rafts and bridges, including the different methods (but not the drills) for forming bridges. Data for buoyancy. Classification of loads. Ruling dimensions. Equipment bridges. Strength of roadbearers. Expedients. Footbridges. Examples. Tables of men, transport and times for bridging and roadwork.

Section III—" Demolitions," at great length ; no less than 83 pages out of 215. The tactical uses are fully discussed and the technicalities treated very completely. Useful tables and illustrations.

Section IV—" Organization of Ground." Defensive organization and the conduct of the defensive battle. The part played by field engineering. The role of the engineers. Data for obstacles, mining, shelters, dugouts. The organization of work.

Logarithms, trig. functions, squares, powers, etc., are given in an appendix. Some blank pages of squared paper are bound in.

The book is bound in cloth and measures 6 in. x 4 in. by less than half an inch. Perhaps its most striking feature is the insistence upon the military objects, aspects and applications of the art of the " Field Company " Officer. Would something of the sort be acceptable to our own Territorial officers ?

I.S.O.P.

A STUDY OF UNIT ADMINISTRATION.

(Gale & Polden, Ltd. Price 6s. 6d.)

After pointing out how the post-war slump in prices has led to a drastic scaling-down of the soldier's pay, of the money available for feeding him, and of the annual income from Canteen Rebate, the author concludes that a highly efficient system of regimental administration is needed to maintain the army standard of living at a suitable level.

He analyses crime in the army under four categories, the last of which is due to lack of money. And this lack of money may follow from a failure economically to maintain an adequate standard of living in the unit as a whole, with resultant inroads on the soldier's purse.

Having thus paved the way, the author sets out to examine four branches of supply in which the Commanding Officer has " a free hand and an adequate staff " (a premise at which some of us may demur), namely, the Messing Account, the Fuel Account, the Canteen Account, and the By-Product Account. His chapters on these subjects are admirable. Without wearying us with extracts from regulations *ad nauseam*, he summarizes the position and makes constructive proposals to achieve the desired ends. Some of these proposals may seem idealistic ; many of them make increased demands on unit staffs, but " 'tis better to have loved and lost, than never to have loved at all." A chapter is included on the Graph System, applied to the Messing

Account (which has been the subject of recent inquiry from the War Office), and another deals with the soldier's Clothing Account.

There are a few points on which the author's meaning is not quite clear. Thus he states (page 2) that Canteen Rebate in an average infantry battalion in 1930 was £700 per annum, whereas (page 13) he reckons that the Canteen Account "should bring in between £1,000 and £1,200 per annum." Again (page 15), he indicates that Canteen Rebate should provide the whole cost of sports, a provision which would seriously curtail the sporting activities of many units. And he leaves unsolved the problem of an unbalanced budget on the By-Product Account.

Nevertheless, this book is one which is well worth the notice of all officers concerned with the administration of troops. It is of a handy size with less than sixty pages of reading matter, suitable alike for a preliminary post-prandial perusal in an arm-chair and for a subsequent more serious study.

D.H.

ORDERED EAST.

By SHIP'S ADJUTANT.

(Gale & Polden. Price 2s. 6d.)

Officers, especially those travelling to India by transport, will benefit by the valuable experience which Ship's Adjutant passes on in this little book.

As a sub-title explains it, the work is "advice on procedure and kit to an officer on transfer to India for the first time." Within certain limits, it is a most useful production, which limits may best be defined, in spite of the proverbial odiousness of the proceeding, by a comparison with the Institution manual, *Notes for Officers Proceeding to India*, obtainable by members at a slightly lower price than *Ordered East*, and by the general public at 3s. 6d.

It must be said at once that *Notes for Officers Proceeding to India* is a far more comprehensive work. There is nothing, for example, in *Ordered East* comparable with Part II of *Notes*—a general, though very condensed, description of India, its climate, history, races, religions, languages, civil and military administration, and so forth. Other omissions are the method of obtaining a passport, any mention of the alternative of a journey overland to Marseilles, the shipment of motor-cars, and hints for ladies and children.

It would have been advisable also to mention the weight system in India—maunds and seers—which an officer comes into contact with on his first railway journey, as also the necessity of obtaining a ticket for his "brake-van" luggage. Another important omission in the list of necessities for a railway journey in India is Keating's powder. The very different climatic conditions which an officer on his first journey in India is likely to encounter might have been emphasized, for example, the difference between the sweltering heat of travel to Secunderabad in April, and the abysmal cold likely to be met with *en route* to Quetta or Peshawar in January.

Lastly, there is no index.

There are, however, many useful points in this work which are absent, or expressed somewhat differently, in *Notes for Officers Proceeding to India*. Among these may be noted remarks on effecting insurance of baggage for sea-transport, a complete and up-to-date list of articles dutiable on landing in India, the advisability of having locks and padlocks workable by one master key, and extensive notes on labelling baggage for embarkation. The lists of kit in Chap. III are very carefully made out and particularly useful, and there are blank columns where a tally can be kept; there is a useful appendix giving the approximate time required for rail journeys from Bombay and Karachi to the principal military stations, and finally there are blank pages for notes. The arrangement of chapters and paragraphs is particularly logical and clear, and makes up amply for any deficiency of subject matter.

F.C.M.

MAGAZINES.

REVUE MILITAIRE SUISSE.

(*October*, 1933.)—1. *Manonviller et Maubeuge.* By General Clément-Grandcourt.

This is a study of the attack and defence of two fortified places on the French frontier during the Great War. Manonviller, situated on the extreme frontier line, was intended to cover the railway from Strasbourg to Paris. The fort, constructed originally in 1880, had been reduced in size and brought up to date. It was subjected to a heavy bombardment by the Germans, but did not suffer as severe damage as many other forts which held out longer. Its early surrender was due to its isolated position: being too far from Toul to receive any support.

Maubeuge was an obsolete fort, more so than Liége or Namur. Its artillery was of old pattern; its garrison, though adequate, was not first-class. The commander, General Fournier, an engineer officer, devoted his energies in the short time at his disposal to the strengthening of the defences. To quote a writer on the subject: "As much was done in twenty days as should have been done in the previous twenty years." But all this work was done to the detriment of military training; General Fournier failed as a tactician.

Moreover, he did not anticipate that the enemy would use artillery of greater calibre than 210 mm., and he thought that the garrison would be sheltered from shell fire in the works themselves. He is also blamed for not showing greater firmness in evacuating the civil population.—(*To be continued.*)

2. *Comment améliorer le tir de précision.*

Major Cottier enumerates the reasons for bad marksmanship in the "repetition" courses and suggests methods of improving it.

3. *Assurance militaire: l'origine du dommage assuré.*

Lieut. Schatz completes his article on insurance, continued from the August and September numbers. He pleads for better collaboration between the army, especially the medical branch, and the insurance companies.

(*November*, 1933.)—1. *Le colonel Charles Sarasin, commandant du 1er corps d'armée.*

Colonel Goudet, who was chief of the staff of the 1st Army Corps, gives a brief account of the life and character of Colonel Sarasin, a cavalry officer, who died in October, 1933, at the age of 63, having reached the rank of corps commander.

2. *Centenaire de la société suisse des officiers.*

The editor gives an account of the origin and formation of the Swiss society of officers, which celebrated its centenary on the 26th November. The present society was started in 1833 with 134 members. It now numbers 10,299. As the writer points out, its history has always been identified with that of the Swiss Army, and practically all improvements and changes have originated with the society.

3. *Manonviller et Maubeuge.* By Gen. Clément-Grandcourt.

The previous article is concluded in this number.

The reduction of Maubeuge was entrusted to General von Zwehl, commanding the 7th Reserve Corps, who considered that a single weak division was insufficient for task, and obtained the loan of the 26th Mixed Brigade. On the 28th August the investment was complete. The siege proper presents three distinct phases:

(*a*) From the 29th August to the 2nd September; bombardment of the left bank and preparations for attack.

(*b*) From the 3rd to the 5th: bombardment of both banks—attack—rupture of the N.E. front.

(*c*) From the 6th to the 8th: supporting position carried, fall of N.E. forts, capitulation and surrender.

General Fournier has been blamed for the capitulation. He did not know, however, that on the 7th the German mortar ammunition had been exhausted, the 26th Brigade had been called away to Laon, and that the battle of the Marne was going against the Germans. Out of a garrison of 50,000 he had lost over 5,000, but he had only a small force of the enemy to the west, and could have withdrawn his force without capitulating.

But though Maubeuge justified itself by holding up the German advance for a time, it is claimed that it should have held out some three days longer, and that the surrender could have been avoided.

(*December*, 1933.)—1. *Confessions de grands chefs.* By Lt.-Col. Mayer.

This is a criticism of the memoirs of three great commanders: Foch, Joffre, and Galliéni. In all three autobiographies there is a lack of general views on the war; the works reveal a banality of thought and of expression. All three marshals content themselves with a record of events, strung together, without deducing any lessons from them. Each, in his own eyes, appears infallible. While criticizing others severely, sometimes unjustly, they do not admit any mistakes or errors of judgment on their own part.

Foch was a convinced advocate—almost a fanatic—of the offensive at any cost. It is well known what disasters this blind conviction led to, and the terrible loss of life that it caused, bearing in mind that the Germans were greatly superior in heavy artillery and machine-guns, and that a war of attrition, with husbanding of resources, was clearly indicated as the one road to success. Little is said about individual commanders, or about Foch's own staff. There is an occasional word about the opposition of Pétain, Haig, or Pershing. He does not criticize Joffre too severely.

Joffre's memoirs are more interesting in some respects, and tell us more about the work of the Commander-in-Chief and his staff. He is a staunch advocate of the offensive at all costs. When the attack failed at the outset of the war, he threw all the blame on his subordinate commanders, and about a hundred generals were relieved of their commands. He failed to realize that the war should be organized in such a way as to cause a maximum of loss to the enemy, while weakening his own forces as little as possible.

Joffre is kinder to Galliéni in his criticism than Foch is. In his *Carnets* Galliéni's general views on the war are lacking in clearness. He was clearly disgruntled at having to serve under Joffre, who had previously been his junior, but it is clear that his long service in the colonies had aged him considerably, and that he was no longer fit to take supreme command.

