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FIFTY YEARS AGO.

THE S.M.E., 1881–1883.

By BRIG.-GENERAL SIR JAMES E. EDMONDS, C.B., C.M.G.

THE recent articles in *The Times* on men and things of fifty years ago have been read with so much interest that I have thought a review of life at the S.M.E. around 1882 might amuse both those who were of that vintage and perhaps younger generations. I apologize in advance on the one hand for a certain amount of "anecdotage," and on the other for the compression of brackets and dashes.

In September, 1881, the establishment of the Corps contained 200 captains and 350 lieutenants (gazetted as such, there were no second-lieutenants). The senior captain had 20 years' service; the senior subaltern, who happened to be head of his batch, had just 12 years', allowing for the six months' antedate then given to the R.A. and R.E. in order that Sandhurst cadets, who joined as 2nd-lieutenants (the name "sub-lieutenant," previously "ensign" and "cornet," had been abolished in 1877) should not have an advantage over them.* General Sir Bindon Blood had just got on to the majors' list—he was to appear at Chatham after the 1882 campaign in Egypt as the smartest and best turned-out of brevet lieutenant-colonels; H. H. Kitchener was 65th on the lieutenants' list. The survivors of the old Indian Engineers were still borne on separate Bengal, Bombay and Madras lists.

The Corps heroes of the time were Field-Marshals Lord Napier of Magdala, Sir Lintorn Simmons, and "Chinese" Gordon; in the

* Promotion got slower, and Mr. Childers, then Secretary of State for War, who had a son in the Corps, in 1882 introduced the regulation that R.E. officers should be promoted captain in any case after 12 years' service, and major after 20.

scientific world, Captains (Sir William) Abney and (Sir Douglas) Galton; and in the cricket world, Lieut. Renny-Tailyour.

The first thing which struck me on arrival at Chatham was the terribly old appearance of the officers of the Corps. The Commandant, Colonel Sir Andrew Clarke, with tired eyes, greyish-white whiskers and greyish-brown complexion, looked to have one foot in the grave—he was to live another twenty years. Most of the senior subalterns seemed heavily built, middle-aged-looking men; two were quite bald, many were adorned with enormous moustaches and thick side-whiskers, and many clad in loose pyjama-like uniforms (we all wore "nighties," however, at that date—I saw pyjamas first in 1884), which detracted from smartness. Some of them, happily still with us, grew younger in appearance as the fashion of clothes and face-hair changed. Perhaps one of them may be induced to write of their Chatham of sixty years ago, and what they thought of last-joined subalterns. A captain, just returned from India, with a grandson in the Corps to-day, had white whiskers, a fringe of white hair and a genuine curry-coloured complexion. One wondered how soon one would be like him. The brigade-major was a magnificent specimen of the field officer of the comic papers: rubicund of face and distinctly portly. He was said to have an acreage of waistcoat only surpassed by two majors, R.H.A., for whose "jackets" nowadays the gold reserve would have to be released.*

The term "Y.O." had not been invented; young officers were spoken of as "officers on the Establishment"; on the other hand, the seniors were called "Blokes."

"Mr. Cox," shortly before one joined, sent one a notice that he could be drawn on for about £10 monthly. (Pay was 5s. 7d. a day, plus 2s. engineer pay.) This was insufficient to settle one's mess bill if one subscribed to the various clubs and drank wine. "Mr. Cox" of those days was, however, the friend of subalterns and let us all overdraw. One contemporary of mine, on being informed that he was too much overdrawn, went up to Craig's Court and saw the head of the firm, who told him not to do it again, and made him a present of a five-pound note. There was not a daily charge for messing; one had to pay for dinner 3s. 6d., whether one ate it or not, except when on long leave; other meals were extras; so the daily total (less drinks) for those who took three meals and tea, was about 6s. Tea, however, was by no means the habit it is now; it was supposed to be bad for the nerves, so sportsmen, after exercise, drank a glass of beer or sherry. The mess dinner, of many courses, was far too

* This B.M.'s instant grasp of a situation was unsurpassed. I recall one instance. At the annual inspection by the Duke of Cambridge the usual question of those days, "any complaints," was asked. A sapper fell out, was intercepted by the B.M., and asked what his grievance was. The man replied, "My captain called me a damned fool." "So you are," said the B.M. "Fall in." He then reported his action, through the usual channels, to the Duke, who acquiesced in the manner the affair had been treated, with audible repetitions of "Quite right, very good."

elaborate, and the endeavour to do justice to it caused much digestive trouble to the weaker vessels. There was not very much drunk: beer, or "Carlowitz" at 4d. a glass, was the ordinary luncheon drink; a pint of claret, 7d., was the usual accompaniment of dinner; afterwards port, sherry, madeira and, on guest nights, claret, were passed round several times. Only on special occasions, like Christmas Day, did the young take more than was good for them, although champagne was only 6s. a bottle. There was usually, however, a certain amount of rowdyism on guest nights. One Christmas night a small officer was put on the grand piano and a whisky and soda poured on his head; he was then told to swim, and obediently struck out with vigour. I remember, however, only one subalterns' court martial. It was held on a last-joined who, on taking off his mess jacket to play billiards,* was discovered to have on only an armless singlet. His sentence was to go to a certain place and sing "Home Sweet Home" there. A few seniors set a bad example as regards drink. There was one field officer who used to play whist—bridge did not appear for nearly 20 years—drinking until he fell off his chair, murmuring "Call me with a cab," which meant "When I am sober, put me in a cab and send me home to my wife." He distinguished himself later by jabbing his pen into the hand of a subordinate who was placing a paper before him for signature. He ended his career in a small garrison by executing a dance before his general's front door.

There was not much smoking. At the first mess meeting which I attended, Major H. Helsham-Jones (Instructor in Military Law and Tactics) proposed that smoking should be allowed in the messroom after dinner. The proposal was rejected; but soon afterwards on a guest night the Commandant sent round cigarettes. There was a rule that one could not go into the messroom for luncheon except in uniform—possibly to keep up the fiction that officers were at work until then. If anyone changed into plain clothes he could only be served with sandwiches, cake, etc., in the ante-rooms—perhaps it was only in the "small ante-room" of those days. During the financial year 1882-3, the "new Annexe" to the messroom, opposite to the band room, was built and opened. I believed it was designed by Major H. C. Seddon, the Instructor in Construction.

In 1881, Chatham and St. Mary's Barracks were still occupied by infantry, and a field battery, R.F.A.,† was quartered in Brompton Barracks,‡ which otherwise was R.E. domain. The submarine miners (the officers were recruited entirely from eminent cricketers,

* Ordinary "pool" was played. I first met "snooker" in 1889 in the R.A. Mess at Sheerness.

† One of the subalterns in the battery, named Anderson, was a nephew of "Chinese Gordon," and went out in 1883 to join him on the Mount of Olives, where Gordon was awaiting the end of the world. He returned to Chatham *rien accompli*.

‡ The R.A. had a small mess establishment of their own at the northern corner of the barrack square, the Memorial Arch end.

footballers and Pollock Medallists, it was said; the last category were expected to do duty when the others wanted to play games on shore) lived in a hulk called the *Hood*, in the Medway off Gillingham Pier. It was handed back to the Navy in 1883, I think. Its inhabitants were said to speak of the rest of the garrison as "barrack-beasts." We saw a good deal of the officers of other arms, as there were cavalry pioneer classes and infantry field-work classes—the classes for senior officers, R.E., were irreverently known as Wild-East classes ("Buffalo Bill" was in England about this time, running a circus show known as the "Wild West," not the "Wild, Wild West of London"—a topical song). These classes were very popular, as town was within reach—7s. 6d. first-class return—and one could get back in time for morning work by the early boat train, which had a slip carriage. The Institute had recently been opened; the Commandant's house was being built by convict labour; a joker among the workers managed to insert a slate in several of the chimneys; this was not discovered until the fires were lighted. There was gas in the mess, in the passages of the officers' quarters, and in the servants' quarters (fish-tail burners, incandescent mantles only appearing in the 'nineties); for their rooms, officers had to provide oil-lamps or candles, receiving a small fuel and light allowance.

The ordinary dress of the period was the braided patrol with garter-blue velvet cuffs and a red "false collar" with thin gold stripe—which represented the red waistcoat once worn under it. In this dress, with red-striped trousers, strapped down, and Wellington boots, one did one's courses. There was no blue or red serge, though for dirty days at field works "jumpers" were provided. The "order" for route marches and field days was laced boots and short black leather gaiters (sometimes called "gambadoes"), the trousers being looped plus-four-wise over them, and tunics. However, in 1881, Daniels & Co. charged only £10 5s. for a tunic and two guineas for red-striped trousers. For mess dress there was a button-up-to-the-throat red waistcoat, a very stiff jacket, fastened at the neck by a gold braid loop—only very senior officers dared to undo the loop, even after dinner—and trousers with a gold lace stripe which lasted for ever, being turned and re-turned until all the wire braid dropped off. The orderly officer of the day wore at mess his mess jacket buttoned up, with the cross belt. Even lieutenants went to levees in cocked hats. They were abolished, it is said, because a colonel, R.A., and a "last-joined" R.E., coming from a levee, both hailed the same hansom cab; the colonel was stepping in, when the cabby waved him aside, saying, "Generals first," and insisted on the subaltern becoming his fare. White pipe-clayed gloves were worn in all "orders." I remember that the Adjutant (there was only one) expressed doubts whether a German Army pattern kid glove—which did not require pipe-clay—could be accepted as regulation.

Officer And Sapper, Royal Engineers.Marching Order, 1883

Chatham Convict Prision

The officers' busby and the men's " shah hat " (of inverted flower-pot shape with a shaving brush in front) had shortly before been exchanged for the spiked helmet, but continued to make appearances on parade. Medals were rarely seen in 1881. An officer with two ribbons (usually Afghan and Indian Frontier) was a great hero ; there was no D.S.O. until 1885. The Egyptian campaigns soon brought a shower of medals.

Plain clothes—a good suit of " dittos " cost five guineas—were not of many kinds : no knickerbocker or flannel suits, no grey flannel trousers,* no " shorts " except for rowing ; no brown shoes ; no flannel shirts (not even for hunting and shooting) ; no " stand and fall " collars (the stiff ones were invented by " Roddy " Owen in 1892, and soft ones appeared much later). The stiff-fronted white shirt was the universal wear. There was a story of a cavalry colonel of those days who reprimanded his veterinary officer for hunting in a flannel shirt ; for, he said, it would look so bad for the regiment if there were an inquest. There were no Homburg hats, and the cap was of very small dimensions.† In town the morning or frock coat with a tall hat were *de rigueur*. One captain whom I knew belonged to two clubs : at the first, not very " classy," on arrival from the country he changed into town dress before venturing to show himself at the Naval and Military.

The R.E. colours were practically the same as those of the Guards, so towards the end of 1883 the late Colonel Smith Rewse suggested the introduction of the present design.

The young officer felt aggrieved if he did not get some form of exercise, if not a game, every afternoon. There was no lack of amusements, although there was no golf or motoring, or even cycling—the high machine of those days was quite unsuited to the Chatham hills, but there was more riding, more shooting, more racquets, more rowing, and, of course, more walking. Parties used to row up on Sundays as far as Aylesford in an old eight ; otherwise one's radius, even with a dog-cart, was limited to 10–12 miles. Much sailing was done, Philip Cardew and John Bogle acting as the instructors of youth. There was no crossing of the Atlantic, but the *Buccaneer*, bought in my time to supersede the *Dotterel*, won a prize in a race to Ostend.

By sharing a civilian groom, with Government stabling free, one could keep a horse (average cost of a " hunter " £40) for 30s. a week. There were four packs near, the Tickham, West Kent, Albert Brassey's Harriers and the Hundred of Hoo Harriers (long extinct) ;

* A contemporary tells me they were worn at Eton for games when he went there in 1877 ; they did not come into general use until the late 'nineties.

† When " on tour " in Wales with Sir Charles Warren to visit coal mines, I recall that my batch brought bowler hats, about two inches high in the crown, and paraded in them one morning. Sir Charles gave one look, and said, " Sorry, gentlemen, I have an attack of fever, so I cannot accompany you."

at the end of The Lines a top rail was lifted in a post-and-rail fence, and once over that one could ride across country—through gaps—to Canterbury, without meeting a wire fence. Tennis was, of course, played on the courts of the garrison recreation ground, then quite new, and " stické " on a court behind the mess.

My batch contained eight officers, plus the first two Canadians; but of the four batches above it one contained seven officers and the other three only five each. So that, although the succeeding batches were a little larger, there were only 30–40 officers on the Establishment,* not enough to provide a good " soccer " team—it was difficult, indeed, to get up two sides for a game, or furnish many recruits for the eleven. With professionalism beginning to show its head, the glorious days of R.E. successes in sport in the previous decade had come to an end.

There was a blight of another character on the S.M.E. On the 11th February, 1881, P. L. O. Roper, a subaltern on the Establishment, had been found shot dead at the top of the stairs of his house (No. 9), just after he had left the mess on the conclusion of dinner. Officers were in consequence careful whom they brought into barracks. There was no clue to the perpetrator of the murder, and it remains an unsolved mystery to this day.

The scientific and professional (less military), instruction provided was of the highest class, almost above the heads of the last-joined. Sir Charles Warren taught survey and astronomy;† his assistant (Sir William) Morris, was reputed to have measured the width of his garden by sidereal observation. Captain M. H. Gregson (who shortly afterwards left to take up " cramming "), was assistant instructor in field works, with Colonel Durnford as chief. Leonard Darwin was teaching chemistry; (Sir Robert) Ruck submarine mining; Cardew (died 1910) electricity—he was the inventor of the first voltmeter. I recall his lecture on " potential," which was to this effect: " Gentlemen, I have several times tried to explain potential

* Of the 32 officers in these five batches, two were killed on active service, two died of disease abroad early in their careers, and two have died this year; one died by his own hand, and another ended his days in a mental home. Twenty are still alive. One, Sir Fenton Aylmer, V.C., became a lieutenant-general; three, including Sir John Capper (a Commandant of the S.M.E.), major-generals, and six brigadier-generals. Major Sir Matthew Nathan was passed over for promotion when Governor and Commander-in-Chief in Hong Kong, because he could not very well be examined for " tactical fitness " in his own colony by officers officially junior to him. He was given the consolation prize of a brevet lieutenant-colonelcy.

† " Charlie " Warren was a great, and very learned, character. He, like the brigade-major, had always *le mot juste*. One of his assistant instructors, newly arrived, marked an officer's sketch, " Poor, very inaccurate." Full of wrath, the owner took it in to Warren, and said, " Look at this. As a matter of fact, I hadn't time to go out, and traced the thing from the 6-inch Survey." Charlie put in his eyeglass, looked up, and said, " I cannot accept such confidences in future." He was a strict teetotaller. I walked with him during a " fortification tour " in the Isle of Wight, and we got wet through owing to a storm. Passing a " pub," he went in and ordered two glasses of gin. I thought better of him. But he poured a glass into each boot, explaining that this would prevent him catching cold. Internal application had the same effect on me.

to young officers, none of them have ever understood my explanation, so we will pass to the next heading in the syllabus." But on those really interested in electricity he would take infinite trouble.

There was practically no military instruction in the R.E. or the Army in the early 'eighties, except in drill and musketry, with plenty of barrack-square drill. Occasionally battalion drill was practised on The Lines; in winter there were route marches as far as Gillingham Church; the eight-mile march to Gravesend, when a recruits' batch or a company went to Milton Barracks for its musketry was looked on as quite a feat of endurance. On rare occasions the R.E. battalion, the R.F.A., and the infantry battalions "practised the attack." This was called "military training"; it meant men advancing across The Lines shoulder to shoulder in line, followed by supports and reserves, and occasionally halting to fire, standing, a little blank. The field battery moved on a flank, remaining behind and dashing forward ahead of the line alternately. The 11th Field Company drew up its wagons and men at the top of The Lines to represent an enemy. Never once did I see outposts, advanced or rearguards practised, or any night operations—except some troops were put out to see if they could be discovered by searchlight. My batch did some "schemes" with Sir Charles Warren, chiefly with a topographical object, dealing with reconnaissances for a march, camping and taking up a position. In winter there were "war games," but there were no "appreciations" or writing of operation orders; the moves were of the chess nature and made on verbal messages; decisions were given not by summing up the situation, but by casting dice; a table in the War Office handbook on "*Kriegspiel*" gave the significance of the throw: "attack succeeds, less 25 per cent.," etc.*

The Annual Inspections by the General Commanding (Sir Evelyn Wood; he was absent for a few months in 1882) were entirely formal. There was a march past, the senior major put the battalion through its "manual exercise," the junior major the "bayonet exercise";† someone else moved the battalion about and formed the battalion square; sometimes the officers did "sword exercise." Sir Evelyn was moved to require something more on one occasion. He called the officers up and asked them questions which could be answered only by a letter-perfect knowledge of the drill-book. Among others, he asked which way the markers faced, if men were used instead of banderoles, to indicate the wheeling points of an oblong for marching past. This stumped everyone. The correct answer was that the

* I accompanied the late Field-Marshal Lord Nicholson, of the Corps, on a staff tour in 1909. He conducted it very well; but confessed afterwards that it was his first.

† At one of the Duke of Cambridge's inspections the major forgot the order of the words of command, and things went wrong. He said to the Duke, "I am afraid the men don't know it." To which we heard the Duke reply: "It's not the men, Major . . . it's not the men."

men should always be facing the same way as the battalion, and turn when it wheeled!

Sir Mathew Nathan has recalled to me that on this occasion he was asked by Sir Evelyn to tell a company "in what part of the supernumerary rank the pioneers should be posted when in line." To this he replied by shouting in his loudest voice ("Dan Leno" was, or pretended to be, deaf): "In companies of engineers which *have* pioneers they are posted behind the centre of the left half-company." Such was the mentality of a Crimean veteran and one of our most bemedalled generals of the 'eighties.* On the other hand, we had two excellent text-books, Hamley's *Operations of War*, and Clery's *Minor Tactics:* why does not the General Staff rewrite them up to date?