2. *Légion étrangère et code pénal militaire suisse.*

Article 94 of the Military Penal Code of 1927 lays down that any Swiss subject who may have served in a foreign army, without the permission of the Federal Council, shall be punished with imprisonment. The writer comments on the unfairness of this ruling, which appears to be directed against the French Foreign Legion. The latter receives a good deal of unfavourable criticism through propaganda which is derived from either pacifist, German, or Bolshevik sources. The writer of the article emphasizes the good work done by the Foreign Legion and the excellent training that it affords to those who serve in it.

3. *L'instruction du tir et les mauvais tireurs.*

Lieut. Daniel suggests that, as a means of eliminating bad shots from the infantry, all recruits should be subjected to a psycho-technical examination on joining, and that only those likely to become tolerably good shots should be taken in the infantry.

A.S.H.

RIVISTA DI ARTIGLIERIA E GENIO.

(*October*, 1933.)—1. *Per l'incremento degli studi militari.*

Colonel Morra, in a brief article, recommends the formation of an Institute of Military Studies, with its headquarters in Rome, under the patronage of the National Fascist Party, and working in co-operation with the Ministers of War, of National Education, and of Economics.

2. *L'artiglieria italiana durante e dopo la guerra europea.*

General Montefinale gives a second instalment of his article on the Italian artillery. In these pages he deals with the second phase of the war with Austria, commencing with the counter-offensive in the Trentino and ending with the retirement on the Piave in November, 1917.

The rapid concentration of their forces on the Isonzo gave the Italians, for the first time, a preponderance in artillery in the battle of Gorizia, but this advantage was somewhat set off by the strong Austrian defence on the Julian front. In the subsequent offensives, in the autumn of 1916, the Italians found it necessary to re-group their guns. Details are given of the guns (heavy, medium, and light) in action, and the rounds expended in the battle of Gorizia, and the battles of the Isonzo of September, October, and November, 1916, and May, 1917.

We next come to the battle of the Bainsizza, in which the Italian artillery fired 1,154,000 rounds, as against 1,600,000 fired by the Austrians. Then came the Austrian offensive of October, 1917. By this time the Italians had put in the field 157 heavy, 2,933 medium, and 3,828 light guns. The most remarkable increase at this stage of the war was in heavy field guns.—(*To be continued.*)

3. *Cooperazione tra fanteria e artiglieria.*

Colonel Reisoli—an infantry officer—gives his views on the co-operation of infantry with artillery. He quotes General Montefinale (Inspector of Artillery) as his authority several times. He follows the progress of a body of infantry in an attack on a hostile position, and also in an advance guard, and shows how important it is that infantry officers should be thoroughly conversant with artillery work and the nature of guns, and, similarly, that artillery officers should understand the point of view of infantry.

4. *L'impiego della radiofonia presso le unità di artiglieria.* By Lt.-Col. Telmon.

The writer maintains that the telephone is the only suitable means of communication in the artillery. In the past the ordinary wire telephone has been the only means of affecting this, but the drawbacks of laying down a cable, taking it up again, repairing and maintaining it, are obvious. This is where the advantages of radio telephony come in. For use by small stations in the field, wave lengths between 50 m. and 150 m. are suitable, with a frequency between 200 and 600 myriacycles.

5. *Contributo allo studio dei ponti militari.*

Colonel Scarzella draws attention to the importance of officers' adapting themselves to any kind of bridging material they may have to deal with in the field, and not being tied down to standard methods and standard material. It is not possible, in the field, to work out calculations with the same accuracy as in a drawing office; the formulæ adopted should therefore be as simple and foolproof as possible. He illustrates a method of calculating the strength of beams, both fixed and supported, as well as of arriving at the most economical sections and spans.

6. *Considerazioni sulle zone non battute nel tiro controaerei.*

An article on anti-aircraft gunnery by D. Borsani.

(*November*, 1933.)—1. *L'artiglieria italiana durante e dopo la guerra europea*

General Montefinale concludes, in this number, the series of articles on the development of the Italian artillery. He deals with the third phase of the war: from the retreat on the Piave to the battle of Vittorio Veneto, and then with the period after the war.

The line of the Piave had been prepared for defence some time previously, so that

when the Italian Army was compelled to retire to it, only few modifications were necessary. The duties allotted to the artillery holding the line are described at some length.

Minor operations took place between December, 1917, and June, 1918. The defensive battle of the Piave was fought in June, 1918. After a partial success the Austrians were compelled, after eight days' fighting, to re-cross the Piave. Further fighting from the 2nd to the 5th July compelled the Austrians to fall back to the right bank of the New Piave.

The next period was spent in preparation for the final battle of Vittorio Veneto. In this battle there were no special lessons to be learnt from the action of the artillery, though the field artillery distinguished itself after the battle in pursuing the routed Austrians.

In the last chapter the writer deals with the post-war organization of the artillery.

2. *La controbatteria nell' azione offensiva in terreno libero.* By Colonel Laviano.

3. *La specializzazione e gli ufficiali del Genio.*

Major Cappuccini discusses the question to what extent engineer officers should be allowed to become specialists in one particular branch of their profession. He traces the history of the Corps of Engineers in France and Italy. In Italy the number of Engineer officers increased from 50 in 1847 to 6,000 during the World War. In the war, moreover, the number of branches in which officers specialized increased from six to eighteen.

The question of the relative advantages of technical and military training is discussed at some length. The writer has no fault to find with officers who have become specialists in one particular branch, but he thinks it desirable that an officer should spend part of his time doing technical work, and part of his time in military employment, if he is to be fitted for a high post.

4. *Angolo di proiezione cui corrisponde la gittata massima.*

Major Vitale compares theory with practice in ascertaining the angle of elevation required to give the maximum range to a gun. In practice it works out to something over 45°. When the Germans bombarded Paris from an extreme range during the war, their big gun was elevated to an angle of 50°. It is stated that the American 16-in. gun will attain a maximum range with an angle of elevation of 53°, while the American 14-in. gun will attain its maximum range with 47°.

5. *Tattica e tecnica dei mezzi radio in guerra.* By Captain Manisco.

There is unlimited scope for the use of radio transmission in warfare, provided it is properly used and controlled. An example of the misuse of radio is given by the Russians at the beginning of the war. They entered the war splendidly equipped with field wireless stations (of German make), but the Germans were able to intercept their messages and learn their intentions, and so win the victory of Tannenberg.

The moment radio stations get to work in warfare, they reveal the commanders' intentions and state of mind to the enemy. It is essential, therefore, that all radio stations should be under the control of the higher commanders. Secrecy is the first consideration in the system in the larger units, whilst urgency comes first in the smaller ones. The advantage of wireless is nullified if time is wasted in coding and de-coding messages. Any code adopted should therefore be simple.

The last part of the article is devoted to disturbing the enemy's radio.

6. *La marcia delle autocolonne.* By Major Amione.

A study of the length and speed of columns of mechanical vehicles and of the carrying capacity of roads.

(*December*, 1933.)—1. *I termini nuovi del problema militare.*

Colonel Biondi discusses briefly the military problems of Italy under the Fascist régime. Whilst recognizing the changes due to scientific progress, he is clearly in favour of the nation in arms, as opposed to a small and entirely mechanized army, which he considers would be very costly, as well as of an aggressive character.

2. *Il traffico radio campale.* By Colonel Sacco.

3. *L'azione del fuoco di artiglieria sul personale.*

This study, by Colonel Roques, is based on experience on the French front, and deals with the moral effect of artillery fire on troops. In some instances comparatively small losses under artillery fire have caused far greater demoralization than much heavier losses in different circumstances.

The writer quotes Voltaire as having stated: "It is not so much the number of the enemy killed that gives victory in battle, as the terror inspired in the living." He illustrates this by an instance that occurred on the French front in August, 1914. The article is an interesting psychological study.

4. *Tiro d'artiglieria nel buio e difesa di città attaccate da aeroplani.* By Brig.-General Faujas.

A study of anti-aircraft gunnery at night. Experience in war has proved that it is inadvisable and dangerous to turn searchlights on to an attacking air force before bringing it under fire. Sound ranging is the only suitable method of dealing with the situation.

5. *Della sospensione elastica del motore.*

Captain Paravagna describes the various methods of attaching a motor engine to its chassis, *i.e.*, (1) rigid attachment, which may be four-point suspension, suspension from more than four points, or three-point suspension; (2) elastic suspension on rubber blocks; (3) by the oscillating motor system, as exemplified in the Chrysler car, and, with modifications, in the Delage and Ford.

6. *L'artiglieria da trincea tedesca.* By Captain Sabatini.

A description of the various forms of trench artillery used by the Germans during the war. The Germans had introduced two types of bomb throwers, in 1911 and 1913 respectively, for use against fortified places. These were kept secret until the war broke out in 1914, when they were burst as a surprise upon the French and proved of great moral effect.

1915 saw a considerable development of the 170 mm. bomb thrower, while a smaller weapon of 76 mm. was introduced in large numbers in 1916. By 1918, the organization of these weapons had developed to such an extent that the German Army could dispose of 2,000 heavy, 3,000 medium, and 13,000 light bomb throwers.

The latest pattern of German "Minenwerfer" has a calibre of 75 mm., fires a shell weighing 6 kg., and has a range of 3,500 metres.

7. *Sulla misura approssimata dell' angolo di paralasse.* By Captain Cavicchioli.

8. *Le alte benemerenze aeronautiche dell' arma del Genio.* By Lt.-Col. Morelli.

A description of the aeronautical work carried out by the Corps of Engineers.

A.S.H.

REVUE DU GÉNIE MILITAIRE.

(*September–October*, 1933.)—1. *Vauban, ingénieur militaire.* By General Frossard.

A brief sketch of Vauban's career. Vauban made strenuous efforts to get the king (Louis XIV) to sanction the raising of regular companies of Sappers, but was unsuccessful. Companies of miners were raised for siege work only. It is interesting to note that Vauban took part in 48 sieges, of which he directed 42 personally: the first one at the age of 23.

He did not create new systems of fortification, but followed and improved upon the work of Italian and French engineers. The great feature of his work was that he adapted the art of fortification to the ground in every case. While improving methods of defence, he perfected the system of attack. The great merit of his system was its simplicity.

2. *Le front de l'Yser en* 1688. By L. Laudy.

A note on the defensive works of Ypres, as proposed by Vauban.

3. *La piscine de l'école militaire de Saint Maixent.* By Captain Botrel.

A description of a swimming-bath for the Military School for Infantry and Tanks, recently completed, illustrated by plans and sections.

The tank itself, as well as the greater part of the building, are of reinforced concrete. An inspection tunnel runs all round the outside of the tank, which is one metre deep at the shallow end, and three metres at the deep end. The roof, which is curved, is carried on arched concrete ribs. There are changing-rooms for officers and cadets respectively, at one end, and below these are installed the heating apparatus and pumps.

The temperature of the water is maintained at 22° C. The 500 cubic metres of water in the tank are filtered and sterilized by chlorination after 16 hours of pumping: this ensures the filtering and sterilization of the whole contents every 24 hours without working the pump at night. The water is changed once a month.

The swimming-bath appears to be an excellent example of an up-to-date bath, worked on sanitary principles.

4. *Les transmissions en montagne.* By Commdt. Bertrand.

A brief study of the means of establishing communication in mountainous country, and of the different methods by which it may be kept up, *e.g.*, telephone, visual signalling, wireless, carrier pigeons, runners, dogs, etc.

5. *Un nouveau procédé de mesure de chambrages.* By Captain Leygues.

6. *Le Colonel du Génie P. A. Renoux* (1806-1882). By I. Griguer.

Colonel Renoux enlisted as a sapper in 1828, and, after an active and varied career, a great portion of which was spent in Algeria, he rose to the rank of Colonel, and retired in 1876 at the age of 70.

(*November–December*, 1933.)—1. *Le pont sur l'Oued Asfalu, au Maroc.*

Chef de Battn. Michelet gives an account of the erection of a steel girder bridge across a deep rocky ravine in Morocco, by a detachment of sappers. The report is illustrated by plans and sections and eight photographs, which show the bridge in course of erection and after completion.

The girder was of the light "Pigeaud" type, with a span of 37·50 metres; the depth of the ravine being 70 to 75 metres. No sand was available near the site, hence the amount of masonry work had to be reduced to a minimum; the ends of the girder rested on steel trestles. Economy was all important: skilled labour was scarce, and the staff was new to this class of work.

The girder was erected on the left bank and was hauled across the gap by steel cables. The erection was completed without mishap.

2. *Pontonniers anciens et sapeurs modernes.*

Colonel Bailly quotes extracts from an old work on military bridges in Europe by the Chevalier de Birago. It deals with the pontoon equipment of bridges from the middle of the seventeenth century up to about 1845. Pontoons have at various times been made of wood, sheet iron, or copper: some have been open, others enclosed. In some cases a series of watertight compartments has been introduced. The enclosed type has always eventually been given up, owing to the difficulty of locating leaks; in spite of the fact that its buoyancy can be more fully utilized than that of the open type.

3. *Les tracas d'un Directeur de Génie.* (*Metz*, 1813-14.)

General Dorbeau rescued from a collection of old documents found at Metz, the register of correspondence of the Colonel commanding the engineers. A perusal of these letters shows the difficulties that the latter had to contend with, partly financial, from lack of funds, and partly caused by the apathy and obstruction of the people with whom he had to work.

4. *Les Sapeurs de Chemin de Fer britanniques.*

Captain Beauvais was given an opportunity of visiting the "Railway Training Centre" at Longmoor Camp, and here gives his experience of that visit. He describes the organization of the Railway Training Centre, the instruction given to the sappers, the course of instruction for officers, and the technical work carried out.

In comparing the training with that given to railway engineers in France, he points out that the British railway sapper is trained to work in any portion of the globe, where he is left to his own resources. This system does not allow of the adoption and provision of standard types of bridges that can be taken to pieces, as is done in the "Établissement Central du Materiel de Chemins de Fer." A.S.H.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(October, 1933.)—1. *Pages d'histoire de l'armée belge au cours de la guerre* 1914-18. *Journées d'offensive, les* 30 *septembre, 1er et 2 octobre* 1918 *au 1er Chasseurs à Pied.* By Lt.-Col. Liévin.

A final instalment of this article, which is an account of a night attack at Most. It is an outstanding example of the successful execution of a well-planned night attack.

2. *Obéir. . . . Servir.* By Colonel Van Egroo.

An article illustrating the importance of implicit obedience to orders. Three historical instances are quoted.

On the 16th June, 1815, at Ligny, the Prussians under Blücher must have been defeated, if Ney had not disregarded Napoleon's orders and recalled d'Erlon's Corps. On the 18th, when engaged with the British, Napoleon relied upon protection against Blücher's attack, but Grouchy failed to carry out the manœuvre entrusted to him, and the result was disaster for the French.

In the Franco-German war of 1870, after the battle of Saarbrücken, on the 3rd August, Steinmetz, commanding the 1st Army, received explicit orders from Moltke to co-operate on the right flank with the 2nd and 3rd Armies. The idea was that the three armies should cross the Saar on the 9th August. Steinmetz, however, disregarded the orders he had received, and crossed on the 6th. One of his subordinate commanders, General von Kamecke, commanding the 14th Division, further disregarded the orders he had received by attacking Frossard's Corps at Spicheren. Had the French not contented themselves with a passive defence, the 14th Division would probably have met with a serious disaster.

In the campaign of 1914 we get similar instances of insubordination. On the 18th August, the Crown Prince of Bavaria disregarded the orders given him by Moltke, to withdraw to the Saar, and decided on an immediate offensive. Similarly, orders issued to the Imperial Crown Prince on the 21st August were ignored. At the beginning of September, von Kluck, commanding the 1st Army on the German right flank, disregarded the orders he had received, with the result that he found himself in an awkward situation on the 6th, and the whole German advance was checked.

Success in war depends upon discipline and upon strict obedience of orders. This does not, however, imply that a commander should not act on his own initiative when occasion arises.

3. *Parallèle entre l'efficacité de l'aviation militaire et celle de l'artillerie de la défense terrestre contre aéronefs dans la défense aérienne des pays de faible étendue.* By Lt.-Gen. Vandeputte.

4. *Méthodologie. De l'enseignement de l'équitation dans les batteries montées.* By Lt.-Col. Vermaelen.

5. *Vauban au siège de Namur.* By Major Delvaux.

Namur, situated at the junction of the Sambre and the Meuse, was the main stronghold of the Spanish monarchy in the Netherlands. In 1692 Louis XIV undertook the siege of the place, with a force of 37,200 infantry and 18,360 cavalry. The Prince of Barbançon, governor of the town, had at his disposal for the defence 18 battalions of various nationalities and a few gunners.

The siege commenced on the 27th May: the town surrendered on the 5th June, but the citadel held out till the 30th, and had then no option but to surrender.

Vauban had technical charge of the siege operations: he refused to be hurried, and avoided all unnecessary sacrifice of life. A point of interest was that, owing to the rocky nature of the soil, all approaches and saps were carried out in remblai, *i.e.*, with sandbags and earth carried to the site.

6. *Le franchissement des cours d'eau.* (*V*).

Lieut. Thonnard gives a summary of the German regulations relating to bridging. A few interesting points mentioned are: (a) the protection of a bridge against hostile aircraft, (b) the change of site of a bridge—in certain circumstances bridges will only be maintained by night and dismantled by day, (c) a 100% reserve of material and 30% to 50% of bridging personnel.

(*November*, 1933.)—1. *Pages d'histoire de l'armée belge au cours de la guerre* 1914-18. By Capt. Yernaux.

An account of a raid carried out by the 1st Carabineers before Nieuport on the 29th June, 1918.

2 *Manœuvre de défense passive du pays de Liége.*

In July last the Belgian authorities organized, in the town of Liége, defensive manœuvres against an imaginary aerial attack. Most elaborate preliminary preparations were made, a number of sub-committees dealing with the various heads, such as railways, power stations, telegraphs and telephones, Red Cross, etc.

The actual manœuvres took place on the 6th and 7th July, according to a carefully prepared time-table. The 500,000 inhabitants of Liége co-operated with the Government in making the trials a success. Trials were also made with an incendiary bomb known as the "Elektron." The conclusions arrived at were valuable, and indicate the lines on which further investigations should be made.

3. *Franchissement des cours d'eau.*

In this final article on the crossing of rivers, Lieut. Thonnard quotes at length from articles by Colonel Bailly and Colonel Normand.

There are four phases in the crossing of a river:—

(1) Detailed reconnaissance and secret bringing up of troops, guns, ammunition, and material.

(2) Crossing of front-line units (personnel and material) by means of rafts and light foot-bridges. It will be the duty of these units to seize the further bank and secure it, then to push the enemy back and secure all observation posts commanding the river. Some light artillery will be necessary.

(3) As soon as the observation posts have been secured or rendered useless, the construction of bridges will be taken in hand.

(4) When the enemy bank has been fully secured and the enemy has been thrown back a considerable distance, heavy bridges will be commenced for the transport of heavy army vehicles.

4. *Vauban au siège de Charleroi* (1693). By Major Delvaux.

Charleroi was named after the Spanish king, Charles II., who fortified it in 1666. Louis XIV took it in 1667. Its defences were improved by Vauban. It was subsequently ceded to the Spaniards in 1678, under the treaty of Nimègue.

In 1692 the French took Namur, but their communications with that place were greatly hampered by the fact that Charleroi was in the hands of the Spaniards. In the following year, on Vauban's recommendation, King Louis undertook the siege of Charleroi.

The place was invested by a force consisting of 30 battalions and 32 squadrons under Marshal de Villeroi on the 12th September. An account is given of the progress of the siege. The town surrendered on the 11th October, and the garrison marched out with the honours of war. The conduct of the siege was one of Vauban's master works.

5. *L'observation de l'artillerie de D.I. en défensive sur un front étendu.* By Colonel Basesens.

(*December*, 1933.)—1. *Pages d'histoire de l'armée belge au cours de la guerre* 1914-18. *Les contre-attaques au "Boyau de la Mort" en mai et septembre* 1915 *par le 9e de Ligne*. By Lt.-Col. Jones.

An account of some desperate fighting, in which the writer took part, for the possession of a "boyau" on a bank of the Yser.

2. *Le formation des observateurs en avion.*

Major Courtois describes the course of training for observers at the "Ecole d'Aéronautique."

It is interesting to note that, on the outbreak of the war, Belgium had only fifteen officer aviators. The war was followed by a period of stagnation in matters of aviation, and it is not till quite recently that the recruiting and training of officer observers has been put on a proper footing.

3. *Tactique des feux et mécanismes des tirs d'artillerie.* By Lt.-Col. Nonnon.