There was a "Muster Parade" once a month. At this the roll was called, and everyone, including officers, answered his name and moved to a new line, so that a paymaster might check that the men shown on the books actually had existence in flesh and blood.

"Purchase" in the cavalry and infantry had been abolished only ten years. It may seem odd, but all the old officers of those arms of whom I enquired were perfectly satisfied with the system. They were certainly opposed to the new promotion examinations. When I went up for the written part of "a" and "b," the President of the Board, an infantry major, first sent away the two members; next he said, "I had a hard day's hunting yesterday, if I fall asleep, don't wake me up. The books of reference are on the table. Oh, by the way, I see that you have to sign a certificate that you have done your work in a legitimate manner. I must not forget that: you had better write your certificates at once." And it was so. We all passed, although one of the questions was: "What is the size of a first-class target?"

The Egyptian War of 1882 was the great event of the period. The first Railway Company, the 8th, and other units, left Chatham adorned with enormous sun helmets, goggles, blue veils and, I think, spine protectors: the men were hung round with all sorts of articles which might possibly prove useful, so that, as one of them said, "they looked like Father Christmases."

Captain J. C. Tyler, of the 11th Field Company, to which I was attached—it was a proud day when I went to church with the sabretasche then worn dangling from the belt—on his return from Egypt set about finding something to take the place of the G.S. wagons, then the transport of the field companies. He evolved the "double tool-cart," which was eventually adopted. He hardly got thanked for his invention and, as I remember, was shortly afterwards removed from a field company. In those days all change was very much

* Being in the crypt of St. Paul's a few years ago, I heard an American voice say, reading the name on a tomb, "Evelyn Wood, who's she?" Such is fame.

deprecated, even when for the better; any minor reform was regarded by the authorities in Pall Mall (the War Office was then on the site of the present Automobile Club) as a "revolution."

The extension of Chatham Dockyard was being carried out by convict labour; the garrison, including the R.E. in their turn, had to find an officers' guard (in tunics) each day at the Convict Prison. There was no outbreak, and the officers varied the monotony by playing billiards with the warders off duty. Concrete was only just coming into general use. I recall that Mr. Bernays, the engineer of the dockyard extension, gave a lecture to us on the advantages of this new building material.

"Gale and Polden" of those days was a small stationer's shop at the far end of Old Brompton High Street, reached by passing through a standing gas-barrage of the smell of fried-eel put down by a small shop near the barracks gate.

One of the amenities of one's course was a visit to the Franco-German battlefields. We knew the doings of Steinmetz, Blumenthal, von der Tann, Constantin von Alversleben and Company as well as we now know those of Haig, Allenby and the Army Commanders of 1914–18. I got a dispensation off several field-work projects for translating a German account of the siege of Strasbourg. There were no Army language examinations or language rewards in those days, but there were certainly better linguists. My batch of eight contained four first-class German scholars—the reason may be that there was not so much to learn in science, economics, geography and history as there is to-day.

The final ceremony which completed one's course at the S.M.E. was a visit to the D.A.G., Royal Engineers, who, sitting at the Horse Guards (not in the War Office) held sway over the destinies of the Corps. To town we went, correctly dressed in black coats and tall hats, carrying brown paper parcels with our "projects" in them. We made our way in pairs to Whitehall, sent in cards and the parcels. After a suitable interval, the parcels were returned with the string undone; I and my companion did not see the great man, perhaps others were more fortunate.

One left Chatham, however, singularly well equipped to face the world, and with a first-class foundation on which to build experience and further knowledge.

WHAT IS REQUIRED OF A RAILWAY IN A THEATRE OF OPERATION.

Lecture by MAJOR-GENERAL M. G. TAYLOR, C.B., C.M.G., D.S.O.

1. It is more than difficult to visualize the scope of railway use in a future war, since no one has the slightest idea of the nature of operations involved.

Experience of the Great War may be quite misleading. I think experience of a past war has always been misleading for certain aspects of a succeeding war. The main principles of strategy tactics and administration never change—they are the same now as in the wars of ancient Rome—it is the details that change, and in no branch of military science are they more liable to change than in administration. That is because the details of the machine change, let alone the details of the conditions under which it must work.

So to forecast—as in a manner of speaking the title of this lecture implies—is not only difficult but apt to be misleading, too. Our manuals do not forecast—there is no prophecy about them. All they do is to lay down and explain principles which will not change. It is for us, or such of us as may be in the saddle at the time, to apply the principles to whatever situation may be facing us.

2. Let me, then, not attempt to prophesy, but so as to avoid fantastic situations demanding amazing solutions, let me picture a future war not so very different from past wars except in minor detail. By this means perhaps I can get at a reasonable idea of the railway effort and of the conditions under which the railway service is likely to have to work.

Finally, please bear in mind that nothing I say has any stamp of authority. It is merely the expression of my personal opinion, and as such is worth just that and no more.

3. One is wrong, in my view, to picture future operations as either "static" or "mobile." True, you will have static conditions obtaining at intervals between periods of mobile operations. You may have these periods at short intervals and of short duration, or they may be long in duration and desperately difficult to break down, so as to develop mobile conditions again. It is only under mobile conditions that a campaign can be terminated successfully, so it must always be the aim of a C.-in-C. to break down the static and impose the mobile. On the other hand, mobile conditions cannot

be prolonged indefinitely, because obviously the strain on administration is likely to call a halt some time or other, and then static conditions must inevitably be accepted for a while.

Therefore the training of personnel and the use of material must be directed to the greatest value during *both* mobile and static periods. I think I shall persuade you that the calls made on the services, and particularly the railway service, differ in nature and in intensity during mobile and static periods, and that some forethought and preparation is required by you to anticipate a change from the one to the other so as to be able to pull your weight when the change takes place.

4. We can safely assert, from past experience, that in a "small war" mobile conditions are the more likely to prevail, whereas in a "great war" it is more difficult to obtain these conditions.

Small wars, of course, vary enormously in "smallness." The conditions under which they are carried on are determined by the nature and number of the enemy and by the topography and climatic conditions of the theatre of operations. But even in the smallest of small wars static conditions are almost certain to intervene periodically. For example, by reason of winter conditions rendering movement across country impossible for troops, or because pauses are necessary, pending further advances, to consolidate captured territory and to collect supplies in forward dumps or advanced bases.

In short, you must be prepared in *every* war, no matter how small, for static and mobile conditions.

5. Now to apply what I have said more particularly to the railway service.

Can one find a keyword, a sort of slogan, which will be of use in guiding training of railway units along the right path? Is there any one desirable characteristic to be kept in view and fostered by training, which will ensure railway units being of the greatest value in mobile and in static periods?

I think there is, and in my view they are these:—

For mobile periods—Flexibility
For static periods—Efficiency } and if I were to be asked baldly

to answer the question you have asked me—namely, what will a Commander require of his railway service in a theatre of operations?—I should answer just so: For mobile periods—flexibility; for static periods—efficiency.

6. You may say: "But we always try for efficiency. Why not be efficient in mobile periods too?"

I say to that: "In the nature of things you cannot be efficient in the railway service if you provide full flexibility, and alternately, when you work at maximum efficiency you cannot provide full

flexibility." It is a characteristic of the machine you operate, the railway machine as a whole, to be inflexible when it is really efficient. You demand regular loads, full loads, regular timings, fixed railheads, clearly defined programmes of maintenance, periodic and regular overhaul of stock and road, well-established shops and stores, regular labour on whose services you can count with certainty, no interference by enemy, ally, or even by your own commanders in the field. All these things are necessary for efficient working, *and they cannot be guaranteed to you during mobile warfare.* Your machine does not really fit into the military scheme of requirements in mobile warfare. It has angles and corners which stick out and cause difficulties. Believe me, the only way to utilize your machine satisfactorily during mobile periods is to rub off the corners, break them off, and to sacrifice ruthlessly the efficiency of your machine to fit it usefully into the military picture at all.

You must accept loyally a set of conditions which must, as good railway men, go sorely against the grain.

You cannot have regular or full loads, nor regular timings and fixed railheads. You may have to take serious risks in over-running your stock without overhaul. You will be lucky if you get regular labour, and your shops and running sheds may be difficult of access and possibly soon out of reach.

But instead of efficiency give the C.-in-C. flexibility and he will bless your name.

Be prepared to accept unsatisfactory conditions of working, to take risks, with shaky roads. Be ready to abandon routes at short notice, to work to others at equally short notice, and to do these things with unsuitable equipment. Get your surveys out quickly, even if they are not too accurate. Your R.C.E. has got to be something out of the common. He must know when is the right time to give way on factors of safety (metaphorically speaking), and he must be *anxious* to accept military traffic in areas under construction and somehow to work it through, not merely agreeable to receive it under pressure from higher up.

During an advance temporary repairs are everything. It doesn't matter at all how they are effected. Time enough later on to substitute better repairs. The sole aim is to get things through, and to do this sacrifice efficiency, railway construction maxims, and civil practice.

"Flexibility"—that really involves doing the most outrageous things with your "railway machine." I am not a technician, and I cannot pretend to say how. You will overcome the difficulties to be faced. But it seems to me that imagination and the power to improvise on the spot are the qualities you want to bring out in a military railway engineer.

I have the greatest admiration for the R.C.E. as we knew him in

the Great War, but he was not really tested for " flexibility," and he never had an opportunity to be tried out under flexible conditions. During the earlier periods of the War we had, you will remember, practically no railway organization. We were in the hands of our Allies. Then came the long static period, and finally, when the mobile period set in, the whole group of Allied Armies was so large that " flexible " movements were almost out of the question. Conditions were different in the Near East, and probably the best area for observing a R.C.E. up against it was in Palestine and Iraq. But, without detracting in any way from the value of the railway services in those theatres, I think I can say that the railway effort as a whole was small in both, in comparison with that in the Western Theatre.

Had we really required great flexibility, combined with a great railway effort, how would the railway services have shown up in the Great War? I do not doubt but that they would have made a good showing, but I do think that we should have heard more often the technical veto. That is to say, that at G.H.Q., when a plan demanding an unconventional railway effort was in formulation, we should have seen clearly that the railway technique was outraged, and that it simply couldn't have been done!

Obviously what a C.-in-C. wants is never to hear such a sentiment or opinion. But the *Manual of Movement* has, I hope, brought home to our future commanders that there are certain uses to which a railway cannot be put, and I hope future commanders will realize their real limitations. If that is so, you of the railway service must, in fairness, sacrifice your railway ethics and do things cheerfully, and as efficiently as may be, to meet " outrageous " demands.

Improvisation is a wonderful thing, and the happy possessor of the power to improvise is a valuable man. How far, I wonder, do you train our future railway engineers in improvisation? It is a quality which has always characterized our Corps in field engineering, but honestly I do not think in the past that its acquisition has always been held up as desirable to the railway engineer. Civil practice is the stumbling block, for we have learnt our railway technique from civilians, and while I am sure that the differences between civil and military practice are realized at this training centre, I wonder whether you go as far along this path as you might.

7. I turn now to " static " periods. Under static conditions you have a state of things which more nearly conforms to your ideal. Firstly you get time to replace your improvisations. Then you have the possibility of regularity, of doing the things you want to do under conditions suitable to doing them. And so you are in a happier frame of mind.

But do not forget that while static conditions may bring you ease

from the demands of flexibility, they will certainly make a heavier demand on your total effort.

While you are straining every nerve to get over the troubles of your improvisations, you will inevitably get greatly increased demands for ton-mileage. Directly troops settle down after movement all sorts of things are wanted. In the first place defence makes demands for field engineering material, for ammunition dumps, for evacuation by rail from comparatively forward areas. Then there come demands for amenities, leave, canteen, hutting, coal, etc., and inevitably large demands for road-metal.

All this sort of thing will descend on you like a wave, and you must be able to foresee it and to prepare for it. For there is no getting away from it. The stuff must be carried, and that is all there is to it. All we ask of you is the will to do it, and the ability to do it as quickly as possible.

The *Manual of Movement* should help again here. If it has been assimilated one can assume that the inherent difficulties of working railways to maximum efficiency will be understood by commanders and staff alike, and thus no obstacles should be put in your way, as I am afraid may have been the case in the past, by ill-considered action from above.

Can we get any measure of this effort, to picture to oneself the sort of thing required?

I have an interesting paper before me compiled just after the War. It shows under 32 different headings the tonnage of stores shipped to France on a weekly average between 1.4.18 and 2.11.18. You will remember that this period was an intensive fighting period, not fully static even during the earlier period when withstanding the spring and summer enemy attacks. It was mobile with very short static intervals during the late summer and autumn. It shows a weekly *average* of 187,005 tons! All of which had to be carried, for at least some period of its journey, by rail. I have another Table I made out towards the end of the War, covering the periods February–March–April, 1918. It shows a *daily* average of no less than 243 trains. If you work this out you will find that the average train load is about 109 tons, which for a 700-ton train is hardly efficient. The explanation will be found to be the unavoidably large percentage of double handling in and ex depot, a fair percentage of partial loading, and a large percentage of empty running which could have been materially reduced by a good system of wagon control. But in the nature of the traffic the vast majority of loaded ton-miles is bound to be ex base to railhead with a correspondingly great return empty mileage.

The efficiency is not so bad as it appears.

So you see that it is difficult to draw true inferences from statistics of this sort, for conditions vary so greatly, but I think it is true to

say that the heaviest demand periods on the railway service must occur on the change from mobile to static periods, and may persist for a considerable time after a static period has supervened. On the other hand, the most difficult conditions (as contrasted with the heaviest demands) are imposed on the railway service during mobile periods, and persist throughout the mobile period.

8. My two slogans are :

" Flexibility first " for mobile periods,
" Efficiency first " for static,

and I now propose to say a little about the staff and service machinery devised, and now adopted, to help you to attain these ends.

9. As I mentioned before I am not a railway technician, and my point of view is derived almost entirely from staff experience. I cannot pretend, therefore, to be able to give any hints or tips as to how the end desired is to be attained. The chief thing is to define the end and to leave it to the expert technician to decide means and ways.

But assistance can be given by ensuring two things :

(*a*) a sound organization,
(*b*) wide dissemination of movement principles.

10. The organization adopted is that laid down in *F.S.R.*, Vol. I, and more in detail in the *Manual of Movements*. It is an organization based on war experience and designed specifically to ensure co-ordination and continuity of movement and of movement services in the first place, and in the second to ensure very early advice to the technical services of movement of any change of plan or of the initiation of operations.

It is further designed to ensure that commanders are kept *au fait* with the movement situation and advised of the best use of movement facilities. Finally, though this function should never be in operation, it is designed to be able to check any activity or practice in a subordinate formation which may have a bad effect on the movement system. Such things do happen, without evil intention, but through thoughtlessness sometimes.

Towards the latter end of the Great War this organization did exist to a large extent, but one important factor was missing—the local movement " Q " staff—and this has now been rectified.

11. The railway service is, of course, only one of the transportation services ; docks, I.W.T., and possibly light railways, are others. Their technical work requires co-ordination so that there shall be no overlap, and consequently waste, of effort. The present organization ensures this.

The technical and financial work of each of the transportation services is quite independent, and is the business of the service itself and of no one else. The present organization ensures this independence.

12. There are in the organization three separate branches, and each permeates throughout the movement organization. They are :

(*a*) The service itself, for the technical job of running the "machine."

(*b*) The transportation service, for the technical job of co-ordinating the several "machines" concerned in transportation.

(*c*) The movement branch of the Q.M.G.'s staff, for the staff job of :

(1) Co-ordinating the transportation effort with the user demand.

(2) Seeing that the transportation services have early advice of any change in demand.

(3) Seeing that the principal staff officer concerned (D.Q.M.G.), subordinate Commanders, and the other three branches of the staff (G., A., and M.G.O.) get the best advice regarding the transportation situation, and do not require impossibilities.

13. I do not think any misconception can exist regarding the necessity for the transportation service. It is obvious, I think, that at any point where two of the movement services touch each other, at tranship points, regulation by some authority of communal technical plant or supplies is required. Or again, where two services, *e.g.*, I.W.T. and railway, can in effect carry out the same job of work, someone must apportion the job between them and decide the effort to be made by each. The conservation of personnel and material has to be watched. During quiet periods stock plant and personnel require to be withdrawn into reserve for reconditioning and rest. How much, and what portions of, a service can thus be withdrawn in the existing movement situation can only be settled by a technical authority capable of assessing technical values. Of course, at points such as railheads, where only one movement service is operating, no such technical co-ordination is required, and at such points the transportation service is not represented.

14. But at all points where movement activity is taking place —such as railheads, docks and base, advanced and auxiliary depots— and at all points where policy is considered or plans made involving

movement—such as formation headquarters—it is necessary to post " Q " movement staffs.

For at all points of movement activity there are user services making demands on the movement services. These demands may or may not be in excess of the capacity of the movement services to meet. They usually are, and in that case priority of loadings must be settled. Demands from user services must also be scrutinized to see how far they can be co-ordinated with each other so as to bring a minimum demand on movement services. Such scrutiny may easily bring to light factors which, by adjustment with user services, may lighten the burden on the movement services. This sort of job is definitely the work of a staff deriving authority from a superior commander.

Again, at all such points the most valuable work (*i.e.*, valuable from the movement service standpoint) can be done by seeing that the responsible local head of the movement service has early advice of impending changes. This sort of thing is especially valuable in the more forward areas of railway activity, and quite essential during mobile periods when changes of railhead are inevitable and everything is in a state of flux.

Someone in authority, too, must be able to deal with the superior officers of local administration areas who (one must never forget human nature) sometimes forget the truth that action affecting movement in one area cannot but react on movement outside that area.

I need say little about formation headquarters. I think it is obvious that if a movement service has an ambassador, as it were, watching its interests at those headquarters, and one it trusts as knowing its difficulties and limitations, it should be satisfied. Far more is this the case when, as I hope, the ambassador in question is trusted, and his services fully utilized, by the commander of the formation.

There is the case for a movement *staff*, as apart from representatives of services, but there is one factor in the nature of " movement " which makes it necessary to differentiate the movement staff from all other staffs and to constitute it on somewhat unusual lines.

This factor is " continuity of movement."

15. Clearly every movement has a beginning and an end, but between the one and the other it may traverse the sphere of authority of many different people. Except for the local rail services ex dock to depot and for the lighter services of I.W.T. in port areas, I think well over 90% of movement traverses more than one local administrative area. Movement must therefore be regarded as a general administrative service, and be subjected to control by G.H.Q., and by G.H.Q. alone without the intervention of local authorities.

This control being effected by the movement staff, it follows that the movement staff must derive authority from G.H.Q., and so we have adopted the unusual expedient of attaching G.H.Q. staff officers to subordinate formations and points of movement activity. These officers actually do derive their authority from the D.Q.M.G., and thus have the power to check local misuse of movement facilities—which I sincerely hope they will never have to do.

16. So much for the organization which has been adopted to help the movement services to make the best of themselves. I think it should do much to save the burden on the services, and to assist at the same time subordinate commanders by relieving them of anxiety.

The other factor I mentioned which should help materially is the wide dissemination of movement principles.

17. I am afraid it has been only too true in the past that the efficiency of the movement machine as a whole, and of the railways in particular, has been impaired at times by the issue of orders which are either impracticable from the movement point of view, or which have resulted in local congestion and disorganization. Then up come wild appeals through technical channels to the technical heads of user services, stormy interviews at G.H.Q., investigations, and counter-orders. All of this, with the trouble it causes, could have been avoided had the science of movement been part of the normal training of an officer. I do not mind whether the war is a small war or a great war, if the principles of movement are over-ridden the results are inevitably serious. Indeed in a small war the results may be worse, because the movement facilities are so restricted that recovery to normal working may take much longer than would be the case in a great war.

So to try and avoid future troubles the *Manual of Movement* was introduced as a standard text-book, and its maxims have to be learnt—and I hope appreciated—by all officers as part of their regular training. There is no method other than this, that I can see, by which movement principles can be widely disseminated, but in addition all commanders do, I think, hold at least one exercise annually in which movement problems are carefully considered. If the lessons are laid to heart, I believe the movement machine will run smoothly and well in any future war, great or small.

18. There is one point on which I should like to touch before concluding, and that is the security of the railway machine against enemy attack.

One knows—it is general knowledge—that a railway system heavily loaded requires minutely exact regulation in order to ensure efficient working. Now any temporary interruption of normal operation will have an increasingly serious disorganizing effect the more heavily loaded the system, and if we assume, as we must, that

during static periods the system behind the army is heavily loaded, then clearly it is to be expected that the enemy will make every effort to cause these temporary interruptions.

Permanent interruptions, by demolition for instance, are really not much more serious than temporary ones if one thinks in terms of traffic. Railway repairs—even serious ones—do not, as a rule, take very long to effect. Temporary interruptions can be effected by air alone, but permanent ones require the use of ground forces. I think, this being so, one would be right in assuming that enemy air action, directed to disorganize traffic, would be vigorously applied, but I also think permanent demolition attempts by the enemy would not be worth the risk. If the latter were undertaken they would involve movement of ground forces sufficiently considerable to ensure adequate defence measures being possible.

Therefore, air attacks against local traffic points are likely to be the chief danger. As to these points, they are as easily determined by ourselves as by the enemy, and their defence from the air can, and will, be carefully assured by our own higher command. They will be determined in the first instance by Q(M) at G.H.Q., and their defence will be undertaken as part of the general scheme of protection of the force as a whole. You may, at any rate, rest assured that the danger is appreciated and will not be neglected.

Incidentally, you yourselves will be expected to produce a scheme of avoiding lines, and branch junction lines, to be carried out as a first step in minimizing the effect of successful enemy air attack.

19. I fear you may say that I haven't really answered the question you asked me: What is a C.-in-C. going to require of us in a future war? I don't know what he will require—no one does—but if you will run your machine so that it is flexible in mobile periods and efficient in static ones, and for the rest meet each day's difficulties in a common-sense way, you will give him at least the best service the railway machine is capable of giving, and that should suffice.

THE DESIGN AND ORGANIZATION OF AN ADVANCED BASE.

By MAJOR AND BT. LT.-COL. C. C. PHIPPS, O.B.E., M.C., R.E.

Note.—This article was written before the recent publication of the *Ordnance Manual (War)*, 1931.

The latter contains certain modifications in connection with the details of Advanced Ordnance and Ammunition Depots, but the principles have not been changed.

I.—GENERAL CONSIDERATIONS.

THE great mobility of mechanized forces and the increased dangers of air attack will tend to make lines of communication considerably more vulnerable in the future than they have been in the past.

The provision of advanced bases on a large scale will, in consequence, become imperative in order to ensure supplies and munitions for an advancing army.

Supposing that an army had advanced, say, 150 to 200 miles from its original base, in a country where communications are not very plentiful. If the enemy possessed a mobile mechanized force and a fairly strong air force, these communications would become so insecure that it would be essential to collect a considerable amount of stores and munitions at the forward end of this line, before any further advance could be carried out.

These conditions are not entirely new, but they did not occur during the Great War and so are apt to be overlooked. A case similar to that envisaged above occurred during the American Civil War, when Sherman collected 30 days' supplies of all natures at Chattanooga before advancing on Atlanta. His communications behind Chattanooga had been previously cut by Forrest's very mobile force of cavalry and were liable to be cut again, and it was essential for him to make sure of some 30 days' supplies before he could advance farther. We will, therefore, examine some of the main factors which must be considered in laying out and constructing an advanced base of this nature.

The study of such a problem, and, in fact, the study of all R.E. work behind the front line, is a very important one.

We are rather apt to confine our attention to field works and R.E. work carried out in the forward areas, and neglect the bigger works which have to be carried out at the base and on the L.-of-C.

As a matter of fact, if we consider a force of about the size of our expeditionary force, there are some 8,000 R.E. employed at the base or on the L.-of-C. compared to about 6,000 employed in Corps and Divisional areas. Any R.E. officer may easily, therefore, be faced with these problems of work in the back areas.

2.—Consideration of a Definite Case.

We will assume for purposes of this examination that we have got to construct an advanced base to hold 30 days' supplies and munitions of all natures, and 10 per cent. reinforcements for a fighting force of four divisions, a cavalry brigade and two medium armoured brigades; with a fifth division and part of the A.A. defence brigade for the protection of the advanced base.

This advanced base to be fed from the rear by one double line of railway. Forward supply to be by road in the first place and eventually by rail when we have been able to construct or repair the line forward.

3.—Information Available in Text-books.

We cannot obtain much information about such an advanced base from any of the official manuals. *F.S.R.*, Part I, refers to the necessity of such a base. *M.E.*, Vol. VIII, gives details of the lay-outs of the depots at a base port. The latter is not, however, quite the same. In the same way the *Supply* and *Ordnance Manuals* give particulars of their respective requirements at a base.

If we delve into these various manuals we begin to bump up against difficulties at once on account of apparently conflicting figures. I will quote one instance only as an example:

M.E., Vol. VIII, 1929, on page 90, states that the actual stacking space required for supplies in a main supply depot works out at 900 tons to an acre.

Supply Manual (*War*), 1931, on page 67, gives the stacking space required for supplies as 3,000 tons per acre.

The difference between the two figures is not due to a misprint or wrong calculation, but to the fact that stacking space means something different in each case.

The difference between the two figures may be due to the fact that 900 tons per acre represents the stacking area in relation to total tonnage of various commodities, *e.g.*, groceries, forage, fuel, etc., which, considered individually, stack at different tonnage figures per acre, while 3,000 tons per acre for general supplies means groceries and medical comforts. Separate calculations are indicated in *Supply Manual* (*War*) for forage, fuel, etc.

The Sappers have got to construct the base, and it will usually

have to be done in as short a time as possible. The layouts of the various depots must be the most efficient that can be arranged on the site available. The R.A.S.C., or the R.A.O.C., may give figures for tonnage and acreage, but the Sapper officer must know exactly what those figures mean. Typical layouts may be given in the manuals, but these are bound to presuppose a perfectly flat site with no obstructions of any kind. Except possibly in a desert such sites do not exist, and any such plans will have to be very extensively modified. Such modifications cannot be made unless the Sapper officer is conversant with the organization and administration of the various depots.

Particulars of the more important points to be considered in connection with the organization of the various depots is given later in dealing with the layouts of these depots, and it will be seen how essential it is to know these particulars before we can make any suggestions regarding the alignment of railway sidings, roads, etc.

4.—Factors Affecting Choice of Sites.

We will now turn to consider the factors affecting the choice of site and layout in more detail.

The general selection of a place for an advanced base is a strategical question which we need not consider here.

The selection of the actual areas where the various depots are to be sited is, however, affected by a number of points which must be considered. Many of these produce conflicting problems which have to be carefully weighed and adjusted. The requirements may be summarized as follows :—

1. Protection from air attack.
2. Protection from ground raids by A.F.V.s.
3. Depots requiring sidings must be fairly flat—1/250 is maximum grade for a loading or unloading siding.
4. Sites for these depots should be close to the main line to reduce railway work.
5. Road traffic will have to be carefully organized. The existing road system must be carefully considered and new road work reduced to a minimum.
6. Water supply is essential, especially for remounts, veterinary hospitals, base depots and hospitals.

5.—Protection of Base.

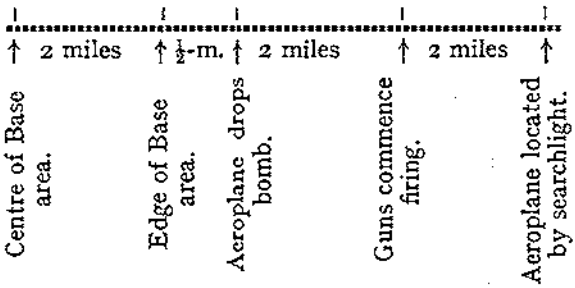
We will consider protection more fully. Protection from an air attack is best obtained by dispersion. Protection from raids by A.F.V.s by concentration and the use of natural obstacles, such as rivers, woods, etc. These are two entirely opposite requirements.

Let us consider some actual figures in this connection.

The minimum area required for a base under the conditions we are considering will be about four miles diameter. This will depend on the nature of the country. In absolutely flat desert country it could be reduced, but the figure given may be taken as a fair average. If we try to prevent the enemy occupying all ground within, say, four miles of the depots, this will mean a perimeter of about 38 miles. It is obviously impossible to have any form of ring defence. We must hold important points and keep a large mobile reserve.

Again, if we consider air attack the most difficult problem is protection at night. Here the searchlights are the ruling factor. The position of the outer ring of lights is fixed by the time required for the guns to pick up and get on to a target at night. The following may be taken as the minimum requirements :—

(*a*) 1 minute to open fire after target is located by searchlight	= 2 miles flight of 'plane.
(*b*) 1 minute for fire effect	= 2 miles	,,
(*c*) Bomb is dropped ½-mile before reaching objective..	= ½-mile	,,
(*d*) Distance of edge of base from centre ..	= 2 miles	,,
Total ..	= 6½ miles.	



This means that the outer ring of lights must be at nearly seven miles radius from the centre of the base or on a perimeter of 44 miles. The lights are spaced about 3,000 yards apart.

The defence of these outer lights will be a most difficult problem. They will have to be dug in and wired and given small infantry detachments for protection against small raiding parties. Even this local defence is not too easy, because the engine working the light has to be about 300 yards away, so that the noise does not interfere with the work of the sound locators. Two sections of infantry, or even a platoon in some cases, will be required for each light which is outside the protected area held by the defence troops. There may be as many as 20 lights or more requiring this special protection. If we are to find these detachments from the units of the division

allotted for the defence of the base, we are obviously going to cause a great deal of disorganization to a large number of units. The only alternative appears to be to employ some of the 10 per cent. reinforcements on this work. There are many obvious objections to this course, including the fact that the personnel will be constantly changed, but it appears to be the only way out of a very difficult situation.

From these remarks it will be seen that, unless the site selected for the advanced base is endowed with the most exceptional natural means of defence, we must concentrate our depot areas as much as possible in order to be able to protect them, although such concentration will mean more liability to damage in the event of an air attack actually getting home.

6.—Areas Required for Depots.

Having settled what is the area which can be defended, we must then consider how the various depots can be laid out.

The following table gives the approximate areas which must be provided for the conditions visualized in our project. These figures are gross figures and not merely stacking areas. They allow for the subdivision of the depots into the various component parts and allow for safety distances between groups in the ammunition and petrol depots. They also allow for irregularities in the ground, but assume that the contours of each area as a whole are suitable for railway sidings where such are required.

Supply depot, including N.A.A.F.I.	120	acres.
Petrol depot (cans cased)	50	,,
Ordnance depot, including workshops and vehicle reception park	70	,,
Ammunition depot	350	,,
R.E. stores depot	30	,,
Transportation stores depot	25	,,
R.A.S.C. heavy repair shops, ,, vehicle reception depot, ,, M.T. stores depot	75	,,
Aircraft depot, including aerodrome	200	,,
Base depot for reinforcements	200	,,
Camp for base construction units	100	,,
Hospitals and convalescent depots	250	,,
Veterinary units and remounts	100	,,

7.—Handling of Stores in the Depots.

In considering the layout of the various stores depots the first point to consider is the question of handling these stores both on arrival and on departure from the depots.

i. Practically all stores will arrive by rail and, therefore, it is essential to run standard 4′ 8½″ sidings into these depots so that trains can be unloaded direct. Any question of transhipment of the incoming stores to decauville or road transport before stacking in the depots is unthinkable. We must, therefore, provide sufficient unloading sidings to enable the incoming trains to be rapidly unloaded and stores stacked either in the open or in sheds alongside these sidings.

ii. Forward supply from these depots will be by road in the first place and eventually by rail. We can, therefore, either (*a*) make roads into the depots alongside all the stacks and load up direct into lorries from these stacks; (*b*) provide decauville tracks and take stores to central lorry filling points outside the depots; or (*c*) provide 4′ 8½″ loading sidings and take stores from these to central lorry-filling points outside the depots.

Considering these alternatives in detail:—

(*a*) saves a considerable amount of handling of stores, but entails a very large amount of roadmaking, which is a slow process and requires enormous quantities of material. Taking the most optimistic figures for this roadwork, and making about 50% of the roads as plank roads, 25% as concrete and 25% as macadam, it would require about 3,000 men and 40,000 tons of material to complete the roadwork, which would be required inside the depots alone, in a month.

This system entails a very large number of lorries passing continuously through the depots themselves.

The daily numbers being roughly as follows:—

Main supply depot	.. ..	380 lorries.
Petrol depot	.. ..	240 „
Ammunition depot	.. ..	75 to 150 lorries

Difficulties would arise over the breaking up of the maintenance companies and the distribution to all the various different sections in each depot.

Maintenance companies often have to fill up at night and this would entail lighting at all the depots and consequent increased risk of air attack.

(*b*) and (*c*) are very similar. Decauville can be laid rather more rapidly than 4′ 8½″ railway, but it is not nearly so convenient for handling of bulky stores.

The 4′ 8½″ sidings can be laid rapidly with sharper curves, if all main line engines are detached at the reception sidings and all work in the depots done by small tank locos.

If these sidings are put in to start with the system will possess the following advantages:—

We shall be ready for forward supply by rail immediately it is required without any dislocation of traffic.

The depots will be working on the normal method for which they are organized, viz., rail in, rail out.

No night work will be necessary in the depots, all outgoing stores can be loaded up by day and sent out to lorry-filling points to be loaded into lorries when required.

Although it entails rather more handling of stores in the first place, this labour will have to be provided eventually when forward supply is to be by rail, and it may just as well be made available from the start.

The best solution, therefore, appears to be to provide 4′ 8½″ sidings at once for both incoming and outgoing stores.

To fit in with this system we shall require a number of lorry-filling points outside the depots, corresponding to railheads.

We shall require one such point for ammunition and two for supplies and ordnance stores.

Although petrol is dealt with in the same way as supplies and goes up on the ordinary pack train, it is advisable to have separate sidings for this commodity. These sidings should, if possible, adjoin the supply-filling point, but may in some cases be completely separate.

One separate siding will also have to be provided for "detail issues" of ammunition and one siding for "detail issues" of supplies and ordnance stores for the L.-of-C. and base troops.

Loading and unloading sidings must be practically level, 1/250 is normally taken for the maximum grade.

Elsewhere than at sidings, gradients must not exceed 1/50 maximum and 1/100 maximum should be aimed at if possible.

A reception *triage* or grid of sidings must be provided outside the principal depots, in which the trains can wait if necessary and can be broken up into the necessary components.

A departure *triage* is necessary in the same way and for forming up pack trains.

8.—Lorry-Filling Points or Railheads.

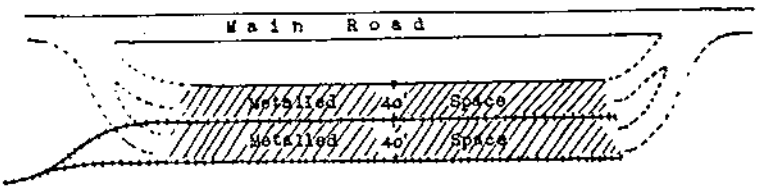
The layout of these points depends mainly on the ground.

The railway siding or sidings must be practically flat (a slope not exceeding 1/250), and in order to reduce roadwork, these sidings must be brought up as close as possible to a main road.

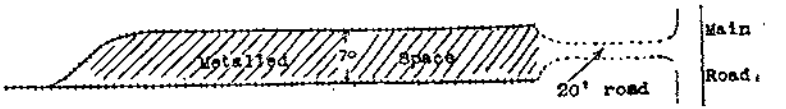
The ideal is where the contours are parallel to the main road.

In this case the railway sidings can be parallel to the road, and on one or more loop roadways made alongside the sidings.

This has the advantage of providing an easy "in" and "out" traffic for lorries.