4. *Le combat de Rossignol—Bellefontaine.* (*22 août* 1914.)

Major Desoil gives a detailed account of the battle of Rossignol-Bellefontaine, fought on the 22nd August, 1914.

The German Army was carrying out its great turning movement across Belgium, its pivot being Metz, and its outer wing between Namur and Brussels. The French commander-in-chief had no accurate information about the enemy, and thought he would find a weak spot in the Ardenne. He sent the 4th Army to the Franco-Belgian frontier between Mézières and Virton, flanked by the 3rd and 5th Armies on its right and left respectively.

On the 21st August, the Imperial Crown Prince, commanding the 5th German Army, decided to contravene the orders he had received from Moltke, and to attack the 3rd French Army. To prevent a gap being formed between the 4th and 5th German Armies, the commander of the 4th Army ordered a change of direction to support him.

The consequence was that on the 22nd the 4th French Army, instead of finding itself confronted by weak detachments, was surprised to find itself up against a very strong force of the enemy, advancing through wooded country.

This study deals with the encounter between the 6th German Corps, in the Rossignol-St. Vincent region, and the following units of the 4th French Army:—The 3rd Colonial Division, a fraction of the 2nd Colonial Division, and the greater part of the 4th Division. A sketch shows the position of the belligerents on the night of the 21st/22nd August; two other sketches, on a larger scale, show the state of affairs at 12 and 17 hours on the 22nd. The fighting was very severe, and resulted in a serious disaster for the French forces, the 3rd Colonial division alone losing about 10,000 men: killed, wounded, and prisoners, and 36 guns.

The writer concludes with the reasons for the French failure (mainly indifferent staff work and defective intelligence) and of the German success.

A.S.H.

MILITAERWISSENSCHAFTLICHE MITTEILUNGEN.

(*October*, 1933.)—This number is of special interest, as it starts off in black-faced type with letters from Herr Vaugoin and from General Schönburg-Hartenstein, both addressed to the Army at large, and with an editorial by Major-General Ratzenhofer, all three commemorating the important changes in Austrian army affairs which took place during the preceding month.

In September the Austrian Federal Chancellor, Dr. Dollfuss, saw fit to offer another post to the Minister for Army Affairs, Herr Vaugoin, and, following an illustrious prototype in a neighbouring great country, to take over the Army portfolio himself. For the necessary assistance in his new task Dr. Dollfuss nominated to the President as his Under-Secretary of State, a distinguished soldier, General Schönburg-Harten-

stein. At the same time the Ministry for Army Affairs was re-named the Ministry for National Defence—a change of some significance.

Herr Vaugoin, who thus hands over the portfolio after the remarkably long term of twelve years as Minister for Army Affairs, takes his leave here in a letter thanking all ranks for their help in the great task he had set himself to do, viz., the bringing of the Federal Army to a position in which would be secured for it "the love and respect of the Austrian people." There is little doubt, as Fürst Schönburg points out, that Herr Vaugoin has succeeded admirably, and that the Army, and especially the nation, is enormously indebted to him. Herr Vaugoin, taking over a People's Army, formed in 1918 after the Armistice, saw clearly that an army, to be of real service to a country as a support to its government, must be divorced from politics. Consequently he set about the abolition of the People's Army, carried it out against many difficulties, and created instead of it the Federal Army. He then, with excellent judgment, worked hard to bind this new army by tradition, names, records, revival of old badges and distinctions, with the units of the old army of the Austro-Hungarian Empire. There has resulted a great improvement in discipline, in training, and also in the attitude of the nation towards the Army.

The second letter is the new Secretary's first Army Order, which is at the same time a greeting, a recognition of past good work done, and an appeal for future efforts. It is interesting to the British reader that the writer, *pace* Rudyard Kipling, refers to the officers "who have always been the backbone of every army." This raises a pretty point. Perhaps it would be correcter to say that the officer has always been the brains of every army. He has only to be also the backbone of the army when it is unfortunate enough to contain an insufficiency of trained N.C.O's. When the Army Order goes on to claim it as an Austrian speciality "always with relatively slight means to achieve the greatest possible success," this is clearly an encroachment on the engineer's prerogative in all countries. The third letter is addressed to the readers of the magazine. It explains the change of title of the Ministry, with the dictum that the defence of the country is a matter for the whole people, and can only be permanently successful when built up on home sources of power and home principles. The new title, the Ministry for National Defence, brings out and emphasizes the larger circle of responsibility. Reference is also made to the great accession of strength which has accrued by the creation of a new military body in Austria. This new Corps of Assistance was permitted by the Powers to complete the quota deficiency of the Regular Army. It has linked with the latter existing formations of a private nature raised for Home Defence, and has already provided more adequate guard for Austria's frontier.

A Capture by "Coup-de-main," by Colonel von Pfersmann. The story told here is one of which any army might be proud.

Although the result of the Seven Years' War was to add a new great power, Prussia, to the great powers in Europe, Frederick, who was nearly always striving against odds, had many ups and downs between his first invasion of Silesia in 1740 and its final cession to Prussia in 1763. An epitome of these ups and downs is furnished by the fate of the fortress of Schweidnitz, 30 miles S.W. of Breslau, which changed hands six times. The fortress itself, built by the Austrians, was in 1761 held by the Prussians. It consisted of an inner star-shaped rampart, surrounding the town, with moats and ditches and a glacis covered with *trous-de-loup* and *chevaux-de-frise;* and of an outer ring of five strong forts with lunettes in the intervals.

Colonel von Pfersmann tells the story of how the Austrian general, Loudon, planned in minute detail, and carried out, the apparently impossible task of carrying this fortress by *coup-de-main.* At 2.30 a.m. on the 1st October the Austrian storming-columns started off with guides, and clear orders, so that every man knew what he had to do, to assault all five of the outer forts simultaneously. Bayonets were fixed and the strictest orders were given that there was to be no firing. The grenadier-battalions had each 100 men armed with hand grenades. Each column carried 60

storming ladders, and had its own sapper, pioneer and labour detachments. Charges were carried for blowing in the gates; also crampons, fascines, axes, crowbars and shovels. The attackers found every fort fully manned and alert, and it transpired that an Austrian deserter had gone over to the enemy the evening before and told what was impending. In spite of this, the Prussians being thus prepared, the forts were assaulted with such resolution that the last of them to fall was captured by six in the morning. By that time many of the captured guns had already begun to play on the inner fortress, and the sector reserves had been overwhelmed. As soon as the gates were stormed the Prussian general surrendered unconditionally. The Prussians lost 1,100 men out of a garrison of five battalions, 339 guns and immense quantities of war material and of provisions.

The Prussians, between whom and the Austrians even in peacetime little love is lost, were at great pains to invent excuses for this galling defeat. They attributed it to treachery, whereas it appears that the only authenticated case of treachery occurred on the other side. They even attributed it to the extra courage derived by the Austrians from a warming tot issued to the troops during an autumn night spent in the open. Frederick himself, who had marched away from the neighbourhood of Schweidnitz, confident in that place's security, in spite of the threat of the presence of Loudon's army, received the news in characteristic fashion by consigning the messenger to the Father of All Lies. The siege by which he re-captured Schweidnitz the next year lasted over two months and cost him 8,000 men.

General Loudon's reward from a delighted empress was the Grand Cross of her own Maria Theresa Order, set in diamonds, and later her portrait in similar setting: the pair valued at 10,000 ducats, or nearly £5,000.

Fighting in Mountains Above the Snow-line. Colonel Ruggera describes the operations by which certain peaks, lying on the Alpine frontier between Austria and Italy, were captured in June, 1915, immediately following Italy's entry into the Great War. The neighbourhood is that of Stilfser Joch, adjoining the Upper Engadine, the pass where the road from Lake Como reaches a height of close on 9,000 feet before it starts to descend into the Tyrol. The fighting described took place on the outlying spurs of the giant Ortler, 12,600 feet high, and the lessons deduced therefrom should be of interest to officers of the army that holds Chitral and may have to fight in the Pamirs.

The chief lessons drawn from the experience gained are :—

(1) Since the failure of an operation generally renders its repetition impossible, most careful preparation is imperative.

(2) No large numbers of men are required or even possible. For that reason each man must be a carefully selected and utterly trustworthy mountaineer, used to mountains, snow and ice, from his boyhood. Decisions are gained by the strength and skill of the individual.

(3) Artillery co-operation, however desirable, is generally impossible owing to the conditions of terrain and weather.

(4) Bad weather conditions are often a welcome aid to the experienced mountaineer in effecting surprise.

A good example of (2) above occurred on Trafoier Joch on June 15th, when a patrol of six men, supported by m.g. and rifle fire, drove the Italian defenders into their ice-cave dugout, and then, standing at the entrance with hand grenades, received the surrender of a captain and 37 men.

Formations of Greater Mobility, by Major-General Wiktorin. For the successful conduct of the mobile warfare of the future there will doubtless be needed, more than has hitherto been the case, formations which are rapid-moving, have cross-country powers, and a sufficiency of fighting strength. The new Austrian F.S. Regulations (Reconnaissance) distinguishes such under the name of "Rapid Formations."

There is a multitude of tasks for these rapid formations to fulfil, from recon-

naissance and raids to rearguard actions. Their value will therefore be incontestable, but their training, maintenance and conduct will be so expensive and so difficult that they can form only a small proportion of an army. Further, as they are incapable of being improvised they must form part of the peace-time army.

As regards their nature they can be horsed, or motorized, or mechanized, or preferably composed of suitable combinations of the three forms of transport indicated. The chief task, as also the chief difficulty, lies in uniting to profitable mutual effort the two essentially different elements of horse and engine. Proposals and trials to this end have been made in Austria and in Italy (*vide The R.E. Journal*, September, 1931, pp. 562 and 563) and in France (*vide The R.E. Journal*, June, 1933, p. 378).

Gen. Wiktorin's proposals are :—

(*a*) A cavalry division, of 2 brigades of 3 regiments each, with 2 H.A. brigades and 2 brigade m.g. detachments, would require the following motorized divisional troops :—1 rifle battalion, 1 armoured-car detachment, 1 artillery brigade (of 3 batteries, gun, light field howitzer and anti-aircraft), 1 engineer company with light bridging column and 1 telegraph detachment.