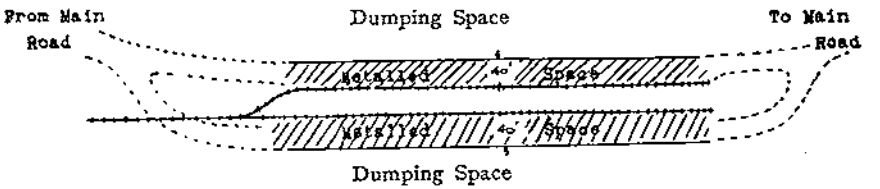


Where, owing to the contours, the sidings have to be made at right angles to the main road, it becomes more difficult to provide "in" and "out" traffic without excessive roadwork and in this case it may be advisable to have a broad, metalled space between two sidings, with a 20' road connection to the main road.



To allow for lorries backing up against railway trucks, a metalled space, at least 40' wide, is required for a single line, or 70' wide for backing against sidings at both sides.

It must be realized that with a normal railhead, as distinct from the lorry-filling points provided just outside the depots in this scheme, it will often be necessary to dump stores alongside the sidings, as the exigencies of the service will in many cases make it impossible to provide for unloading immediately the whole of a pack train direct into lorries. Cases also arise when it is necessary to send up commodity trains instead of pack trains. In consequence of this railheads should, if possible, be laid out so that there is space to dump stores alongside the sidings and for lorries to load up either from the railway or from the dumps. To cope with this the best arrangement is as shown below :—



To simplify the carry from the siding to the dumping ground, the width of roadway should be kept to a minimum. As stated previously for end-loading of lorries, this cannot be reduced below 40 feet. Alternatively the space between the two sidings can be used for stores.

9.—DETAILS OF THE ORGANIZATION OF THE VARIOUS DEPOTS.

MAIN SUPPLY DEPOT.

The total force to be supplied, including the various base and L.-of-C. troops, may be taken as 180,000 men and 35,000 horses.

From *Supply Manual* (*War*), 1931, we get the following figures :—

General Supplies.

180,000 men at 7 lb. per day for 30 days = 17,000 tons.

Forage.

35,000 horses at 22 lb. per day for 30 days = 10,000 tons.

In order to get stacking spaces, we must further subdivide these figures into the various different sections of the depot, as follows :—

Groceries = 30% of 17,000 = 5,100 tons at 3,000 tons per acre	= 1¾ acres.
Biscuits and preserved meat = 30%	= 2 ,,
Fuel = 30%	= 2 ,,
Miscellaneous = 10%	= ½-acre.
Hay (S.R.D. pressed) = 50% of 10,000 tons at 9 sq. ft. per ton + 50%	= 1½ acres.
Grain = 50% of 10,000 tons at 3,000 tons per acre	= 1½ ,,

Total = 9 acres actual stacking space or, say, 90 acres gross depot area.

If we limit the depth of stacks to 150 feet, then the frontage of stacks equals :—

Groceries	approx.	500 feet.
Biscuits and preserved meat	,,	600 ,,
Fuel	,,	600 ,,
Miscellaneous	,,	150 ,,
Hay	,,	450 ,,
Grain	,,	450 ,,

Subdivide stacks into 200 feet frontage and leave 100 feet between stacks. This gives us a total frontage of some 4,000 feet or, say, a minimum of 5 1,000-ft. sidings in and 5 1,000-ft. sidings out, as we have five principal groups if we combine " Miscellaneous " and " Hay," and sidings should seldom be less than 1,000 ft. in length.

If ground is suitable these sidings should be increased in length and space also left for additional sidings to allow for expansion.

The ideal would be to allow for sidings capable of expansion to 1,500 feet length and leave 500 feet between consecutive incoming sidings to allow space for duplicating all sidings.

The above figures are based on 30 days' supplies, but actually it is normal to keep 60 days' supplies in a main supply depot.

AMMUNITION DEPOT.

The main factor affecting the layout of this depot is the necessity for subdivision into four groups, each separated if possible by 400 yards, or an absolute minimum of 200 yards from each other.

The accommodation required for a 4,000-ton depot is as follows :—

Component Ammunition.

Shells, stacking space .. .. = 300′ × 30′.
Cartridges, stacking space .. .. = 100′ × 30′ (2 sheds each).
Fuzes, stacking space .. .. = 20′ × 30′ (2 sheds each).

Transit platform, 300′ × 30′ is required for sorting out various sizes of ammunition.

Boxed Ammunition.

Stacking space = 2 spaces each 300′ × 30′.

Bombs.

Stacking space = 350′ × 30′ divided up into 10 separate compartments, each 16′ × 25′, separated by 20′ of earth.

A transit platform, 300′ × 30′, is also required in this section.

Miscellaneous.

Stacking space = 1 shed, 150′ × 30′, and 1 group of 5 huts, each 16′ × 25′, separated by 20′ of earth.

In every case 100 ft. must be left between adjacent sheds or stacks in the same row, and 400 yds. (or 200 yds. min.) between stacks in parallel rows, even if of the same group.

To comply with these requirements it will be found that a siding about 1,800 ft. long is required for component ammunition and about 1,200 ft. long for each of the other groups.

Space must be left for expansion and this can be met by making all sidings 1,800 ft. long and leaving space for an additional 1,800 ft. siding for extra component ammunition.

It will be found that a minimum area of 300–400 acres is required, if 400 yards is left between groups.

The total weights to be stacked in the various groups has been taken as follows, although these figures are at present under revision :

Boxed	2,000 tons.
Component	800 ,,
Bombs..	400 ,,
Miscellaneous	800 ,,

A suggested layout is shown on plate " A."

ORDNANCE DEPOT.

This depot must be divided up into a stores depot and a gun and vehicle park.

Two "in" and two "out" sidings are required for the stores depot. The two pairs of sidings, each about 1,200 ft. long, will allow for space between the various sections and also room for expansion. Area occupied will be approximately 1,200′ × 400′, of which about 90,000 sq. ft. should be covered if possible.

Gun and vehicle park requires to be about 1,200′ × 600′. One "in" and one "out" siding is required. A roadway 40 ft. wide must be provided down the centre of the park. An end-loading ramp must be installed and also a dock siding with a 20-ton gantry.

The advanced ordnance workshops and vehicle reception park will normally adjoin the gun and vehicle park.

The workshops should be about 800′ × 100′, with room for expansion, and the vehicle reception park should be on the opposite side of the workshops to the gun and vehicle park and requires a space about 1,200′ × 300′.

The vehicle reception park will require one "in" siding, and the "out" siding of the gun and vehicle park, referred to above, should adjoin the workshops and serve the latter as well as the park.

A suggested layout is shown on plate "B."

PETROL DEPOTS.

The following particulars with regard to the stacking of petrol are given in *Supply Manual* (*War*), 1931:—

(*a*) Petrol cans *cased*.

i. Cases contain 4 cans and they can be stacked 5 cases high.
ii. 176 gallons = 1 ton.
iii. 3,000 tons to an acre stacking space.

(*b*) Petrol in cans *uncased*.

i. Cans stacked 4 high, laid flat on sides.
ii. 250 gallons = 1 ton.
iii. 1,000 tons to an acre stacking space.

Assuming that all petrol in the depot is in cans, *cased*, then we require about 5 acres of stacking space or, say, 50 acres total area, allowing for space between dumps.

R.A.S.C. M.T. DEPOTS AND REPAIR SHOPS.

The R.A.S.C. M.T. stores depot should be sited so as to have convenient access to both railway and road. Any suitable existing workshops will, of course, be utilized if available for heavy repair

shops. Access by road is required for the R.A.S.C. vehicle reception depot, and a railway line with siding is also desirable. When circumstances permit, it is advantageous to site these three units as close together as possible.

BASE DEPOTS AND CONSTRUCTION UNIT CAMPS.

Large areas should be provided for these camps and they should be kept dispersed as much as possible. Every advantage should be taken of woods and orchards to provide concealment from the air.

A system of narrow slit trenches should be provided for protection in case of air attack.

Men will be accommodated in tents.

Huts will be provided for cookhouses, latrines and ablution rooms.

Water will be laid on to cookhouses and ablution rooms.

Latrines will be either on the bucket or deep trench system.

HOSPITALS

Will be accommodated when possible in suitable buildings. The remainder will be in tents, which should be replaced by huts as soon as possible. A siding for hospital trains should be provided if possible in the hospital area.

REMOUNT AND VETERINARY CAMPS.

Animals will be in the open and personnel as for base depot camps.

Water will be one of the deciding factors in selecting the site.

R.A.F. AIRCRAFT DEPOT.

The site of this depot will usually be fixed by the necessity of having an aerodrome attached to the depot as well as rail access.

One railway siding is required and a certain amount of roadwork.

Personnel will be accommodated in tents.

Bessoneau hangars will be provided for workshops, storage of aeroplanes, etc.

R.E. DEPOT.

This depot should be provided with both railway and road communications.

TRANSPORTATION DEPOT.

This depot will for the most part contain stores for the construction of the railway forward, and all communication will be by rail.

LOCO. DEPOT.

A separate depot will usually be required for this purpose and will contain running and repair shops. An expense coal store will be in this area and arrangements must be made for watering engines.

10.—SUMMARY OF R.E. WORK TO BE CARRIED OUT.

The object of this article is not to go into details of the R.E. work to be carried out in connection with the construction of a base, but to give a brief idea of some of the many factors which affect the selection and layout of the base. Unless the R.E. officer is conversant with these requirements it will not be possible to co-ordinate the whole in such a way as to get the best results, especially as the R.E. requirements will often conflict with those of other corps.

A brief summary of some of the R.E. work, must, however, be included. The following figures have been taken from a scheme worked out in the neighbourhood of Maidstone, based on the force quoted in this article.

Railway Sidings.

About 28 miles of 4′ 8½″ track would be required to be laid.

The weight of this track without ballast would be approximately 7,560 tons. It is reckoned that two railway construction companies and one composite railway company with about 2,400 unskilled labour would be required to lay this track in a month, assuming practically no earthwork.

Roads.

The amount of roadwork will depend entirely on the country and no general figure can be given. In the Maidstone scheme, where there was a very extensive network of existing roads, it was calculated that the equivalent of at least 12 miles of 20′ road would have to be constructed. This figure includes about 3½ miles of 40′ road in connection with the lorry-filling points. This is an enormous problem to compete with in the time available, which will seldom be much more than a month of actual working time.

The type of road to be constructed will depend largely on the materials available and the time required to lay. We should probably have to construct two or three different types.

If we assume that we divide up the 12 miles of 20′ road into :

6 miles of plank road
3 ,, ,, tarmac road
3 ,, ,, concrete road

we get the following weights of material to be handled :—

Timber for plank roads	10,000 tons.
Stone and metalling for tarmac roads	20,000 ,,
Concrete and reinforcement for concrete roads	10,000 ,,

It is reckoned that 2½ road construction companies, together with 2,000 unskilled labour, could construct these roads in approximately

PLATE "A"

ADVANCED AMMUNITION DEPOT
TO STOCK 4000 TONS

NOTE ADDITIONAL ACCOMMODATION FOR EXPANSION IS SHOWN HACHURED

DETAILS of STORES (EXCLUDING INCREASE for EXPANSION)

BOXED AMMUNITION	2000 TONS	2 SHEDS 300'×30'
COMPONENT AMM.	800 TONS	1 SHED 300'×30' (SHELL) 2 SHEDS 100'×30' (CARTRIDGES) 2 SHEDS 20'×30' (FUZES & TUBES)
BOMBS	400 TONS	1 GROUP of 10 HUTS EACH 16'×25' (EACH SEPARATED BY 20' OF EARTH)
MISCELLANEOUS	800 TONS	1 SHED 150'×30' 1 GROUP of 5 HUTS EACH 16'×25'

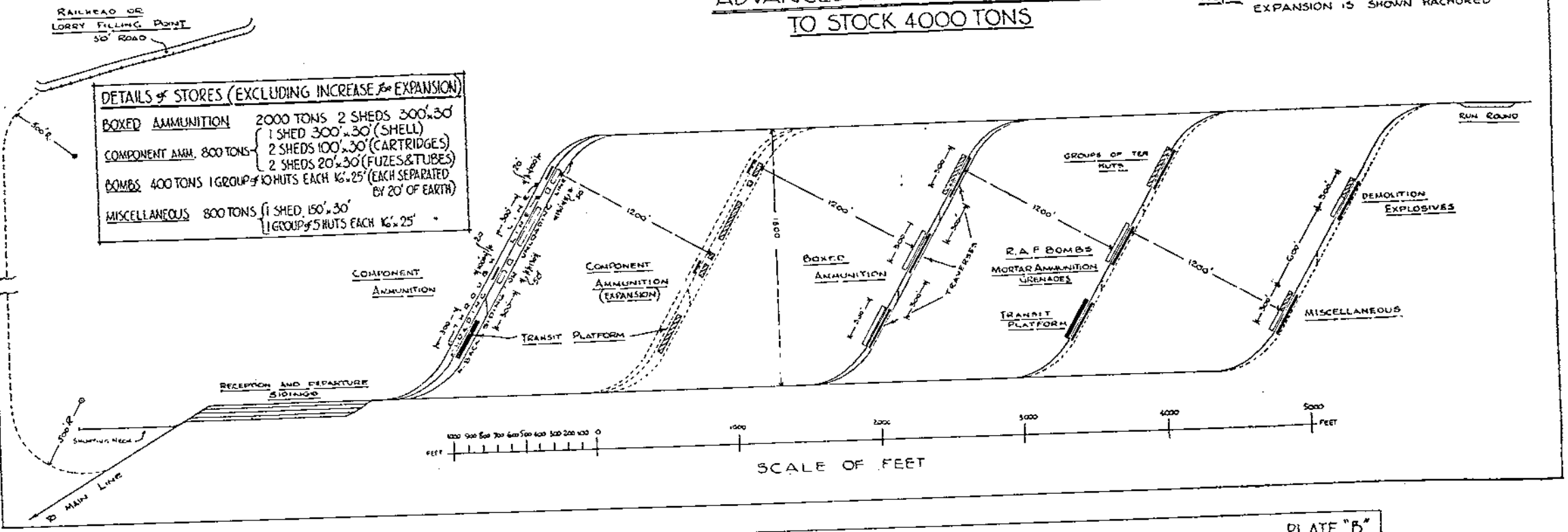


PLATE "B"

ADVANCED ORDNANCE DEPOT

FOR A FORCE OF ABOUT 6 DIVISIONS & 30 DAYS STOCK
APPROX. AREA 70 ACRES

INDEX

ROADS - ----------
A, B, C, & D - STOREHOUSES
RAILWAY LINE - ——————
G - STORE FOR DEALING WITH MIXED CONSIGNMENTS FROM BASE

one month, provided that a constant supply of material could be maintained and delivered at half-mile intervals and provided that one road roller and two concrete mixers were available for every half-mile of tarmac and concrete road respectively.

It is hoped that experiments now being carried out with bituminous oil-bound roads may simplify the road problem in the future.

Lorry Standings.

The above figures for roadwork do not include anything for lorry standings. The total number of vehicles belonging to the maintenance companies of the whole force amounts to approximately 1,800.

Of these, about 600 will be permanently located in the base area, and the remaining 1,200 may also have to be located there when the fighting force has advanced some distance. It will obviously be impossible to provide standings for all these vehicles and arrangements will have to be made for as many as possible to be parked alongside the roads. Lorries so parked require about 100 yards for every six vehicles, allowing space for shunting, etc.

Hutting.

About 1,000 tons of hutting stores will be required and two Army Troops companies, with 600 unskilled labour, should be able to complete this work in about a month.

Water Supply.

This will depend on local conditions and it is impossible to give any useful figures. In the Maidstone scheme, where a fairly extensive system of mains was in existence, it was reckoned that the following would be required :—

12" Victaulic pipe, 3 miles ; 6" pipe, 5 miles ; 4" pipe, 12 miles ; 3" and under, 14 miles.

Electric Light and Power.

This would depend entirely on local conditions.

II.—Conclusion.

It is hoped that this brief survey will have shown that there are many conflicting factors which affect the layout of the base ; that the engineering work to be carried out and the amount of stores to be handled are very large ; and that the time available for doing the work is very short.

It is essential, therefore, that all concerned should be thoroughly conversant with the organizations and limitations of all the other branches if we are to get the job done at all in the time available, and if we are to produce an efficient working organization such as is essential for the successful conclusion of the operations.

HISTORY OF THE ROYAL ENGINEER YACHT CLUB.

By CAPTAIN W. G. FRYER, R.E.

THE R.E.Y.C. is an old club. In the whole world only eighteen yacht clubs are senior, of which thirteen are in the British Isles. It was formally established in 1846, but it existed in a nebular state for some years previously. There are signs that the club existed in 1840, and probably it began soon after Waterloo. Not, however, until 1865 was it enrolled among the Royal Yacht Clubs of the United Kingdom, with permission to fly the blue ensign. The R.E.Y.C. burgee, too, first appears in the club records about 1865.

Title. The earliest rules now existing are of "The Engineer Boat Club" of 1855, which laid down an annual subscription of £4 10s., with an entrance fee of £1 10s. Soon after 1855, the title was changed to the Royal and H.E.I. Co.'s Engineers' Yacht Club (Honourable East India Co.). This title changed soon after the Mutiny to the Royal Engineers' Yacht Club. A final change to the Royal Engineer Yacht Club in 1911 made it less cumbrous still.

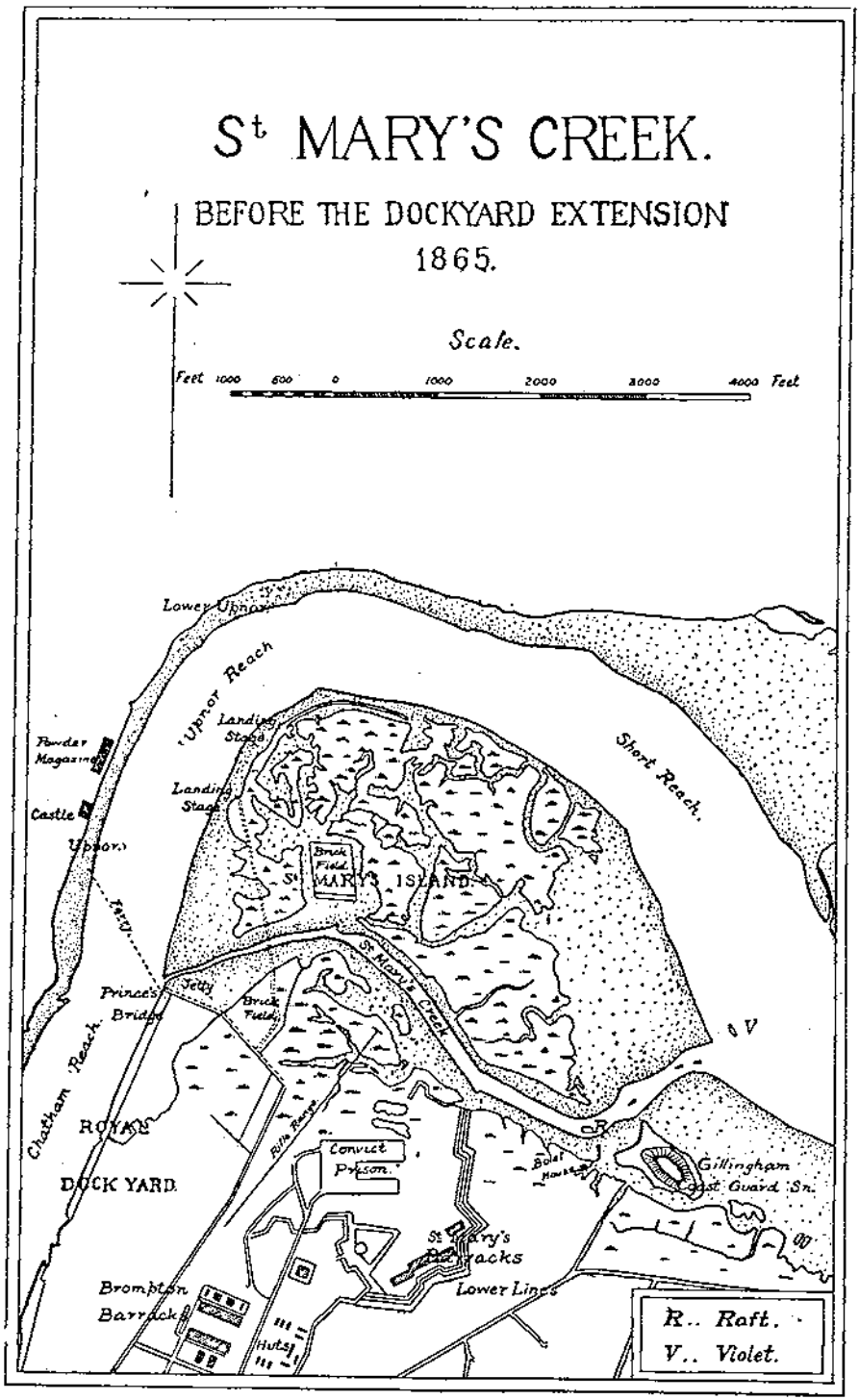
I. THE FOUNDING, 1845, UNTIL 1864.

The year 1812 saw the establishment of a military engineering school at Brompton Barracks, Chatham, and in 1815 engineer cadets of the Honourable East India Company came from Addiscombe to swell the numbers. Woolwich remained the Headquarters of the Corps of Royal Engineers until as late as 1857, however; so that the R.E.Y.C. had to rely upon young officers under engineer training for both its origin and support.

The R.E.Y.C. appeared formally in 1846; but the *Whim*, a fat, slow little 3-tonner, had been bought in 1842. Rowing had been practised before this. The early title, "The Engineer Boat Club," well covers the blend of rowing and sailing which exists to this day.

All boating pursuits were carried out from a raft and boat shed in St. Mary's Creek, the traitor waterway which had carried back the Dutch fleet after its bombardment of Upnor Castle in 1667. Yachts were moored near the raft. This convenient site vanished when, in 1866, St. Mary's Creek was struck off the map and absorbed into the dockyard extension works.

The Medway of these early days was a pleasant, gentle stream running lazily beside marshy banks right down to the sea: while


St MARY'S CREEK.
BEFORE THE DOCKYARD EXTENSION
1865.
Scale.
Feet 1000 600 0 1000 2000 3000 4000 Feet
Lower Upnor
Upnor Reach
Landing Stage
Landing Stage
Powder Magazine
Castle
Upnor
Ferry
Brick Field
St MARY'S ISLAND
Short Reach
St Mary's Creek
Prince's Bridge
Jetty
Brick Fields
Chatham Reach
ROYAL
DOCK YARD
Ropery
Convict Prison
Boat House
Gillingham Coast Guard Sn.
St Mary's Barracks
Lower Lines
Brompton Barracks
Huts
R.. Raft.
V.. Violet.

a dockyard in the days of wooden ships was a clean, wholesome establishment, far different from the grimy factory which now disfigures the neighbourhood. Cement works, too, were then unknown. Most wonderful of all, sailing leave was to be had in large, generous slices.

Nothing definite is now known of the earliest rowing activities; but in 1855 a disaster befell the sailors. On 16th December, the *Diver*, 2½ tons, capsized in Rainham Creek on a duck-shooting expedition. Æneas Macdonald, Morton Eden, George Battine, H.E.I. Co.'s Engineers, and James Battine, Bengal Cavalry, were all drowned. All except Eden, who was never found, were buried in Gillingham Churchyard; and a marble tablet was erected to their memory in St. James's Church, Croydon.

There have been two other tragedies. The *Whim* capsized in Pinup Reach in 1867, and of the three officers on board Lieut. J. J. Robertson was drowned; and, in 1931, 2nd-Lt. C. H. Minton-Senhouse was drowned when the club dinghy capsized in Yantlet Creek, close to the scene of the *Diver's* accident.

The earliest club rules, even as far back as 1855, lay down fines for grounding and for abandoning vessels. By 1863, the club was in the habit of holding both sailing and rowing races each season, a captain for each yacht being elected at the spring general meeting. Lieuts. Blood, English and Bucknill appear in the club records at the close of this period, and with them a new wave of energy sweeps through the rowing and sailing branches. Seamanship was at a premium, and anchor dragging was considered a finable offence.

In 1864 a four, North, Ommaney, Bucknill, Harrison and Lee (cox) won at Sheerness, Wateringbury and Rochester regattas; and the *Talisman*, 10 tons (crew: Burton, Rathborne, Bucknill and Kirkwood) went to Boulogne on what seems to have been the first foreign cruise of the R.E.Y.C. The club was £134 in debt, and a steamer was chartered (cost £12) to take R.E.Y.C. members and guests to view the R.T.Y.C. Regatta. A proud year. The foreign cruise called for a larger yacht, and at the end of the year the R.E.Y.C. bought the *Violet*, schooner, 12 tons, the cost being met by the issue of debentures to members.

Col. Bucknill gave a description of the yachts which greeted his (Mascall's) batch, when he joined from the Shop in 1864 :—" The *Talisman*, clincher built and leaked badly, a poor purchase; the *Mona*, a narrow five-tonner and rather a beast; the *Whim*, an old tub built of oak, very strong (she had been 24 years in the club), very slow, and very dangerous in a sea way, being far too short for her beam; the *Mary*, a nice little four-tonner, handy, fast and safe "—altogether an odd mixture. Rowing was done in wherries, or half-outriggers, from a raft and boathouse at the bottom of St. Mary's Creek; and the yachts were moored close to the raft. The

boathouse was close to Gillingham Fort, which had been built to guard the Creek after the Dutch exploit, and was used as a coast-guard station.

This handy and sheltered anchorage had fostered the R.E.Y.C. from its birth; but in 1864 a dark cloud gathered up windward, blew down as a dockyard extension scheme, and cut off the creek. Soon it was time to go. Lacking a run-through of tide, the creek slowly silted up; and, in any case, the whole creek was shortly to be swallowed up by the new dockyard. This early period ends with brilliant success at rowing, energetic cruising, and much uneasiness as to the future home of the club. The club debt, though steadily increasing, caused little annoyance, however, for a rule was passed that "Dilapidated blokes . . . shall pay ¼ fees only." A deficit merely provided an occasion for the issue of debentures to the wealthier members of the committee.

II. Reign of the "Violet," 1865 to 1883.

The arrival of a 12-ton schooner, the *Violet*, gave more dignity to the club, and application was made to the Admiralty for enrolment as one of the Royal Yacht Clubs of the United Kingdom. A warrant was applied for. The burgee appears at the 1865 regatta. The earliest existing blue ensign warrant is dated 2nd April, 1872.

Once more the oarsmen did well at the local regattas; but the year's honours went to the *Violet*, which sailed to Flushing in 16 hours; crew: Chadwick, Curling, English, Fanshawe, Gill, Macdonald and boy. In 1866 the Admiralty took over St. Mary's Creek, and the rowing-boats moved up to a new raft opposite the Marine Steps. This new raft was provided by the Admiralty as compensation for the loss of the old boathouse and hard. The old raft was moored upstream of its flashy new partner; but in 1868, disgusted by the change, sank and set adrift several rowing-boats.

Yacht races in the club were started from moorings with all after-sails set, and the courses were usually to Sheerness and back. Lieut. Bucknill won one single-handed race in a close finish in *Talisman*. They were hardy sailors, and the yachts were kept sailing winter and summer. The *Violet* and *Curlew* spent a merry Christmas in Stangate Creek in 1868, *Violet* losing a dinghy, getting on fire in the fo'c'sle, and splitting a foresail. On 13th March, 1869, the crew of *Curlew* nearly perished during a night of hard winds and snowstorms off the Isle of Grain. *Violet* often raced about the Estuary with fair success.

In 1871, the *Violet* collided with a brigantine and lost her foremast, and there were groundings without number. Another cruise, starting on the ill-omened date of Friday, 13th February, 1880,

nearly sank the *Dotterel* and her crew of five. They anchored off Lowestoft in a heavy fog and a steep breaking sea which continually came aboard. The *Dotterel* had an open well, and was only kept afloat, through a whole long winter's night, by constant baling. Crew: Sankey, Askwith, Mascall, Adair, Roper. The log of this cruise ends with three notes:—

1. A small boat with an open well is not suitable for cruising in the North Sea during winter.
2. Never hoist a distress signal—go to the bottom first.
3. Lifeboatmen are swaggering extortionate vampires. (A lifeboat came out as the *Dotterel* was getting clear.)

The *Violet* served the club until 1884 as a reliable cruiser. She was not fast, but managed to win one or two pieces of plate at the local regattas. Burnham does not seem to have appeared in the logs of cruises, and Brightlingsea and Whitstable were the nearest harbours visited.

The *Dotterel*, cutter, 9 tons, was bought in 1878 as a novices' yacht, and she served the club wonderfully well for twenty years, earning her cost in half-crown grounding fines several times over. She was seen at Leith as late as 1908.

In 1868, Lieut. J. J. Curling, R.E., was musketry instructor at Gravesend; and he kept there a fine yacht, the *Lavrock*, 72 tons, yawl. He was an adventurous subaltern, and did some surprising things. From Dover he paddled and sailed a canoe across the Channel alone one night, telling nobody of his intention. He also rowed a light skiff from Gravesend round to Chatham one evening. In 1868 he was elected a member of the R.Y.S. In 1873 he sailed the *Lavrock* to Newfoundland, and took up missionary work. Nine years later he returned in the *Sapper*, a 52-ton schooner, which he had designed and built out there.

Rowing.—When the rowing-boats left St. Mary's Creek in 1866, and moved to a new raft off the Marine Steps, a boathouse was built at Upnor, at the cost of £8, to protect them during the winter. The new raft seems to have been merely a plain deck, moored at one end, and quite lacking in changing accommodation. The Admiralty can have provided only a part of this new raft, for it seems to have been made chiefly of Government timber lent by the Fortification School. It was too short to carry an eight, and proposals were made for lengthening it. These were not agreed to, but a light roof was added in 1879. In 1881, much to the consternation of the Yacht Club, the I.F.F. called for 225 cu. feet of his timber, and the raft was sawn down seven feet to provide it. A new shed was built at Upnor in 1880. Convict labour was used, and it only cost £120. As usual, the club was in debt, and so the money was borrowed by issuing debentures to members.

In 1883 it became essential to build a new raft, as the old one was quite waterlogged. This was done in the following year by increasing the club debt and taking the surplus of the *Buccaneer* fund. The old raft sold for £6.

Rowing had been in a flourishing condition ever since the 'fifties, and in 1868 most of the club interest was centred in that sport. In that year a professional coach was engaged, the R.A. were challenged to a four-oared race, and the club presented a cup, value £20, to the Medway Regatta. In 1870, the R.A. were challenged to row an eight-oared race, and both the R.A. and R.E. crews entered for the "Thames" at Henley Royal Regatta. It was the first appearance of the R.E.Y.C. at Henley. In 1875, sliding seats were provided on most of the boats, and crews were entered for regattas at Molesey, Putney, Barnes and Kingston. Lieut. J. T. Bucknill entered for the Diamond and Wingfield Sculls at the Henley Regatta of 1876, where he met with fair success. So little interest was then taken in sailing that, in 1876, the *Nellie*, cutter, 9 tons, bought in 1871, was put up for sale to provide money for rowing. The raft, indeed, must have become far too popular; for about this time a rule appeared which laid down a social standard for any ladies invited there as guests.

At the end of 1883 the *Violet* was sold for £70, having served the R.E.Y.C. for nineteen arduous years.

III. "King Buccaneer," 1884–1905.

Sir Charles Warren became President, R.E.Y.C., in 1883. He found the club in debt, the raft about to sink, and a strong movement afoot to separate the club into oarsmen and sailors. The *Violet* was old and was quickly put up for sale. Money was raised by an appeal to the Corps to subscribe for a new yacht, and by squeezing £70 out of the R.E. Games Fund for a new raft. The appeal raised £319, and the club found itself rich enough to buy both a new yacht and a new raft.

The *Buccaneer*, yawl, 19 tons, and only five years old, was bought for £350. An excellent raft with good changing-rooms, and floating on pontoons, was made by Messrs. Aveling and Porter for £288. Lieut. H. V. Kent bore most of the burden of the new designs and purchases. The former raft had depended on baulks for its flotation.

Flag officers were:—

Commodore: H.R.H. The Duke of Cambridge.
Vice-Commodore: Lt.-Col. G. A. Leach.
Rear-Commodore: Major T. English.

The *Buccaneer* was a grand choice. She did little but cruise in

1884, as she was rather out of her class on the Medway ; but in 1885, with a new mainsail presented by the Vice-Commodore, she won £53 in prizes, getting firsts in the Dover–Ostend race, and the Ostend–Southsea race. Crew: Kent, Wright, Gaynor, Baker Brown, Ashworth, J. Bogle, Adam Bogle, Noel. This success was never repeated ; but for twenty years the *Buccaneer* sailed around the English, French, Belgian and Dutch coasts on energetic cruises, her decks wearing thin under the feet of a generation of Sapper yachtsmen. Sometimes she won or got placed, but, as time went on, her slowness to windward and lack of new sails made racing successes very few and far between. As a cruiser she was admirable. Often the *Dotterel* went for cruises in company with her. The *Daphne*, a fast 5-ton cutter, was bought in 1889, and met with success in the Royal Corinthian races from Port Victoria ; but she was soon sold, as she was more of a racing than a cruising type. The R.E.Y.C. was now becoming so well known in the yachting world that for a race from Port Victoria to Southsea in 1887, the owner of *Eva*, 16 tons, offered to hand her over to a Sapper crew ; and nineteen members sailed in various yachts, the old "*Buc.*" getting second prize.

The year 1896 was seized upon by Capt. Gaynor, the active secretary of the club, to celebrate a R.E.Y.C. Jubilee. A committee, under Sir Charles Warren as president, sent out the appeal, which was, naturally, inseparable from a jubilee ; and the hat returned brimful of coin. The R.E.Y.C. netted £523. No niggardly spirit restrained the committee. A fine new raft with tea-rooms was built for £606, and the *Brizo*, 7-ton cutter, was bought for £200 to replace the old *Dotterel*. The club debentures of £200 were left unredeemed. They seem to have been regarded in much the same light as the National Debt.

The *Brizo* was a fine little yacht, but not such a good vessel for beginners as the *Dotterel*, which was capable of standing the roughest treatment ; also the restrictions on novice crews, the Boer War, and the heavy upkeep of the "*Buc.*" combined to increase the club debt. By 1905 the raft was in great need of repair, the debentures had risen to £300, the Regatta had shrunk down to two or three events, and the Submarine Miners left Gillingham, where for so many years they had carefully guarded the R.E. yachts. It was as if a fatal paralysis was creeping on the club. The final blow was struck at the end of the year when a scheme to move the whole school to Cooper's Hill was being examined. This removal seemed so likely that all yachts were sold to pay off the standing debt. The *Brizo* fetched £45. The old "*Buc.*" was sold to Messrs. Lynch, of Rochester, for £120, and was broken up in August, 1906, at Messrs. Gill's yard on the north bank of the river. The R.E.Y.C. was now without a yacht for the first time in its history.

Dinghy classes.—There had been several club sailing dinghies in the early 'nineties; but sailing punts were becoming popular, and two new ones were bought in 1899 which were a great success. In 1900, after much opposition, the club invested in two *kittiwakes*, which were raced in a class above Rochester Bridge. These were half-decked, 17 feet long, easily upset, and specially built for racing. They were unsuccessful until Usborne bought one from the club and raced it himself; and they merely proved that club ownership in a one-design class leads to failure. They were sold with the yachts in the Cooper's Hill scare of 1905.