(*b*) A motorized brigade, of 3 battalions—universally regarded as the largest unit capable of being placed on wheels—would contain, in addition, brigade artillery, 4 field (2 of which are mechanized) batteries and 1 A.A. battery; 1 observation flight; 1 reconnaissance detachment, consisting of small tanks, armoured cars, infantry and infantry-guns; 1 coy. of engineers with light bridging column, 1 telegraph coy. with wireless and pigeons; M.T. column with workshops and spares; supply and medical services. Approximate totals, 7,000 all ranks, 250 motor-cycles and 800 motor-vehicles.

(*c*) A mechanized brigade to consist of 3 tank battalions, 2 of medium and 1 of light tanks; an artillery brigade of 3 batteries, 2 field, 1 A.A. (the A.A. and one field battery being motorized); a security battalion (either an m.g. battalion or an infantry battalion specially equipped); 1 observation flight; 1 reconnaissance detachment of armoured cars and small tanks; 1 engineer battalion with bridging, stores and tool column; 1 telegraph coy. (wireless and pigeons) with stores column; remaining services the same as for the motorized brigade, except that more petrol must be carried and more workshops provided. Approximate totals—Other ranks, 6,500; motor-cycles, 250; motor-vehicles, 1,000.

The Tradition of Tactical War-experience. Training and Combat Regulations lay down principles derived from war experience, but by their very nature cannot contain more than principles. For the understanding of those principles high demands are made upon the imagination. The best means of stimulating this imagination is the tracing back of those principles to such happenings in the combat as those upon which they were based. This may be done practically by repeating with troops on appropriate ground situations and events taken from actual warfare; in fact, the converse of the full-size rehearsals which used to take place in back areas in France before some operation, raid, or attack with limited objective. Or it may be done, as Colonel Rendulic does it here, by means of sketch-maps and a narrative showing where action accorded with principles laid down in the Austrian Combat Regulations, or—since the winner in war is he who makes least mistakes—generally, violated them.

War-prisoners as a Source of Information. This article is too short to be able to do more than enumerate the points about which the intelligence officer should interrogate war-prisoners and the points about them which he should observe for himself. Major Klumpner, however, makes one interesting excursion into the psychological side. The novelty of his surroundings, the relief of being in comparative safety, and the probably thrilling experiences through which he has just passed, all contribute to

making the freshly-gathered prisoner compliant and communicative. This, then, is the moment when your best interrogator should tackle him—before he dries up.

Mechanical Transport Training in the Army. Gives a synopsis which answers convincingly the ever-recurring question, " Why does a military course take 6 to 8 months to train M.T. personnel, when a civilian school can turn a normal being into a driver in from 20 to 40 hours ? " A sidelight is thrown upon the answer by the statement that in ten years of very great progress in motorization in the Austrian Army there has never been a serious accident ; and also by the eagerness said to be shown by civilian employers in engaging ex-army-trained M.T. drivers.

Psychotechnic suitability tests which are made before candidates are accepted at the courses have not only reduced the number of failures, at the end of the last course held, to 4%, but have considerably lightened the work of the instructors.

Cinematographic Tests of Hollow Cylinders. Hitherto the best visual examination for the discovery of flaws in the interior of gun barrels and other hollow cylinders has been very slow and has required specially-trained expensive labour. Results, too, were not certain, in that flaws might be missed. A description is here given, with drawings and photographs, of a barrel camera, made for the Askania Company of Friedenau, Berlin, by the A.E.G. Turbine Factory on the lines of the apparatus used by themselves for proving turbine cylinders. A tube carrying an object-glass is inserted in the barrel to be examined, and which may be down to 75 mm. in diameter and up to three metres long, or six metres working from both ends. A cinematographic film is then made of the interior as one long spiral strip, the whole movement being mechanical.

The military value of this invention extends beyond manufacture to investigating the effects of wear.

Vauban, 1633-1933. The high opinion of the Engineer officer which still prevails in the French Army originates from the first officer of the Engineer Corps to become a Marshal of France. Vauban's international significance makes certain facts and figures of his career of interest, showing as they do his unequalled opportunities of combining theory with practice. Entered the Army, 1651 ; appointed Royal Engineer, 1655 ; as a captain in 1658 conducted the siege of three fortresses ; took part up to 1707 in one hundred and thirty fights and conducted forty-one sieges, in which he was eight times wounded. He designed and was in charge of the building of the fortification of the whole of France, over 300 reconstructions and 33 new fortresses. He also did successful work in canal construction, and as a writer was occupied with questions of national economy.

(November, 1933.)—*On the Subject of the Break-through Battle.* Lieut.-Colonel Kiszling's article in the February *M.M.* (reviewed on p. 375 of *The R.E. Journal,* June, 1933), in which, for the purpose of discovering the underlying principles, he examined what he considered the seven greatest break-through battles of the Great War, has stimulated General von Horsetsky to write a retrospect. This writer claims the break-through as a creation of Napoleon's, in fact as that rapid movement towards one portion of an enemy's forces which placed him on interior lines, and thus enabled him to overwhelm it, while evading or holding off the remainder of the enemy, to be disposed of later. The strategic break-throughs of Napoleon consisted thus of several strokes, or, as the case might be, of operations of deception, of defence or of pursuit, separated from one another by time and space. It was this method of conducting war, of which he was a masterly exponent, that was typical of Napoleon. It is exemplified by his campaigns of 1796-7, by Ulm, Jena, Regensburg, Dresden, Leipsic, the 1814 operations E. of Paris, by Ligny and Waterloo.

Napoleon also at times employed the tactical break-through, notably at Austerlitz, with the greatest success, and at Aspern, where it failed.

General von Horsetsky's definitions are :—Tactical break-through has as its object the piercing of all lines of the enemy's first position. Operative break-through includes the foregoing and also the following up of the enemy, after he has been

pierced, and its results. Strategic break-through is that which should follow, viz., the crumbling of the whole enemy front and the smashing to pieces of its parts. Definitions are, however, dangerous things; and in the many examples of break-through battles which the writer examines—Austerlitz, Aspern, Wagram, Custozza, and, in the Great War, Gorlice, Luck (September, 1915), Folgaria, Luck (June, 1916), Zalosce, Tolmein, Chemin des Dames—his classifications appear to revert constantly to the simpler ideas that a strategic break-through is one that alters the strategic situation, while the tactical break-through does not.

Cadorna and Capello. Under this title Major Heydendorff investigates the decisions arrived at by the Italian commanders in the autumn of 1917, in order to throw light upon the fact that the capture of the Bainsizza plateau and the great victory of the Italians in the 11th Battle of the Isonzo were followed hardly two months later by their crushing defeat at Caporetto. The writer finds that Italian G.H.Q. had every intention of continuing its offensive, and the necessary movement of troops and ammunition to that end were in full progress, when on the 18th September General Capello, the Commander of the Second Army, the victors of Bainsizza, suddenly and surprisingly received from the Commander-in-Chief orders to stop all offensive preparations and to go over to the defence *à outrance*. This decision, which allowed the initiative to pass into the hands of the enemy, and which, contrary to all expectation, provided him with the necessary breathing-space for the preparation of his offensive, was the real germ of the catastrophe of Caporetto. General Capello, who was all for the further offensive, received his orders with mixed feelings, and by pleading the unsuitability of his present position for defence *à outrance* prevailed upon the C.-in-C. to allow the Second Army to prepare for defence by counter-stroke in the grand style. Even this permission was withdrawn on October 20th, but it was then far too late to make any adequate arrangements before the storm broke and caught no less than fifty batteries on their way to the Tolmein sector, where the Austrians had remained in possession of the bridgehead.

Communications and their Susceptibility to Attacks from the Air, by Major Ringel. The network of communications which a country possesses, and the carrying capacity of that network, are the foundations of that country's national economy. From the same also may be gauged a measure of the country's military power and the quickness of its blow. The air warfare of the future, having its targets far behind the frontiers of enemy nations, creates entirely new conditions for making such estimates. Those factors, which together contributed to determine the separate values of railways, roads and waterways, have now had added to them a new disturbing factor of unknown strength, viz., the extent to which each one of them is liable to be affected by air attack. The vastly increased use of motor transport since 1914 has brought into prominence the interchangeability of the different methods of transport, so that the possibility of change between the different networks has become a principal factor in evaluating a country's communications. The ideal solution to the problem of how to avoid traffic disturbances, caused by attacks from the air, falls into the province of technics, viz., to provide carriages and trucks capable of running either on rails or on the road, the change from one system to the other being made with ease. (Note.—A short description of the London, Midland & Scottish Railway's "Road-Railer" is given on p. 367 of *The R.E. Journal*, June, 1933.)

Taking the various communications in turn the writer points out the comparative insusceptibility to air attack of the lines of railway themselves, since short portions of the permanent way which are destroyed, *e.g.*, when a train has been bombed, can be made good comparatively quickly. The same applies to roads. On the other hand what are really vulnerable and must therefore be protected by all means, by camouflage, by A.A. guns, by balloon-aprons, as the case may be, and, wherever possible, by construction underground, are railway junctions, railway bridges, electricity works, road-bridges, and on waterways and airways, canal docks, hangars and workshops.

Since the national life depends upon internal communications being kept open, and since these are threatened by recent improvements in aircraft, it is in the system of communications that the first lever will have to be applied to reduce a country's susceptibility to air attack.

Incidentally, Major Ringel disposes of the military objection which has often been made to the electrification of railways, viz., that trains, each drawn by its own steam locomotive, are alone permissible in war, owing to the possibility of air-action against central electricity supply stations, by pointing out that in modern practice a network of electrified railways is fed by as many as possible interconnected supply stations, so that a particular track is no longer dependent upon one particular supply station. That eggs must be kept in many baskets is one answer to the menace from the air.

Supply and Transport in Mountain Warfare. Written at the request of officers' circles in Switzerland, who asked for actual experiences, this article gives an account of how a battalion in position on the Marmolata—the Queen of the Dolomites—was supplied during 3½ years of warfare. The engineering side of the matter extended from the provision of accommodation, roads and paths, to the erection and maintenance of funiculars. The chief difficulties, apart from enemy action, which repeatedly interrupted the funiculars' working, arose from a winter lasting nine months, and providing avalanches at any time between November and April, both inclusive. These avalanches cost far more lives than shellfire, and point to an avalanche-proof construction as a first necessity.

At the Zenith of the Great War. This title is chosen by Major-General Kerchnawe for his notes and memories of the events related in the latest parts of Vol. IV of the Austrian *Official Military History*. These two parts deal with the 1916 offensive against the Italians from the Tyrol, and with the great Russian break-throughs at Luck and at Czernowitz, known together as the Brussilow offensive, respectively.

Of Part 1 Gen. Kerchnawe says it is idle to quarrel about whether it was the Russian advance in June which, by drawing Austrian troops away from the Tyrol, first heavy artillery and then two divisions, brought the Austrian offensive to a standstill, or whether the offensive would have run itself to a dead stop in any case. Hence, when later he definitely adopts the former view by saying that the Russian June offensive saved Italy from having to retire her eastern armies, first, behind the Piave, and then even beyond the Brenta, it appears to be a clear instance of the man who is "not arguing, but only telling you."

Writing of Part 2, Gen. Kerchnawe first likens the Austrian breakdown before Brussilow to what happened to the Prussians at Jena, since both Prussians and Austrians lost their heads at their first defeats, having hitherto considered themselves invincible. Later he finds a psychological resemblance between "the consternation of the Austrians, leaders as well as troops," and the feelings of the Italians at Adowa, and those of the "terrified Englishmen" at Isandula. These comparisons are picturesque. They will further doubtless have their intended effect of bringing comfort to the Austrian reader: but it seems hardly possible that the feelings of troops who saved themselves by retirement can really have resembled the feelings of those who died fighting, cut up to the last man. Or did Melville and Coghill, planning to save the colours from the Zulus, with the stickiest of all deaths both certain and imminent, really feel like——? *Verbum sat. sap.*

(*December*, 1933.)—*The Line of Resistance in the Tyrol.* Colonel von Pfersmann's two most interesting articles in the May and June numbers (*vide The R.E. Journal*, September, 1933, pp. 534 and 537) have stirred up a pretty quarrel. Colonel von Pfersmann showed how the continuous line of defence the whole length of the Tyrolese mountain frontier came to be adopted instead of reliance being placed upon the existing system of small barrier groups, *i.e.*, of works placed so as to defend the main lines of approach, while the interval between one group and the next was either regarded as impassable or its defence was to be left to mobile troops.

These articles, written by a layman, have somewhat naturally brought forth a

rejoinder from the side of the Engineers. Major-General Ellison-Nidlef, in peace time a builder of fortifications and in war a commander of troops in the Tyrol, consequently writing with authority, finds much to contradict in Col. Pfersmann's utterances. His historical retrospect shows that the fortification of the Tyrol took place in four periods: from 1835, starting with Franzensfeste, to 1861; the fortress of Trient, 1880-1884; a third period from 1884-1900; and the latest period from 1907 onwards. A consideration of the necessary consequences leads the writer to lament that the rule, which applies to warships, of replacement after twenty years, is not applied to fortifications. He points out that the works according to significance, position and strength, fulfilled their purpose, and were the iron skeleton of the four years' successful defence of the Tyrolese frontier. The latter part of this claim will presumably not be denied, since evidence of its truth is clearly to be seen in Col. Pfersmann's articles, although the fact is not expressly stated. Whether they fulfilled their purpose is another matter, and it is precisely here that the two writers differ. Col. Pfersmann gives offence by saying that the intervals were not intended to be defended, because regarded as impassable, though in many places not so, or where recognized not to be impassable their defence was to be left to mobile troops. On this point General Nidlef brings proofs from pre-war manœuvres, staff-rides and T.E.W.T's that "no officer who served in the Tyrol in the last few years before the war was in any doubt of the passability of the intervals between the forts." Unfortunately this is not sufficient. What really matters is whether those ideas had found expression in any Defence Scheme or other orders, as to work required on the frontier and the conduct of its defence, issued by Command Headquarters to the Commandant of the Frontier. Col. Pfersmann says that they had not, and explains their absence therefrom by stating that the authorities, both Engineers and General Staff, were still under the ban of the group-system and regarded the continuous line in fortification as long obsolete.

The Moral Effect of Cavalry. Examples from history of the effect of cavalry upon infantry, apart from shock effect. The examples even extend to a case in which no cavalry were present at all. An Austrian battery, finding itself too much exposed, limbered up and started to change position by galloping across dry fields. A panic is said to have been produced in a Serbian battalion at the sight of the large clouds of dust raised, and at the "fatal" sound of "Cavalry" passed by the bugles from company to company. Either leave your bugles at home, or keep them for joyous and not "fatal" sounds.

Manœuvres in 1933, by Major-General Schäfer. Limitation of expenditure was the common sign under which nearly all countries held their manœuvres this year, especially army manœuvres. In Italy only one division operated against another (later two), but to each side was added an ultra-mobile force of a cavalry brigade, a cyclist brigade, a motor-cyclist company, and tanks. The main object was tactical leadership. French manœuvres were of the nature of tactical technical trials; motorized troops being used, and the latest tanks of all kinds and sizes. Secrecy was maintained by a cordon of police round the manœuvre country. The Russian manœuvres, which were to have been held near the Polish frontier, were cancelled, partly owing to the political *rapprochement* with Poland, but also doubtless on account of men and money being required for the Far East. Poland, however, held its manœuvres, but published no details.

In July the R.A.F. held large manœuvres in the South of England. 162 bombers operating against the A.A. defences and 152 of the latest aeroplanes. Combined naval and air manœuvres took place in September on the Scottish coast, when a portion of the Home Fleet with the aircraft-carriers *Courageous* and *Furious* attacked, and the R.A.F. defended.

French naval manœuvres were on a specially large scale, and had a similar object to those of the Italians last year, viz., the question of sea-communication with N. Africa. There was also a combined attack on Toulon.

In Italy after the large-scale air manœuvres of 1931, and the large-scale naval manœuvres of 1932, naval manœuvres this year were small, while air manœuvres were omitted, the great flight to North America in a way replacing them.

Japanese air and naval manœuvres took place on the largest scale, and lasted over a long period. In these manœuvres the new Japanese fortifications on Pacific islands formerly belonging to Germany appear to have played a part.

The United States, who have had both Atlantic and Pacific Fleets united in the Pacific for the last two years, held manœuvres off the Sandwich Islands and off the Californian coast. Their Armada in the Pacific consists of 212 vessels and 236 aircraft.

The Resources of a Conquered Country. Relates a triumph of forethought and organization worked by a handful of officers and government officials, after the 3rd and 11th Austro-Hungarian Armies, by reason of the Bulgarian outflanking movement, had driven the Serbian Army out of Serbia at the end of 1915.

It was imperative to utilize this conquest for improving the supplies of the Central Powers, and a central station was established in Belgrade, with depots and offices throughout the country, for agricultural exploitation. Against the representations of those who, knowing something of the basis of every enterprise, human nature, recommended a system of contingents, the government insisted upon confiscation, *i.e.*, taking all produce except quota per head for personal consumption, and allowances for fodder and for seed.

In the third year of occupation the Government was obliged to abandon the system of total confiscation in favour of contribution by contingents, *i.e.*, the producer was allowed to keep for himself, or sell, all produce beyond the government quota. The result as regards total products was excellent.

Amongst the commodities dealt with were vast quantities of fruit. Here the motto had to be, " What does not take place to-day cannot take place at all," and much good work was done in picking, packing and transporting. There were also undertaken the drying of prunes (1,200 railway truck-loads the first year) and jam-making—plum, but no apple—(830 railway trucks in one year). From the grapes in the first year 440,000 gallons of a light red wine, containing 10 to 11.5% of alcohol, resulted. This the Government wisely decided should go straight to the troops. Upon which decision becoming known, a unit telegraphed :—" Reference impending wine issue this units strength officers 10 N.C.O's 20 men 100." It is gravely suspected that a judicious insertion of noughts had occurred in the message as originally written.

The whole work, which included supplies to the civil population, was cost-accounted. In the second year the profit was over 30 million kronen, or double the invested capital. In the third year the profits rose to 59 million kronen, say £2,500,000. Organizer and director of this great undertaking was Colonel Kerchnawe of the General Staff.

Calculations of Time and Space in Mountain-marches, by Colonel Hubicki. Upon this subject the *F.S. Regulations, Part II*, of the old Austro-Hungarian Army content themselves with saying that the rate of marching is to be regulated according to the slope. This rate on the flat is taken as 4 km. (or 2½ miles) per hour. Tactical handbooks are more explicit :—" The total time a march will take, worked out as on the flat, is to be increased by 1 hour for every 300 metres rise, or 400 metres fall ; by ¼ hour for every 100 metres rise, or 200 metres fall, provided that such rise or fall occurs through slopes of over 1 in 10."

Against this method of reckoning Colonel Hubicki here proposes a new method based upon his experiences of mountain-marches in war. His experience goes to show that in mountain-marches, as soon as the rate of marching falls below the normal 4 km. p.h., distance plays no part, and the time the march will take depends exclusively upon the difference of height. He allows 1 hour for every 300 metres up and 1 hour for every 500 metres down.

By this method Colonel Hubicki has checked the times on various tourist maps

which, albeit uniformly high, are known to be very reliable, and has found them check very well. The method has the great advantage that while the length of the route on generally very winding ways is not easily determined, differences of height on maps of mountain country are easily arrived at by means of the contours and the marked heights of trig. points. A few examples are given.

The Battle of Komarov. Major-General Kerchnawe praises highly *Die Schlacht bei Komarow*, by K. Leppa, published by Adam Kraft, Karlsbad: 527 pp., 10 maps; price 44 marks. The battle of Komarov, which the reviewer calls "the largest battle fought out independently by the Austro-Hungarian Army in its existence of over four hundred years," was a part of the first great clash of the Russians with the invading Austrians at the end of August, 1914. The formations taking part were the Austro-Hungarian Fourth Army and the Russian Fifth Army (or about 160 battalions on each side); and the former with the timely aid of the left-hand Corps of the Army on their right, the Third, won a "brilliant" victory, the fruits of which, however, it was quite unable to reap owing to misfortunes elsewhere. It is not easy now to see how anything but disaster could result from the impetuous Conrad's proceedings, viz., advancing into Poland with three Armies (the fourth being still on rail) against five Russian Armies. The Austrian victories on the left and in the centre, at Krasnik, Zamosc and Komarov, were all wasted when the line had to flow back again because its right had been overwhelmed. All of which does not detract from the merit of Komarov *per se*.