Rowing.—The 1884 movement to break away from sailing met with severe defeat at the general meeting; and the provision of a new raft, from money which had been subscribed for the *Buccaneer* purchase, put the oarsmen in a happy condition. The 1885 raft, a very good one with a narrow central changing-room and good shelter for the boats, cost £288. It was sold to the Chatham Rowing Club in 1897 for £30, and served them well for many years, moored off the Sun Pier. The 1897 (R.E.Y.C. Jubilee) raft was a very solid erection floating on four wooden pontoons. It was built in two stories. The bottom story housed all the boats, and the top story was divided into tea-room, changing-room and bathroom. This raft was very popular while the interest in rowing was maintained, but in 1904 this had dwindled sadly. The Regatta survived only in two or three events in the men's Regatta at Fort Clarence, and even these competed unsuccessfully with the shore attractions. In the autumn of 1904, owing to the neglect of the raftsman, one of the pontoons filled, and the raft listed so heavily that the top story collapsed upon the boats below, doing immense damage. After great labour, the damage was made good in the winter of 1904–05 with the help of the Submarine Miners, for it would have cost £200 to carry out the repairs in a local shipyard. During the Cooper's Hill scare, the Medway Rowing Club was approached and an offer of £100 obtained for the raft, the sale to take place when the R.E. left Chatham.

The Warren Shield.—In 1898 Sir Charles Warren presented to the R.E.Y.C. a challenge shield for competition by twelve-oared service cutters manned by crews from any unit of Army or Navy in the Thames district.

This race has been rowed annually, with a War gap, ever since; and great keenness has always been shown; sometimes as many as eight cutters have been entered. The R.E.Y.C. is still solely responsible that a fair and sporting race results, but on several occasions this has been far from the case. There are many loop-holes for the exercise of sharp practice in an inter-unit struggle of this kind, and the race requires the strictest supervision. Cutters

have been pared down for lightness, favourites have been fouled by second strings, and officers of high rank have shouted hard, bitter insults at each other. Recently the complaints have been cut down by ruling out second strings, and racing on a straight course in Chatham Reach. The early races were from three to four miles long, and sometimes involved a turn round a buoy in the lower reaches. A favourite course was from Folly Buoy to Cockham Woods. About 1909 the R.E. Regatta was held above bridge, instead of from the Gun Wharf, and this brought the cutter course above bridge too.

IV. THE REIGN OF THE "FULMAR," 1906 TO 1925.

The threatened move to Cooper's Hill never came off, and in 1906 the R.E.Y.C. found itself without a cruising yacht. Happily the raft and rowing-boats had not been sold; and the R.E.Y.C. Regatta of 1906, held at the Gun Wharf, was a great success. Much of the success was no doubt due to the fact that the Regatta was held close to the June Ball. In the old days the Regatta was invariably held on the day after the Ball.

The club cupboard was quite bare of gold, and an appeal was sent out to the Corps which brought in £443. A sturdy spoon-bowed cutter, *Fulmar*, was bought for £350, leaving a surplus which lifted the club out of debt for the first time since 1880. She was not fast, but she sailed some startling cruises and won races here and there. Many a time she grounded in heavy seas, but survived them all to be sold in 1925, at the end of the first Fastnet Race. She was built in 1901.

The Great War found her cruising on the South Coast, and she was rushed into Southampton, where she spent the whole war. In 1919 she was sailed back to Chatham for a most energetic six years, during which the post-war classes learnt sailing by the usual method of trial and error. Burnham cruises were standard week-ends, for there was little yachting on the Medway itself when the Royal Corinthian Y.C. failed to return to Port Victoria after the war. On these cruises, as often as not, *Fulmar* spent all her time at sea, for Burnham is just beyond the safe range of a short week-end. The crews were very keen, and many small private yachts were kept at Gillingham by members. *Fulmar* herself was often kept at Upnor.

In 1920, *Fulmar* lost her mast in a heavy sea off Calais. In 1921 she set out on her longest foreign cruise, and visited Holland and Heligoland. On the way back she blew out all her headsails and finally grounded in a heavy sea while running to Nordeney for shelter. The crash was so severe that it broke the boom and tore the mainsail into ribbons. She clawed off the lee shore with a trysail, although the cliffs were within three cables' length before it could be hoisted, and then she ran back to Heligoland. A huge sea was

running and she leaked badly, so that the crew had to bale hard all the way. The water was swilling about in the saloon at bunk level. A boom and a new suit of sails were made, labour free, in the German Naval Dockyard, which was then under the kindly control of a British Commission. Crew: N. A. Blandford-Newson, Capt. S. J. Armstrong, W. M. Blagden, C. A. Mead, W. G. Fryer.

Blandford-Newson, who was skipper on this historic cruise, soon showed himself to be one of the best natural seamen the Corps has ever produced.

In 1925, the Fastnet Race, 615 miles long, was first started, and the little *Fulmar* was entered. She got second prize in fairly heavy weather, which made a number of entrants give up. This was a rare success, and gained the club a great reputation in the ocean racing world. The rules have since been altered to bar such a small yacht from entering for the Fastnet Cup. *Fulmar*, however, had shown the result of her many groundings, and she leaked badly during the race. It was decided to sell her and buy a faster, sounder and larger yacht. Fastnet Crew: N. A. Blandford-Newson, Capt. R. M. H. Lewis, G. L. Watkinson, J. H. D. Bennett, P. L. Wilkinson, H. A. Macdonald.

Fulmar was sold for £175. She still lives, and ventures into the Estuary when the waves are kind, and there are prospects of that genial breeze, the Soldiers' Wind, of which she saw so little when the soldiers used to man her.

Small Yachts.—In 1907, the club bought the *Hearty*, one of the Corinthian one-design class, but it was not a success. She was little used, seldom won, and was sold in 1908. Other small yachts, *Maia*, *Mist* and *Mignon*, followed her, spent an energetic life in the club, and passed away to gentler hands. In 1913 Col. J. T. Bucknill presented *Thalassa*, a fast 7-metre sloop, to the club. She was a fine vessel, capable of holding her own with the Burnham ex-24-footers. Many a time has she left Chatham at Friday dusk, sailed all night, raced on the Saturday at Burnham, and returned on the Sunday. There was no accommodation below decks—she was a racing shell—and the crew found it more comfortable to sail her all night than to sleep in her. She was one of the first English yachts to have a Bermudian mainsail. It was an odd sight, as Col. Bucknill had designed a curved mast which evaded the existing sail measurement rules. In 1922, *Thalassa* won outright the Hollingsworth Challenge Trophy at Burnham from the ex-24-foot class. Crew: Major H. E. Day, N. A. Blandford-Newson, J. H. D. Bennett, E. J. Palairet. The R.E.Y.C. presented the Thalassa Cup in place of this piece of plate, which now serves coffee in the Headquarter Mess.

Thalassa was expensive to keep up, and was sold in 1925 for £60. She was no cruiser, and as a racer she was out of her class on the

Medway. A sextant was, with Colonel Bucknill's permission, bought for *Ilex* with part of the proceeds of her sale.

Nippy and *Magnolia* were bought just after the war as small cruisers. *Nippy* was an awful failure and was sold as scrap: her end appears in the *Yachting Monthly* of 1930. *Magnolia* was larger —3 tons against 1 ton—and behaved well enough.

Rowing.—The Regatta flourished in peace-time, and we often sent a boat to Henley. The 1896 raft had vanished when the post-war oarsmen came together, and only the boathouse at Upnor remained. In 1925, largely as the result of efforts by Major E. F. Tickell, a fund was gathered together from keen oarsmen and from the R.E. Games Fund. Another raft was built and moored at the Marine Steps. This raft cost £1,014, and was made out of an old barge, the *Gnat*, with floats and boatracks on either side. This is still most successful. Post-war regattas were rowed from Upnor boathouse. In 1924, the R.E. Bombay Yacht Club was wound up, and presented the R.E.Y.C. with £55, credit balance, which went to swell the raft fund.

R.E. rowing reached great heights in 1910 and 1911 under the energetic guidance of C. E. P. Sankey, one of the best strokes that have ever been seen at Henley. His energy was unbounded, and he managed to secure a first-class coach for the R.E. Eight by arranging a course of Territorial instruction for him at the S.M.E. during the training period. Both the 1910 and 1911 R.E. Eights rowed extremely well at Henley in the "Thames." The 1911 crew put up the second fastest time in the event while losing to the winners. The 1910 crew was as good or better. They raced in an old eight borrowed from the London Rowing Club, while the 1911 crew picked up a light eight at Henley shortly before the race.

The R.A. *v.* R.E. boat race flourished during this period. Gibbon was the famous gunner stroke and he and Sankey were worthy rivals. Sometimes the race was rowed on the Medway, but more often on the Thames. The 1906 and 1907 R.A. *v.* R.E. races were events in Henley Royal Regatta. It was found impossible to fix an annual boat race after the exceptionally hard one of 1911, and the score now stands at six wins each.

The flag officers at the end of this period were :—

Commodore : H.R.H. The Duke of Connaught, K.G., K.T., K.P.
Vice-Commodore : Lieut.-Colonel T. English.
Rear-Commodore : Lieut.-Colonel J. T. Bucknill.

They are still serving.

V. "ILEX," OCEAN GREYHOUND, 1926 ONWARDS.

An old Nicholson-designed yawl, *Ilex*, built in 1899, was for sale. She was a good type of fast cruiser, 20 tons T.M., with a small

THE R.E. CREW, HENLEY, 1910.

Bow, P. K. Boulnois; 2, W. F. Hanna; 3, C. M. G. Dunhill; 4, A. E. Grasett; 5, E. C. Whiteley; 6, R. P. Pakenham Walsh; 7, H. G. Pyne; Stroke, C. E. P. Sankey; Cox, B. Ward.
Beat Kings and First Trinity II after close races, succumbed to Merton in semi-final.

History of REYC

auxiliary which might deal with a calm Sunday night. Water-line length 40 feet, draught 7½ feet, breadth 10·4 feet. She was bought for £850, and, in early spring, sailed round from the Menai Straits by two subalterns and a cook. Although old, she was in perfect condition, and she was a great bargain at the price: she had no reputation as a racing yacht, however. Her purchase money was raised by grants from Corps funds, the sale of *Fulmar*, and £100 by individual subscription.

In 1926 she won the Fastnet Race from a strong field. She was sailed with great determination, and actually had two men overboard at once while taking down reefs on a very black and dirty night. Crew: N. A. Blandford-Newson, W. M. Blagden, J. H. D. Bennett, H. A. Macdonald, P. L. Wilkinson, Capt. J. J. Carter, Capt. R. M. H. Lewis, G. N. Russell, D. N. B. Hunt and Carter (paid hand).

Since then, *Ilex* has appeared in every Fastnet Race with varying success. In 1929 and 1930 she took third prizes. In 1929 she raced from Plymouth to Santander and won second prize (a gold cup and £96). She also won the Careaga Challenge Cup in a race from Santander to Bilbao. In that one year she won four cups and £102. Santander crew: D. N. B. Hunt, W. G. Fryer, M. T. L. Wilkinson, Major S. J. Armstrong, Capt. Rupert L. Brown, G. D. McK. Sutherland and Carter (p.h.). In 1930 she won the race to Santander and, with it, the Queen of Spain's Cup and £132. Her old rival, *Jolie Brise*, was beaten on handicap by four minutes at the end of a 435-mile race. There were eleven starters, drawn from no less than four nations. The *Ilex* crew dined at the Royal Palace with Their Majesties after crossing the line. Crew: D. N. B. Hunt, H. A. Macdonald, M. T. L. Wilkinson, H. S. Francis, J. de V. Hunt, E. F. Parker, Major J. Pennycuick, Ll. Wansbrough-Jones, and Carter (p.h.). This was a great year for Dennis Hunt. In the early summer he had been awarded the R.H.S. Medal for saving Parker's life when he fell overboard from *Ilex* in a rough sea off Flushing, and in July he was skipper of the only yacht to complete the Channel Race, the other nine starters having been forced, by the heavy weather, to return to Cowes without rounding the Havre Light Vessel. There have been only two British ocean races for the Queen of Spain's Cup, and *Ilex* and *Jolie Brise* have both taken a first and a second.

On 4th July, 1931, *Ilex* was one of ten starters which set out from Newport, Rhode Island, on a race across the Atlantic to Plymouth. A special fund was raised in the Corps to ship her to the start. £980 was guaranteed, and, of this, £712 was spent. Retired officers of the Corps gave a crew fund of £120. *Ilex* got seventh place in a close finish, having taken 21 days to cross: she was the first British ship to finish. Crew: D. N. B. Hunt, H. A. Macdonald, Capt. W. G. Fryer, M. T. L. Wilkinson, H. S. Francis, J. de V. Hunt,

T. P. Brown, and H. Carington Smith. Dennis Hunt was, as usual, both skipper and navigator.

Theresa, a slow 5-ton yawl, was bought in 1928 for £200 as a small cruiser. In 1923, a 12-foot dinghy class was formed, which was a great success, and has raced, on and off, up to the present. In 1931 one of our junior subalterns surprised everyone by spending a week's leave in one of them, visiting the Mouse Light Vessel, and even anchoring for the night close to the Maplin; it was, too, a more wintry summer than usual.

Rowing.—The post-war young officers spent much of their time at Cambridge, and rowing keenness shifted there. During long vacation, however, the raft showed great activity; but since 1927 no Sapper crew has rowed at Henley. In local regattas we have always done fairly well. In 1931, the R.E.Y.C. Regatta was held from the Gun Wharf for the first time for many years.

Conclusion.—The Royal Engineer Yacht Club is an ancient and unique association of keen energetic yachtsmen and oarsmen. All over the Empire its burgee has flown, fluttering over the sheltered waters of Naini Tal, the stormy Australian seas, and the broad grey Atlantic. No other Corps can show such a brilliant record with sail and oar; and, as the years roll by, its lustre gleams the brighter. In this civilized age, adventure is not easy to come by; but there is rare adventure lying hid in every scrap of canvas and wood for those who would care to hunt it out. May the years that follow have as brave a tale to tell as those which have gone by, and bring good luck to all those who love the silent rivers, the still harbours, and the fickle breezes which are at once our pleasure and pain. For who would sleep on a fine moonlit night, while the ship heels gently over, and the breeze blows freshly on the helmsman's brow as he sits alert on the gunwale, watching for the lights to flash out their beckoning ahead, guiding him to safety at the end of some wild sea ordeal which has vanished into the past like the foaming wake astern?

BRANCHES OF THE HOME CLUB.

The story of R.E.Y.C. activities in foreign stations is less easily told, as no written record exists. It would have to be collected through the dubious sources of regatta small-talk, after-dinner braggadocio, and night-watch confidences. Malta, Gibraltar, Bombay, Hong-Kong, Nova Scotia and Singapore have sheltered the most active branches. Startling ocean voyages were made from both Singapore and Ceylon; West Indian and Bermudian R.E.Y.C. stories are standard currency of conversation; and India has, for a

long time and at various stations, kept up the R.E.Y.C. pursuits. The preceding history, therefore, lacks an account of these branch activities and tells nothing but the story of the R.E.Y.C. (Home). It is left to someone else to compile the history of the R.E.Y.C. (Abroad), which, indeed, is certain to be full of interest, for it is the world-wide character of the club which makes it so different from any other yacht club in existence.

LIST OF R.E.Y.C. YACHTS.

NO.	NAME.	RIG.	TONS.	BOUGHT.	PRICE.	SOLD.	PRICE.	REMARKS.
1.	*Whim* ...	Ctr.	3	1842		1867		Capsized 1867. Lt. Robertson drowned.
2.	*Diver*	Sprit.	2½			1859		Capsized 1859. Four officers drowned.
3.	*Undine* ...		3	1855?				
4.	*Mary* ...	Slp.	3	1853?		1863		
5.	*Rosamund* ...	Ctr.	6	1860		1863		Gift of Lieut. Manderson, Bengal Engineers.
6.	*Talisman* ...	Ctr.	10	1862		1871	£40	
7.	*Curlew* ...	Bawley	8	1866		1871	£40	
8.	*Silver Cloud* ...	Ctr.	12					
9.	*Mona* ...	Ctr.	5			1864		
10.	*Sylph* ...	Slp.	2			1868	£3	
11.	*Bel Esprit* ...					1868	£80	
12.	*Violet* ...	Sch.	12	1864	£220	1884	£70	
13.	*Swallow* ...	Slp.	4½	1868		1889	£10	
14.	*Nellie* ...	Ctr. and ywl.	9	1871	£150	1880	£42	
15.	*Dotterel* ...	Ctr.	9	1878	£118	1898	£40	Built 1874.
16.	*Buccaneer* ...	Ywl.	19	1884	£350	1906	£120	Built 1879. Won £52 in 1885.
17.	*Daphne* ...	Ctr.	5	1889	£151	1892	£80	
18.	*Brizo*	Ctr.	7	1898	£200	1905	£45	
19.	*Hearty* ...	Slp.	3	1906	£40	1908	£25	Corinthian one-design.
20.	*Fulmar* ...	Ctr.	14	1907	£350	1925	£175	Built 1901. 2nd prize, Fastnet, 1925.
21.	*Maia*	C.b.slp.	5	1908	£60	1913	£13	
22.	*Mist*	C.b.slp.	4	1909	£18	1910	£12	
23.	*Mignon* ...	Slp.	4	1911	£37	1918	£20	
24.	*Thalassa* ...	Bm. slp.		1913		1925	£60	Gift of Col. Bucknill (R.-C.), 7-metre.
25.	*Nippy* ...	Slp.		1920	£65	1922	£5	Scrapped.
26.	*Magnolia* ...	Slp.	3	1921	£160	1927	£37	
27.	*Ilex*	Ywl.	20	1926	£850			Built Camp. and Nich., 1899. Won Fastnet and Santander Races. Crossed Atlantic.
28.	*Theresa* ...	Ywl.	5	1928	£200			Built Leigh.

R.E. ROWING AT HENLEY ROYAL REGATTA.