Worth preservation is the author's modest utterance regarding his work, "Errors are unfortunately not to be avoided, since, owing to human imperfection, all that we create must remain human patchwork."

F.A.I.

WEHR UND WAFFEN.

(*October*, 1933.)—*Tanks and Engineers*, by Lieut.-Col. Kubitza. This is the revised and enlarged German text of an article written for the *Royal Tank Corps Journal*, republished here by permission of that magazine. The author, who starts with Napoleon's dictum that the blow struck by an army, like momentum in mechanics, is a product of its mass and its velocity, examines first the effect of the invention of the explosion-engine upon the conduct of war.

Apart from motor-transport, improvements in many branches of engineering, wireless telegraphy, workshops, etc., the internal combustion engine has given to war new weapons in aircraft, the tank and the submarine. Of the two components of tactics in land warfare, fire and movement, the former through technical improvements attained such superiority in the Great War that movement became almost impossible. The tank was invented as an attempt to answer the question of how the much-desired mobility was to be re-introduced into warfare, in order to allow decision to be arrived at. It is essentially a weapon of attack, and in its present stage still a close-fighting weapon. The device under which it fights is "Gain movement by force, and maintain it." The trouble is that when by its nature the tank has been able to restore movement to the battle-field, it is also likely by reason of its nature to fail to maintain that movement. The questions at once arise, "How long? As far as the next obstacle? How quickly over it?" This is where the engineer gives the decisive answer; and Lieut.-Col. Kubitza gives us his ideas about the requirements of tanks as regards the tasks of the engineers, their equipment, training and organization.

In considering what the engineers must be called upon to do on behalf of the tanks he steers a middle course between the ideas of the warfare of the future, which he associates with the names of Colonel Fuller and of Captain Liddell Hart, a warfare to be carried on exclusively by armoured land-fleets, and on the other hand what he calls the present-day French and American ideas of tanks whose chief duty is to

support the infantry. Actually he considers what will be required of the engineers assigned to or called upon to assist tanks within the framework of the so-called light division, as tried out by certain nations at their manœuvres, and which Great Britain " appears to be on the point of adopting."—(*To be continued.*)

Thorn and its Railways. The writer of this article, having disguised himself under the title of *Miles Ferrarius*, is able to indulge a humorous vein at the expense of a Gilbertian railway situation. The visitor to Eastern Germany, studying railway time-tables, might well imagine, from the frequent recurrence of the name Thorn on various lines, that he had to do with a large city well served with railways. Contrariwise, Thorn consists of a small old-world ramparted town, surrounded by modern buildings, barracks and fortifications. It has several goods stations, and five passenger stations, the chief of which can be reached from the town in the following ways :—(1) On foot and by steam-ferry (when the river is not frozen over or silted up), distance 2·5 km. as the crow flies ; (2) by carriage over the road-bridge, 3 km. ; (3) by train, and railway bridge, from the Town station, which is on the eastern outskirts of the town.

A genial suggestion was made many years ago, and deserves from various points of view to be rescued from oblivion. The old town ramparts, instead of being converted into parks and gardens, should be made, cheaply enough, to carry a railway through the town, and a central station be built upon it, to replace the present main station on the opposite bank of the river. The suggestion would gain greatly in point, should Thorn revert to Germany, while the Corridor, and the left bank of the Vistula, remain Polish.

Important New Foreign Railways since the War deals this month with France's African railways, which, it states, will " open up undreamt-of military possibilities for France in a European war by guaranteeing the quickest supply of Colonial troops from the inexhaustible black reservoir."

Recent improvements in rapid transport have brought Algiers within thirty-seven hours of Paris. This route, owing to its ability to supply Paris with fresh vegetables from North Africa, is called, not without humour, " the Vegetable Line." The steamer portion of it is doubled by ships plying between Marseilles and Biserta, thus connecting with Tunis by train.

The first of French railways in N. Africa is the so-called coastal line, which starts at the harbour of Sousse, and runs thence, connecting up the headquarters of one corps, of four divisions and nine brigades, to Tunis, inland to Constantine, to Algiers, Oran, and to Oujida, where it enters Morocco. The line from Oujida to Fez is not due for completion until 1936, but the first one-third of it, from Oujida to Guercif, was taken into use in 1932. From Guercif to Tasa (also a divisional headquarters) the work is well on, and between Tasa and Fez (divisional h.q.) the work has started. From Fez there is a railway completed in 1927 by the *Société Franco-Espagnole des Chemins de Fer* connecting with Tangier. From there, too, a year later was completed the great railway through Meknes to Rabat, and thence *via* Casablanca to Marakesh, which will be an extension of the great coastal line as soon as Tasa and Fez are connected up.

Important as this railway is, it will have to take second place politically and economically to the projected Trans-Sahara railway. This was originally planned to run from Constantine, *via* Biskra (built), Togourt, and the Italian oasis of Ghat to Lake Chad. Military objections over-ruled, and the northern outlets of the Trans-Sahara railway will now be the harbours of Algiers, Oran and Nemours, while new construction commences at Bu Arfa, the terminus of an existing branch line from Oujida. From Bu Arfa the trace runs, Ugarta Oasis, Twat, Reggan Oasis, then 500 km. of desert to the Sudan boundary at Tessalit Oasis (? In-Tellabit), and the shortest route to the Niger—in fact very much the Sabatier-route, and about 150 miles east of the Timbuctoo to Colomb Béchar crossing by the Estienne brothers in 1925. The Niger having been reached at In-Tassait, one branch will run west up the river and meet

at Segu the line from Dakar, picking up the Ivory Coast and New Guinea railway extensions, while the main line continues south to join the Dahomey railway and so to reach the Bight of Benin. The work is estimated to take eight years, which works out at about 1 kilometre a day.

Barbed Wire. The firm of Felten and Guilleaume Carlswerk is reported to have succeeded in making steel wire without the peculiar springiness which renders it unsuitable for the work of putting up entanglements in the field. For the same strength steel wire can be of 1·6 mm. diameter instead of 2·6 to 2·8 mm., or about one-third the cross-sectional area of ordinary wire, with a corresponding reduction in weight; or, allowing for the barbs, which are unchanged, say a reduction of half the weight. The steel wire is both harder to cut with the pliers, and offering with equal strength less surface would withstand shell explosions better.

(*November*, 1933.)—*Angular Measurement.* The question of the best method, from a purely artillery point of view, of sub-dividing the angle represented by the sum of four right-angles, was considered in the December, 1932, number of *Wehr und Waffen* (*vide The R.E. Journal*, March, 1933, p. 183) by Lieut.-General Marx, who recommended the adoption for artillery purposes of a division into 6,400 parts, preferably marked 1 to 3,200 in each sector of 180°.

Dr. Maurer here considers the same question, but for general purposes. He has drawn up a comparative table of sixteen different ways of computing four right-angles, which shows whether or not the common trigonometrical angles 30°, 45°, etc., are represented by figures equally easy to remember; the conversions into time at 24 hours to 360°; and the conversion into great-circle kilometres or sea miles. His conclusion is: "If we ask ourselves which of the sixteen divisions best fulfils the greatest number of the requirements laid down, we are obliged with astonishment to admit that the best system of division is one that has hitherto been almost completely unused, only proposed for artillery use. It is the division of the circle into 6,000 parts with further decimal sub-division."

Dr. Maurer hopes that the artillery, who happily hit on this system, and also the Committee of Units and Standards in Germany, will press for its universal adoption.

Future Cares and Duties of the Artillery. Treats of the vastly increased importance of this arm in modern warfare, which has brought with it fresh duties and responsibilities. The Great War taught not only the decisive role of the artillery, but also, as on the 15th July, 1918, in Champagne, gave indications of how to avoid its overwhelming effect by distribution in depth and timely withdrawal. In the attack artillery preparation was much curtailed, while both attacker and defender made extended use of camouflage, and adopted more flexible forms. Mobility is the trump upon which the fate of the game depends, and the accompanying artillery in the attack must be able to serve itself in this respect without waiting for the engineer to open up a way. The same applies to the artillery in the defence. An immobile defence will fail before every attack. The masked fixed position has given way to the camouflaged movable position, to such an extent as to defeat air observation. *Activité* and *vitesse* have become again, as in Napoleon's day, the soul of the art of war and the secret of victory.

Automatic Paint-Spraying. The furrows left by a brush show hand-painting to be far inferior to spraying for obtaining an even surface, *i.e.*, the best protection, especially when high-pressure spraying is done. This article shows photographs of three patterns of paint-spraying machines, two automatic and one half-automatic. The former, working at 1½ h.p., can paint projectiles up to 3,000 an hour.

Tanks and Engineers (continued). Lieut.-Colonel Kubitza discusses in turn the new tasks falling to the Engineers through the advent of the tank, and how they are to be fitted for these tasks by equipment, training and organization.

He demands for the tanks, as for infantry and cavalry divisions, their own engineers, permanently allotted and available. They must be equipped with bridging tanks and heavy trailers. This is considered essential; for although the difficulty of

tanks following the infantry closely over the first water obstacles may be got over by using amphibians, bridges will be required for those that follow. Moreover, adequate bridges will be required very quickly. The effect of delay in trans-shipping is now greatly multiplied, since it is a question of putting across not troops who can march 15 miles in a day, but motorized formations covering from 60 to 180 miles in the same time. If obstacles are to be crossed larger than the tanks engineers can deal with, the work must be done by the divisional engineers (either those belonging to an ordinary or to a light, *i.e.*, motorized, division), or with their assistance. Divisional engineers will have to be equipped accordingly, *i.e.*, they must possess cross-country m.t. vehicles for personal and for bridging material; also for their own a.t. defence. Considering the extra work thrown on the divisional engineers by the tanks, a fourth company of engineers should be added to every division. This is over and above the engineers allotted to tanks, who should be included in the headquarters company of each tank battalion. Failing the addition of a fourth company to the divisional engineers, and provisionally in any case, a battalion of engineers for tanks should be added to the Corps or Army.

The Engineers are the cardinal point of the whole motorization problem.