The 1906 and 1907 R.E. *v.* R.A. boat races were rowed as events in Henley Regatta. Other R.E. crews appeared as follows :—

YEAR.	EVENT.	REMARKS.
1870.	Thames.	Both R.A. and R.E. crews entered.
1876.	Diamonds. Wingfield.	Lt. J. T. Bucknill, R.E., entered privately and was finally beaten by the Champion of the Thames after leading him most of the way.
1906.	R.A. *v.* R.E.	
1907.	R.A. *v.* R.E. Wyfold.	
1909.	Thames. Wyfold.	The R.E.Y.C. boat is described by an onlooker as a heavy seagoing craft.
1910.	Thames.	An eight borrowed from London Rowing Club did very well, getting through two rounds and then losing in fast time. Crew: P. K. Boulnois (bow), W. F. Hanna, C. M. G. Dunhill, A. E. Grasett, E. C. Whiteley, R. P. Pakenham-Walsh, H. G. Pyne, C. E. P. Sankey (str.), B. M. Ward, son of "Barney" Ward, O.C.T.B., was cox.
1911.	Thames.	Our most successful season. The R.E.Y.C. eight met the winners in the semi-final and lost while putting up the second fastest time in the whole event. Crew: P. K. Boulnois (bow), W. F. Hanna, H. G. Greswell, H. C. B. Wemyss, A. H. Morse, N. D. Noble, A. E. Grasett, C. E. P. Sankey (str.), W. O. Winter (cox). Boulnois, Sankey, and, later, Grasett, were elected members of Leander.
1913.	Thames.	Started well but an unlucky injury to stroke gave trouble at the wrong time.
1919.	Eight.	This was the Peace Regatta and the old trophies were not competed for. No success.
1920.	Wyfold.	
1923.	Wyfold.	
1924.	Wyfold.	Beaten by winners in second round.
1925.	Thames.	
1926.	Thames.	Beaten by winners.
1927.	Wyfold.	

R.E. *v.* R.A. BOAT RACES.

YEAR.	COURSE.	BOAT.	WINNERS.	REMARKS.
1869.	Putney.	Eight.	R.A.	2 lengths.
1870.	,,	,,	R.E.	J. F. Brown, str. Same crews rowed at Henley. 3 lengths. (Thames Cup.)
1871.	Medway.	Four.	R.E.	1 length.
1900.	,,	,,	R.A.	3 lengths.
1901.	,,	,,	R.A.	8 lengths.
1902.	,,	,,	R.A.	¾-length.
1903.	,,	,,	R.E.	2 lengths.
1904.	,,	,,	R.A.	4 lengths.
1905.	,,	,,	R.E.	6 lengths.
1906.	Henley Royal Regatta.	,,	R.E.	3 lengths. Rowed as an event in Henley Regatta. W. Cave-Browne (bow), G. B. Pears, R. F. A. Hobbs, G. G. Waterhouse (str.) and P. de Fonblanque (cox).
1907.	,,	Coxless four.	R.E.	2½ lengths. Crew also rowed Wyfold Cup.
1911.	Henley.	Four.	R.A.	½-length. Late in year. A very hard race.

The race has not since been rowed. Total wins: R.A., 6; R.E., 6.

HISTORY OF THE 7th FIELD COMPANY, R.E., DURING THE WAR, 1914–1918.

With a short Record of the Movements and Campaigns since the Formation of the Company.

By CAPTAIN H. A. BAKER, M.C., R.E.

(*Continued.*)

CHAPTER V.

THE BATTLE OF THE SOMME, AND AFTER (SEPTEMBER, 1916, TO MARCH, 1917).

THE FINAL PHASE OF THE SOMME BATTLE (1ST SEPTEMBER TO 16TH OCTOBER, 1916).

Map VI.

THE 50th Division joined the III. Corps in time to take part in the final allied attacks on the Somme in 1916.

The earlier phases of this battle had been fruitful in lessons regarding the employment of engineers in the attack. The 50th Division was fortunately able to profit by the experience of previous divisions with the result that skilled labour was no longer wasted on indefinite tasks in the initial attack.

In the attack of the 4th Army, in conjunction with the French and the Reserve Army, which took place on the 15th September, the 50th Division frontage extended from opposite the northern edge of High Wood to near the Albert–Bapaume road. The Division succeeded in reaching and maintaining its final objective with an extreme depth of advance of about 1½ miles, thus causing a deep salient in the British line. Throughout the operations its communications were kept up to within a few hundred yards of its most advanced infantry. This work included the construction during the 15th/16th of 2½ miles of road to take transport and guns (*i.e.*, from south end of Bazentin-le-Petit, through that village to High Wood), of which the first mile was shell-torn metalled road and the remaining 1½ miles was on the site of a chalk-bottomed third-class road of which there were few traces and whose existence was only conjectured from the map. This was followed during the succeeding and final phases of the attack by the construction of 1,500 yards of 60-cm. steel tramway on the forward slopes of the High Wood ridge running towards Eaucourt l'Abbaye, all of which was under direct observation of the enemy. The guns were thus

enabled to advance on the evening of the 15th to positions just behind the captured High Wood ridge and the advanced infantry were able throughout to receive rations, water, ammunition, etc., and to evacuate wounded. The communications of the flanking divisions were not similarly developed. The success obtained by the 50th Division in these attacks was recognized by a congratulatory wire from the III. Corps, in which the work of the engineers received special commendation.

The actual work carried out by the 7th Company during this period was as follows :—

1st to 6th September. Making a double-company strong-point for all-round defence in Mametz Wood. This work was of cruciform pattern, containing revetted shell slits (each with two entrances), to accommodate most of the garrison and emplacements for machine-guns firing down glades cut in the wood, with all-round and flanking wire. No infantry working parties were available, the work being carried out and completed by the four sections of the Company. During this period, billets were moved from Bécourt to dugout shelters at the south-west corner of Mametz Wood.

7th to 14th September. Work in preparation for the general attack of the 4th Army, namely :—large, mined dugouts for brigade and, later, division battle headquarters in a quarry near Bazentin-le-Petit (completed by continuous day and night shifts) ; protected shelters for dressing stations in the same quarry ; splinterproofs in forward saps ; a regimental aid post in Jutland Street C.T. ; steel sector dugouts for a brigade headquarters ; bomb and ration stores at the south corner of Bazentin-le-Petit Wood ; road work.

15th to 20th September. On the 15th the general attack took place, zero hour being 5 a.m.

Rapid road construction. The whole Company, with two platoons of the 7th D.L.I. Pioneers, left camp at 5.30 a.m., with orders to repair the road up to and through Bazentin-le-Petit village (1 mile), then a mass of débris and large shell holes, and thence to re-make the old French third-class road leading to the west corner of High Wood (1½ m.). As the ground was entirely shell-torn, it was necessary to dig throughout to find traces of this road, which had formerly consisted of six inches of chalk, with little or no metal.

Work was commenced at 6.30 a.m., and by 1 p.m. the road was completed as far as the cross-roads north of the village (1 m.), the ruined houses giving a plentiful supply of brick for filling in the shell holes. During this time the village was shelled intermittently. The parties were rested and fed from 1 to 2 p.m., when work on the second road sector was commenced and carried on till 6 p.m., by which time 570 yards had been opened up (with much digging) and 300 yards had been completed, with shell holes bricked. Six (specially boxed) trestle and G.S. wagons were used for the work. During this time

the enemy still held High Wood, but was too closely engaged to pay much attention to the working parties. The work was intermittently shelled with remarkably poor 4·2-in. shell and only four casualties resulted, although the wagons had to gallop through the northern corner of the village in order to avoid shells bursting at regular intervals at this point. Fortunately the intervals were so regular that it was possible by careful timing to ensure a clear passage. One officer, sitting on a wheelbarrow, was blown head over heels off his perch without, however, suffering anything worse than a nasty shock. During this work the British tanks were seen in action for the first time, but they had little chance in High Wood, where two were " bellied " on the shell-torn tree stumps.

At 6 p.m. the 1st Northumbrian Field Company took over the work till 6 a.m. on the following day (16th), when the 2nd Northumbrian Field Company followed till 6 p.m., being succeeded in turn by the well-rested 7th Company till 6 a.m. on the 17th. By this time the road was virtually complete as far as High Wood (captured on the 15th/16th) and had been extensively used on the 16th by the 50th Division artillery moving up in close support to fresh positions. The 18th and 19th were spent in widening the road and its cuttings to take two-way traffic more readily and in adding brick and metal throughout. The weather was wet and the thin chalk soling (invaluable during the first 48 hours of the battle) soon started to give out. The C.R.E. had arranged for large quantities of metal and its carriage to the site of the work in D.A.C. wagons. The whole length to High Wood was heavily metalled by the 20th, by which time forward dumps of all sorts were formed on the near side of the High Wood ridge.

21st to 30th September. On the night of the 21st/22nd, three sections of the Company, with one platoon of the 7th D.L.I. Pioneers, constructed and completed a large strong-point (Vaux Post), 400 yards north of High Wood and clear of any marked features. This " post " was designed for all-round defence by a garrison up to one company, with revetted shell slits, open machine-gun emplacements, and 450 yards of double French wire and double barbed wire apron (150 coils barbed wire used). Special measures were taken to secure its concealment from enemy aeroplanes. It was only to be garrisoned on counter-attack developing. It was sited in conjunction with two similar works on the 50th Division's frontage, the important High Wood position being thus effectively consolidated some 800 yards behind the advanced infantry, who had hastily dug themselves in stage by stage as they advanced. Only a few casualties occurred in the construction of these posts.

Forward tramline construction. On the night of the 21st a reconnaissance was made for a 60-cm. steel tramline to run down the forward slopes of the High Wood ridge in the direction of Eaucourt

l'Abbaye, to connect the newly-constructed road with the advanced infantry. The construction, maintenance and control of this line now became the Company's chief work and is interesting both from a tactical and a works point of view.

Traversing ground in direct view of the enemy, its construction was only feasible at night, though small maintenance parties worked by day. The ground was thoroughly shell-torn and the work of lay-out and levelling, the accuracy of which was important to allow of immediate use and of subsequent tractor draught, was necessarily rough and ready—bayonets in shell holes by eye and at night being the substitute for a line of levels! The enemy whizz-banged the work at intervals but only occasionally checked it. Work commenced on the night 22nd/23rd (7 p.m. to 5 a.m.), a company of the 7th D.L.I. Pioneers working with three sections of the 7th Company. Records of this night's work show 700 yards taped, 350 yards formation prepared, 150 yards rail laid, further 150 yards rail carried to site. Casualties, 1 N.C.O. killed and 3 men wounded.

By the 28th September 1,400 yards of line were completed and in full use for hand-pushed tracks as far as Prue Trench. During its construction the line was used by the infantry for bringing up rations, ammunition, etc., and it also served as an easy track through the wilderness of shell holes, disused trenches, wire, etc. This greatly impeded the work, but its value to the infantry as a track was so evident that its use as such was permitted. It necessitated trench-boarding throughout at an early stage. Had this difficulty been foreseen, the simultaneous construction of a trench-board track some distance from the tramline would have been advisable. By the 2nd October, when the 50th Division was relieved by the 47th Division, the line had been extended beyond Prue Trench to its next (and final) objective, a point on the Martinpuich–Eaucourt l'Abbaye road, 2,400 yards from its starting point, the last 1,000 yards having been swung round roughly parallel to the outpost system, thus affording convenient dumping points a few hundred yards in rear of that system.

The work naturally attracted a good deal of attention from the enemy and the casualties incurred in its construction were considerable. Thus on the 25th the daylight maintenance party lost by shell fire: engineers, 2 wounded; infantry, 1 killed, 5 wounded; and on the night of the 30th by rifle and shrapnel fire: engineers, 2 wounded; infantry, 2 killed, 5 wounded. But in a military sense the casualties incurred were not heavy in view of the essential nature of the work, without which the advanced infantry could only with great difficulty have held their hardly-won positions.

Serjt. Collins, D.C.M., No. 2 Section, was severely wounded on this work on the 30th by a bullet in the abdomen. His strong and cheerful personality, devotion to duty, to sports and to all that affected

the welfare of his section and the Company made his loss greatly felt. He had come out with the Company in August, 1914, and throughout these two years had shown unfailing cheerfulness and marked courage.

The total 7th Company casualties during the operations 15th September to 2nd October were 29, viz.: 1 officer and 16 O.R. gassed, 12 O.R. wounded. The gas casualties occurred on the 11th September during the preparatory phase, when 2nd-Lieut. Wade and No. 2 Section were attempting to proceed along a narrow and congested C.T., then being heavily shelled. Some of the shell contained phosgene gas, whose presence was not at once detected and gas helmets were not put on till sickness occurred. 2nd-Lieut. Wade, 2 N.C.O.s and 14 men thus became casualties, but most were soon back at duty. The infantry also failed to recognize the presence of gas and suffered correspondingly. After this first experience of gas shell early adjustment of helmets became customary.

SPECIAL WORK ON III. CORPS LIGHT RAILWAYS IN THE SOMME AREA (17TH OCTOBER, 1916, TO 29TH JANUARY, 1917).

Map VI.

On the Division being relieved early in October the 7th Company was retained to work on the forward 60-cm. tramlines or "light railways," whose rearward extension to meet the heavy-gauge line south of Bazentin village was undertaken together with the construction of a number of branch lines for artillery service. Similar lines were now in hand by the other divisions of the III. Corps.

The appalling state of the roads caused by the immense concentration of troops in what had been a comparatively roadless agricultural district, and the enormous mass of artillery which had to be supplied with ammunition and food, rendered the problem of supply very difficult and critical. Add to this the continual rains which converted the roads into streams of liquid chalk and it will be realized that the only solution to the problem, if the offensive was to be continued, was the rapid development of a network of light railways under corps control, with a proper movement control staff and operating and maintenance personnel.

On the 17th October the 7th Company was detailed "to maintain, extend and control all III. Corps tramways."

The receipt of the following letter from the C.R.E., dated 19th October, 1916, was very gratifying to the Company. (At this time it appeared that the Company might be leaving for good the 50th Division, with which it had served since June, 1915.)

"O.C. 7th Field Company R.E.

"Now that the 7th Field Company R.E. is shortly leaving this Division, I wish to take the opportunity of bidding farewell to the

Company and of thanking all ranks most heartily for the manner in which they have worked under my command during the past 15 months.

"During this period the Company has constantly earned ungrudging praise from the G.O.C. Division and from the G.O.C. Brigade to which it has been attached. The work of the Company has always been carried out with cheerfulness and efficiency during often very difficult times, more especially in the spring of this year and during the recent fighting here. . . . No task has been too hard, nor have difficulties ever been raised. . . . I am proud to have a Company with such a record under my command and now I can only deplore the fact that for the good of the service it has been found necessary to take you away to other work, and to most heartily congratulate you on being selected out of the field companies of four divisions for this special work. . . . Will you please pass on to all your officers and to all ranks of the Company my warmest thanks for the past and my good wishes for the future, with the hope that you may soon return to the 50th Division.

(*Signed*) C. W. SINGER, Lieut.-Colonel, R.E.,
19.10.16. C.R.E. 50th Division."

The employment of a field company on work of this nature was somewhat unusual.

A permanent working party, 1,450 strong, was attached to the Company, with 5 officers selected on account of previous railway experience.

This party was known as 7th Company B Échelon and consisted of 4 platoons of pioneers, 4 platoons of infantry and 50 gunners furnished from each unit of each division of the III. Corps—a somewhat heterogeneous crowd at the start. They, however, soon settled down to a most efficient body and relations with the sappers were most cordial. The work consisted of extending the tramways as far forward as possible and rearwards to join up with railhead.

The tramlines joined up with the broad-gauge railheads at Bazentin (Langland Circus) and Peake Wood.

The main lines were (1) Bazentin–High Wood–Eaucourt l'Abbaye, with a branch to Turks Road and Factory Corner, and (2) Peake Wood–Martinpuich with two forward branches. By the end of December the total mileage was 24.

The work was interesting, regular and, at times, sufficiently exciting, as the main lines went over a ridge in full view of the enemy and down a long forward slope.

In order to obtain the maximum output from the system, regular train services were run, with petrol tractors to draw the loads as far as the enemy would permit. The working of these time-tables and control of the rolling stock were in the hands of traffic officers

attached to the Company, and living in dugouts at High Wood, Peake Wood and Villa Station. Maintenance parties for repairing breaks in the line, which averaged three or four a day, had to be maintained along the line, in addition to the regular maintenance gangs employed on ballasting and extending the lines.

One very serious trouble was caused by the use of the track by all and sundry as a road. The spaces between sleepers were at times almost knee-deep in mud.

As there was no other way up to the front the trouble could not be prevented, so had to be cured. This was done by Capt. Glubb's idea of putting down poling boards or rough planks between the rails.

On one occasion about 27 mules of a string of 100 belonging to Canadian gunners were killed alongside the line at the top of the ridge above Martinpuich. As no one would bury them they became somewhat embarrassing, and the assistance of a very high authority had to be obtained to get them removed.

On the right sector the line in front of High Wood was worked by pushing, as it was not fit for tractors and was in full view of the enemy, who frequently shelled it. On the left sector, engines ran fairly regularly to Gunpit Road and Martinpuich Station, but, in clear weather, trains could not cross the ridge owing to sniping by whizz-bangs. The part forward of Gunpit Road was so exposed that the infantry preferred to carry stores up the Bapaume Road. The enemy used to fire m.g. bursts along it at night. Nevertheless, it was ballasted throughout by Littlewood and No. 2 Section working by night.

The camp with its workshops, sidings on the main line, etc., and the presence of a 12-in. gun on a railway spur attracted unwelcome attention at times from a 13·5-in. gun. The first visitation of a shell from this gun completely destroyed the Company incinerator, together with two men working at it. It was thought at the time that the incinerator was placed on a " dud " shell as this particular gun could not be heard. The incinerator and men simply disappeared. When, however, another shell arrived on the Company " parade ground," making a large crater and covering the huts with enormous clods of frozen earth, the truth was realized.