(*December*, 1933.)—*Railway Anti-aircraft Guns*, by Capt. Wagner. Many indications were given in the Great War of the attraction exercised by railway junctions and termini upon bombing aeroplanes. Recently in the Far East the Japanese bombing squadrons destroyed no less than four Chinese railway centres in less than six weeks. It is certain that in future wars railway junctions and works lying on sidings will receive even more attention from bombers than hitherto, and to consider their effective protection against such attacks becomes of paramount importance. Capt. Wagner does not here enter into the comparative merits for this purpose of fighters, balloon or kite aprons, smoke screens, camouflage, or A.A. artillery, but investigates the best way of mounting the latter. Against its only possible competitor, the A.A. gun mounted either on a cross-country six-wheeler lorry or on a self-propelled carriage, the A.A. gun mounted on a railway truck has many great advantages. In the case of the former the calibre is limited by considerations of weight, as affecting mobility. The vehicle itself must not be too heavy. A day's supply of ammunition, 300 rounds, will weigh 3 tons in any case. All these troubles fall away at once when the gun is mounted in a railway truck. The calibre can be increased from 7·62 cm. or 8·8 to 10·5 cm., a gun with a fine performance; and in 20-ton trucks plenty of ammunition can be carried. The train can also be armoured to an extent that is impossible with the cross-country vehicle. Further, it can move rapidly from one to another of its alternative positions, and there plug itself through to the report centre which is permanently connected with the listening-posts distributed in the neighbourhood. All the other connections, viz., of command post, range-finders, searchlights, are permanent on the train; whereas the motor transport A.A. gun must have all its arrangements made afresh every time it goes into action in a new spot.

An anti-aircraft train might consist of two trucks containing two 10·5 cm. guns each, two trucks each containing a range-finder, a searchlight, and either two 3·7 cm. A.A. guns or a pair of heavy machine-guns coupled together on a special mounting, one small truck containing battery-commander's post, wireless set with frame aerial and an engine-dynamo combination, and a small Diesel locomotive, or better, two, so as to facilitate splitting the train into parts and separate use.

The question of concealment is very important. The usual camouflage-painting has little effect, since any train on the rails in the open can easily be recognized by airmen. Hence A.A. trains must stand in sheds, in tunnels or on short sidings in woods with the foliage drawn together over them, leaving such cover to come into action only when the "alarm" is given.

The First Large Traffic Aeroplane Diesel Engine, by O. P. van Steewen. Even a few years ago it was believed to be out of the question that the Diesel engine would

ever seriously compete in aviation with the petrol engine with spark ignition. Nor could the Diesel engine's great development for stationary engines, for sea and even land transport, be regarded as opening up such prospects, since the overcoming of the great difference in weight between these engines and light aircraft engines must provide the greatest difficulties. When, twenty years ago, Junkers' idea of the double-piston Diesel engine had proved its practicability in stationary engines, it was decided to use this form of construction for aircraft. The war, however, turned all research energies in other directions, and subsequently came the crippling post-war period, when little could be done. The advantages of running on heavy oil at one-fifth to one-quarter the price of petrol, and the elimination of the danger of fire caused Germany to re-tackle the problem, and much progress was made. The first five-cylinder engine did its trials, and in 1930 the production of the Junkers Jumo 4 made it possible for people to speak of the problem of heavy oil as motor spirit for aviation as solved, seeing that the Jumo 4 has passed through three years of trials since then essentially unaltered, containing in itself all that was necessary for its subsequent development. As its power has been raised to 750 h.p., while its weight has been reduced to 750 kilos, it has, with a 1 : 1 ratio of weight and horse-power, taken its place alongside the best water-cooled petrol engines. The result is that the German Lufthansa have decided to fit a four-engine Junkers G38 aeroplane, flying weight 27 tons, with four Jumo 4 engines, " a pioneer of a new epoch in German and in the world's aviation."

Photographs show elevation and sectional elevations, longitudinal and cross, of a Junkers six-cylinder double-piston heavy oil engine, and a Jumo 4 without casing as built into the plane. A drawing shows elevation of engine with a long shaft; and diagrams compare fuel-consumption of petrol and heavy oil aircraft engines (the latter saving 26% at full load), and show the increase in useful load by the change to heavy oil in Junkers G38, corresponding to an increase of range from 4,500 to 7,000 km.

F.A.I.

CORRESPONDENCE.

DEMOLITION OF THE BRIDGE AT COMPIÈGNE, 31ST AUGUST, 1914.

S.M.E., Chatham.
16th December, 1933.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

It is a great pleasure to read the authoritative account* of the successful demolition of the bridge at Compiègne on 31st August, 1914, by the officer who was actually in charge of the operation. Anyone who has read *Fear, and be Slain,* by the Rt. Hon. J. E. B. Seely, C.B., C.M.G., D.S.O., of which the following is an extract, must

* " The Diary of an R.E. Subaltern with the B.E.F. in 1914," by Major B. K. Young, R.E., *R.E. Journal*, December, 1933.

have received the impression that the demolition, if not a failure, was not by any means as successful as it should have been. (Actually, the exploder failed and the officer then lit the safety fuze.)

> "It was decided to blow up the bridge at Compiègne early in the morning, and I was deputed to watch over this operation and report its completion at Headquarters, which was to retire in order to continue to supervise the rear-guard actions of both wings. As generally happened in the early stages of the War this great bridge, which had been carefully prepared for demolition, resisted the shock of discharge when the button was pressed. Henry Wilson, afterwards Chief of the Imperial General Staff, used to say to me: 'The French have decreed that the bridges shall be made to jump, *faire sauter*, but they do not jump.' On this occasion the French engineers were present in order to 'make to jump' the bridge. News had come that the Germans had already crossed in small numbers five miles to the east, so there was hurry. There was a tremendous bang. For a moment large black objects were seen flying high into the air, but when it was all over a large portion of the bridge was still intact. Devoted men, both English and French, started at once to endeavour to lay fresh charges, but it was too late. Rifle fire could be heard to our right; roaring motor-cyclists came up with the news that the Germans were across the river in force. It was time to go and we all went."

It is interesting to compare this account with that of the officer in charge.

THE "WATCHER."	THE OFFICER I/C.
"On this occasion the French Engineers were present in order to 'make to jump' the bridge."	Mentions a French officer (believed to be the local borough surveyor disguised as a territorial) who produced plans and 1,000 kilos of melinite. The entire work was done by 1 R.E. officer, 1 serjeant and some 8 sappers. "My orders were to get the job prepared, keep the bridge open to traffic all the time, and to blow the charge at 11 a.m. next day, August 31st."
"Devoted men, both English and French, started at once to endeavour to lay fresh charges, but it was too late."	(*a*) *When the Exploder Failed.* "I had now to rely on my own handiwork, the safety and instantaneous fuze. The only error here was over-celerity; the 6 ft. of safety went in about 30 secs. but detonation was very, very complete."

THE "WATCHER."	THE OFFICER I/C.
	(*b*) *After the Charge had been Fired by Safety Fuze.* "I came to, so to speak, conscious that I was holding out my hand to Newcombe and feeling rather an ass. . . . Thus do our great moments come to an end. As a matter of fact, we hadn't time now for anything except to get clear quick—the whole place was quite deserted."
"There was a tremendous bang. For a moment large black objects were seen flying high into the air."	"There were two surprising features about this demolition; there was practically no noise and there was no tangible debris."
"When it was all over a large portion of the bridge was still intact."	"There was a definite feeling of concussion and a big cloud of black smoke; when the latter subsided there was no bridge. I expect this can be accounted for by the fact that the charge was below water. I cannot describe the feeling of relief with which I saw the bridge go."

The "watcher" says that he had been deputed to report the completion of the operation at Headquarters. One cannot help wondering what he reported. A failure? If so, he was clearly inaccurate. A success? If so, why does he convey the opposite impression in his book? The following paragraph of the German First Army Operation Order issued at 9.45 p.m. on 2nd September (2½ *days later*) is significant:—

> "9. . . . The temporary bridges for heavy motor transport at Noyon and Compiègne are ready. The 18th Pioneer Regt. will follow the III. Corps."

The provision of a temporary bridge at Compiègne is a very fair indication that the permanent bridge (13·75 metres wide between parapets) had been destroyed.

Finally, there is the assertion that most of the bridge demolitions in the early stages of the war were failures, *and technical failures at that.* It is not clear whether this is directed against the French engineers, or the Belgian, or the R.E., or all three. In any case, the careful compilation of facts published in *The R.E. Journal* of June, 1932, under the title of "Demolitions Carried Out at Mons and During the Retreat, 1914," by Major-General Sir Reginald Buckland,

K.C.M.G., C.B., is the best evidence as to the results obtained by the British engineers whenever they were given a reasonable chance of success.

Yours faithfully,

I. S. O. PLAYFAIR, *Bt. Lt.-Col., R.E.*

THE CROSSING OF THE RU-KUCHUK.

Culworth, Bideford,
December 13th, 1933.

To the Editor, *The Royal Engineers Journal.*

SIR,

In a footnote on p. 588 of his interesting article on " The Crossing of the Ru-Kuchuk," in the December, 1933, *R.E. Journal*, Major Clark comments on the rise and fall of the river owing to the daily melting of snow, adding that " the diurnal rise and fall is probably characteristic of many mountain rivers."

It may be interesting to readers of the *R.E. Journal* to note a similar experience on the Swat River, N.W.F.P., India, in 1911 and 1912.

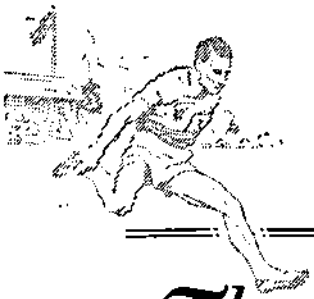
I was carrying out training works to protect the abutment of the Connaught bridge, Chakdara, built by Lieut., now Brig.-Gen., H. Biddulph.

I found that in the earlier months of the flood season, March and April, the water level in the evening was about one foot higher than in the morning ; this was due to snow which had melted during the heat of the day on the hills forming the basin of the Swat. Later in the year the diurnal rise was less marked, and the lag after the high day temperatures was greater, as there was less snow to be melted, and the water therefrom had further to run.

An article on the training works appeared in *The R.E. Journal* for February, 1913.

Yours faithfully,

F. C. MOLESWORTH,
Colonel (retired).



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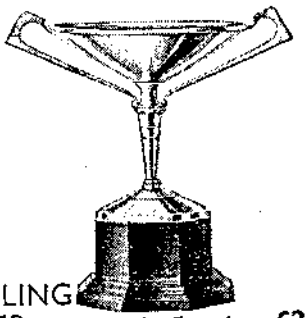

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