2nd-Lieut. C. W. S. Littlewood joined the Company in October. The Company mess at that time was in an old gun pit, just in front of rows of all kinds of guns, and his entrance to the mess was marked by a salvo of 60 pdrs., which literally nearly lifted the roof off the mess.

ALBERT—RETURN TO THE 50TH DIVISION (30TH JANUARY TO 9TH FEBRUARY).

Adjustments of frontages allotted to Corps resulted in the Company, with its " B Échelon," being withdrawn on the 29th January

to Albert (6 m.), where ten days were spent in route marching, drills, general overhaul and brushing up after the many months the sections had been more or less scattered over a wide area. A successful Company smoking concert was one feature of the stay at Albert; another was the enemy's night bombing, which now became a serious nuisance.

On the 3rd February orders were received to proceed with B Échelon to near Chuignes and to take over on the 8th all the 60-cm. railways in the hands of the French corps immediately south of the River Somme. The operation of taking over 20 miles of light railway from the French light railway companies, and readjusting their organization, etc., to suit ours, proved interesting in many ways and afforded opportunity for some exchange of hospitality with the French engineers.

On the 10th February, however, orders were received to march to Méricourt-sur-Somme, a few miles to the west. At the same time the III. Corps arranged to furnish to the A.D. Transportation the nucleus of a III. Corps "Foreways Company," to consist of 1 operating company and 2 construction companies. The officers and men of B Échelon were used for this purpose and the 7th Company rejoined the 50th Division. The question had been earlier mooted of using the 7th Company to form part of this nucleus, but it was at once recognized that the Company's whole history, tradition, training and experience demanded its preservation as a Field Company.

FOUCAUCOURT (14TH FEBRUARY TO 5TH MARCH).

Leaving Méricourt on the 14th February the Company marched into hutments at Foucaucourt (6 m.). The 50th Division remained in this sector until the 5th of March, during which period the Company was mainly employed on "back works," namely, hutting, bunking large French huts to take 120 men in each, dugouts, stabling, divisional baths, etc. The Company, having been continuously in the line since the previous September (five months), enjoyed the change of work and scene and the return to more normal duties with its division.

CHAPTER VI.

THE BATTLE OF ARRAS—THE THIRD BATTLE OF YPRES, AND AFTER (MARCH, 1917, TO MARCH, 1918).

MORCOURT-SUR-SOMME (6TH TO 20TH MARCH, 1918).

Maps II and VII.

General situation. During February the enemy, anticipating a renewal of the British and French offensives, and anxious to shorten his line, carried out a planned retirement to the strongly fortified

Hindenburg Line, completely destroying behind him bridges, railways, wells, dumps, etc., and adding formidable obstacles in the form of craters up to 30 feet depth at cross-roads. Under these circumstances the British divisions, some of which were newly formed and but recently arrived from England, were only able to follow up the retirement slowly and with difficulty. Early in March an interesting 50th Division staff ride was conducted through Génermont–St. Christ–Tertry, *i.e.*, across the evacuated area, from which it was seen that the rate of " pursuit " must have mainly depended on the rate at which the formidable physical obstacles (including long stretches of shell-torn and bottomless roads) were overcome by the engineers and other labour.

It therefore became the aim of future allied attacks to shake clear from the start, if possible, of any such accumulation of obstacles, and this involved effecting rapid break-through and exploitation of any success gained. The XVIII. Corps was formed, under Lieut.-General Sir I. Maxse, to carry out the role of pursuit during the coming operations, if opportunity offered. The 50th Division was selected to form part of that Corps and its units were instructed to carry out intensive training for open warfare.

Training for open warfare. The 7th Company now spent three weeks in billets in the village of Morcourt-sur-Somme, whose neighbourhood was well suited for training purposes. After an autumn and winter spent in the line on work outside the normal scope of a field company and having by now in its ranks a high proportion of officers and men but little experienced in open warfare, these three weeks afforded a splendid opportunity for the Company to regain its former field efficiency and to prepare for the variety of work and experience likely to fall to its lot in the coming offensive. By the end of the month the Company was in excellent form.

ON THE MARCH TO ARRAS (30TH MARCH TO 12TH APRIL).

Map II.

Leaving Morcourt on the 30th March the Company marched to Arras on the 11th April, stages being La Vicogne (22 m. bus and march), Gézaincourt (8 m.), Ligny-sur-Canche (12 m.), Guinecourt (8 m.), 4th to 6th April *via* St. Pol to Averdoingt (13 m.), Ambrines (4 m.), 8th to 9th (Agnez-lez-Duisans (11 m.), 10th to 11th Arras (6 m.).

The Company was inspected on the march at Beauval by the XVIII. Corps Commander.

On the 7th April, as the Company passed through St. Pol (headquarters 3rd Army), its marching was noticed by the B.G.G.S. 3rd Army, who took occasion to compliment it warmly through headquarters 50th Division as " the best marching unit in the 3rd Army,"

much to the appreciation of the Company, which, during its recent training, had taken march discipline seriously.

The weather at this time was very severe, as the following extract from my diary shows:—

"April 11th. Stood by all day to move. Orders at 4.10 p.m. to move at 5 p.m. I had to push off right away as billeting officer. Company moved at 5 p.m., but when they had got a mile were sent back and the march postponed two hours. Frightful blizzard—waited outside dugout in snow for two hours while staff captain got billets. He had no billets for us, so I had to ring up C.R.E., who could only give us a field. As you couldn't see your hand in front of your face, I decided, on advice of 61st Company, to billet in Arras. Met Company about 1 a.m. and settled down in Arras. The snow has almost ruined the Push. . . . It was real war last night in the snow!"

THE BATTLE OF ARRAS (13TH TO 26TH APRIL) AND AFTER (27TH APRIL TO 23RD MAY).

Map VII.

General situation. The opening phase of the battle of Arras (9th to 12th April) had resulted in the penetration of the enemy's strongly fortified positions immediately east of Arras, on a front of about 10 miles and to a depth of about 5 miles. No "break-through" was, however, secured and the divisions comprising the XVIII. Corps were used to reinforce the attacking Corps, a second general attack being launched on the 14th April. One function of the British operations was to attract German reserves away from the French attacks on the Aisne and the Chemin des Dames. It was believed that this result had already been largely obtained, and that the German army east of Arras had been heavily reinforced. But hope of a break-through had not yet been abandoned and preparations were made to follow up rapidly and exploit any success gained.

The C.R.E. 50th Division (Lieut.-Colonel W. Rathbone, D.S.O., *vice* Lieut.-Colonel C. W. Singer, C.M.G., D.S.O., appointed C.E. XV. Corps) held a conference of field company and pioneer battalion commanders at Arras on the 12th April, when the position was outlined and instructions issued regarding works to be undertaken during the coming fighting. The 50th Division was to attack on a single brigade frontage, the 151st Brigade leading. The 7th Company was detailed as the forward field company, and was to receive orders for work direct from the C.R.E., but keeping in close touch with the leading brigade (whichever that might be from time to time) and meeting its special tactical requirements as they might arise—at the expense, if necessary, of other work in hand.

This arrangement worked admirably. The 7th Company remained the forward company throughout the operations (13th to 28th April)

and was able, over and above much divisional work, to meet the tactical needs of the successive brigades (151st, 149th, 150th). These latter included:—151st Brigade (13th and 14th April): clearance of roads through Wancourt, 2½ sections being so employed from 8 p.m., 13th, to 8.30 a.m., 14th. By 4 a.m. heavy tree blocks and the débris of fallen houses had been cleared and shell holes filled with brick to allow of passage of guns and limbers through the village to advanced positions east of the small Cojeul river. The village and approaches were considerably shelled during the work and a few casualties were incurred. 149th Brigade (16th to 17th April): a massive concrete machine-gun nest immediately north of Wancourt Tower, which it was anticipated the enemy would endeavour to recapture, was destroyed on 16th April by 2nd-Lieut. Littlewood, using 70 lb. of guncotton. The value of this work was demonstrated when the enemy recaptured the hill and was easily driven off again.

150*th Brigade. Rapid construction of a H.Q. deep dugout.*

On the afternoon of 19th the Company received orders to construct battle H.Q. for two battalions and cover for a regimental aid post in a bank on the slope east of Wancourt, to be ready for occupation by the 23rd and to be used subsequently as brigade headquarters.

The site was under direct view from Guémappe, 1,600 yards away. It was considered essential to make a deep dugout, but, as the time was very short, a very special effort was required to complete the work.

Large carrying parties for mining setts and for removal of spoil were required and all this had to be done at night. It was calculated that, by using day and night shifts and employing carrying parties (there were 450 man-loads of timber alone), a dugout, 30 ft. x 10 ft. x 6 ft., with two entrances 20 ft. apart, could be made in the time available. The soil was rather loose and treacherous chalk. Work was commenced on night 20th/21st, carried on throughout the 21st, and completed by 10 p.m. on the 22nd. The dugout was occupied the same night. Two cut-and-cover dugouts for orderlies (12 ft. x 6 ft.) and two for R.A.P.s were also constructed in the bank.

As the working party on the latter was leaving at 4 a.m. on the 22nd, a heavy shell burst on the party, causing 16 casualties, including 2nd-Lieut. R. E. E. Chaplin, Lce.-Cpl. W. Nunn and 7 sappers killed and 8 sappers wounded, all No. 1 Section.

On the conclusion of these operations the commanders of each brigade wrote, expressing appreciation of the Company's work and asking that the Company be informed.

During the same period (13th to 25th) the Company also carried out the following works under the divisional programme, namely:—

(1) Clearing routes through Wancourt. After the 13th the 7th D.L.I. Pioneers took over this work. The heavy shelling of the village necessitated permanent clearing gangs.

(2) Maintenance and timbering-up of the existing brick bridge over the River Cojeul immediately east of Wancourt. As this bridge was under direct view and machine-gun fire from Guémappe (800 yards distant), it was only feasible before the 23rd to collect materials in Wancourt and to arrange for work to commence on the day of attack. The work was then completed by one section in nine hours and was carried out under occasional machine-gun fire and a steady light shell fire. Gas masks had to be worn intermittently. Although the bridge was twice hit by shells during the work, only two casualties occurred. Certain batteries galloped across the bridge later in the afternoon to take up positions on the slopes to the east, but were shortly withdrawn owing to the enemy's barrage, which included heavy shell, being maintained on the line of the River Cojeul.

(3) Making two routes with light infantry footbridges across the valley and the River Cojeul. This was carried out by 2nd-Lieut. Littlewood on the nights 16th/17th and 17th/18th. An attempt made on the 15th/16th was stopped by enemy's shell fire.

(4) Clearing damaged cellars and German dugouts in Wancourt to accommodate a reserve battalion, reclaiming seven wells and repairing pumps. Work on the cellars and dugouts was slow for three days, as entrances were blown in or buried at a rate almost equal to that of repair. Owing to the snow and bad weather, importance was attached by the division to the preparation of advanced accommodation for reserves as the attack progressed. Cut and cover shelters were also made for two companies of reserves in a bank site immediately west of Wancourt. Curved steel sections on sandbag revetments were used.

(5) Making an alternative bridge with approaches, to carry heaviest field loads including tanks, immediately north of Wancourt brick bridge. Here again work could not be started prior to the attack on the 23rd, for similar reasons, beyond collecting and marking down material in the vicinity.

The major part of the heavy timbers and rolled steel joists (24 ft. x 8 in. x 3 in.) for the two heavy bridges entailed (one of 22-ft. span and one of 15-ft. span—R.S. joists on crib piers with 3-in. decking) were obtained from the German dump on the River Cojeul, 500 yards distant. Work was commenced at 6.30 a.m. on the 23rd by No. 4 Section, under 2nd-Lieut. Slattery, with the remnants of No. 1 Section, under Serjt. Wadkinson, together with a weak platoon (1 officer and 28 men) of the 8th D.L.I. as carrying party. The selection and carrying of material were supervised by 2nd-Lieut. Baker. As the dump was consistently shelled with heavy shell all the morning the operation demanded of the carrying party good discipline and determination.

It was necessary to wear gas masks for some hours, which impeded progress. At 1 p.m. the work was suspended by the O.C., owing

to the barrage on the Cojeul increasing in density, the work receiving two direct hits from medium shell which caused five casualties. Guémappe, 800 yards distant, changed hands twice during the day and was finally captured in the early afternoon. The bridging operation was subjected to occasional bursts of machine-gun fire from this village. About 4 p.m. the enemy's fire slackened and work was resumed till 6 p.m. 2nd-Lieut. Baker was wounded by a shell splinter during the afternoon in Wancourt village, whilst endeavouring to mark the progress of the attack.

The work was renewed at 6.30 a.m. on the 24th and the bridge completed for temporary use by 4.30 p.m., the 120 yards of approaches being then at formation level.

On the 25th all three sections, together with one company 7th D.L.I., completed by 1 p.m. the 120 yards of corduroy roadwork required, together with the drains and brick metalling. The Company marched back in the afternoon to Arras (7 m.), after 13 days' severe work.

As a result of the attacks of the 14th and 23rd April the enemy was pushed back two miles, from the River Cojeul to the River Sensée. Heavy German reinforcements prevented any breakthrough being effected and the German line was generally stabilized by the end of the month.

Throughout these operations Company headquarters and two sections bivouacked in a sunken road, one mile west of Wancourt, convenient to the advanced brigade headquarters, with two sections in concreted cellars vacated by the enemy in Wancourt. Owing to snow followed by rain the conditions in bivouac were very rough. Wancourt was consistently shelled but the good concrete cellars were tolerably secure and few casualties were suffered by the sections in the village.

Total casualties between the 13th and 26th amounted to 30, namely, 1 officer (2nd-Lieut. Chaplin), 1 N.C.O., 6 sappers killed; 1 officer (2nd-Lieut. Baker), 14 sappers wounded, 2 sappers gassed.

The following immediate awards were received:—Military Cross —2nd-Lieut. H. A. Baker, 2nd-Lieut. C. W. S. Littlewood; Military Medal—Serjt. J. Farrer, Lce.-Cpl. R. Cutts, Sappers A. Southern and J. Edwardes.

On the 27th the Company marched to Humbercourt, a pleasantly situated village on the River Grouches, and rested there until the afternoon of the 1st May, when it moved forward again with the 151st Brigade group to Pommier (8 m.).

Establishing advanced divisional H.Q. At 6 p.m., 1st May, orders were received from the C.R.E. to have a camp (1 marquee, 2 Armstrong huts, 16 Allen canvas shelter huts, 8 tents with cookhouses, etc.) established by 4 p.m. the following day, immediately west of

Neuville Vitasse, 13 miles distant, for occupation by divisional H.Q. and Signals Section.

Marching at 7 a.m. on the 2nd May the Company reached the camp site by 11 a.m. Meanwhile, hutting material had been fetched in lorries from a corps dump. All material had to be carried by hand 300 yards, pending completion of an approach track with culvert. Work, commenced at noon, was sufficiently completed by 5 p.m. to allow of occupation by D.H.Q., etc. The whole job was not finished till 10 p.m., when the sappers had a meal and turned in after a very strenuous day.

The Division had been moved up in support of the general attack of the 3rd, 1st and 5th Armies about to commence, and the rapid accommodation of D.H.Q. was, therefore, important. The G.O.C. 50th Division (Major-General Sir P. Wilkinson) expressed appreciation the same evening of the Company's effort, and the following letter was sent to the C.R.E. :—

> "The G.O.C. wishes to place on record his appreciation of the work carried out by the 7th Field Company R.E. during the period 12th to 26th April, and the manner in which they established advanced divisional headquarters at a few hours' notice. Their work throughout has been excellent.
>
> (*Signed*) H. KARSLAKE, Lieut.-Colonel,
> 4th May, 1917. G.S. 50th Division."

The general attack of the armies on the 3rd May did not achieve extensive results and the Division returned to its rest area, the Company being again located at Humbercourt from the 8th to 17th May. Useful training, including bridging, at Lucheux was carried out and again at Monchy-au-Bois, where the Company bivouacked from the 18th to 22nd May.

On the 23rd the Company marched to Gombremetz and on the 24th to Souastre, remaining there in billets till the 15th June.

2nd-Lieut. H. A. Baker, M.C., rejoined the Company at Souastre. Other reinforcements received included 2nd-Lieut. H. G. Pottle, R.E., and 2nd-Lieut. W. H. Rebbeck, R.E.

On 21st April, A./Serjt. F. Parker, D.C.M., was appointed A./C.S.M. He came out with the Company in 1914 as a sapper and did much excellent work, serving continuously until he was killed in May, 1918.

SOUASTRE (24TH MAY TO 14TH JUNE).

This period was devoted to training, repairing various billets, baths, wells, etc., and to constructing a 12-target 500-yards rifle range near Coigneux. The latter job was of some magnitude and included the making of 12 6-ft. revolving target frames, 48 6-ft. targets, some 50 yards of 8-ft. shelter trench in which the targets were operated, together with the preparation of 5 firing points.

Commenced on the 1st June, it was completed on the 3rd June, and in use on the 4th. At this time the importance of musketry training for the infantry was again being stressed. The 7th Company itself fired a course on this range.

Very successful mounted sports were held whilst at Souastre, including that always popular event "wrestling on horseback." This provided an opportunity for much friendly rivalry and proved a very pleasant day's relaxation.

EAST OF ARRAS (15TH JUNE TO 4TH OCTOBER, 1917).

Map VII.

On the 15th June the Company marched with 151st Brigade group *via* Adinfer to St. Martin-sur-Cojeul (17 miles) in relief of the 18th Division. This march took place in great heat, many units being severely affected. Only one man of the Company had to be fallen out.

The sector taken over ran from the River Cojeul, north of Vis-en-Artois, to Fontaine-lez-Croisilles on the River Sensée, and had been the scene of the Division's fighting east of Arras in April.

As this ground had only been captured two months previously a great deal of work remained to be done, and, the soil being very friable, revetment of trenches throughout was necessary. Revetment with steel post and expanded metal, with wooden "spreaders" (to keep the feet of the steel stakes in position and to act as transoms for trench-boards), was now becoming a favoured method. With proper organization, many hundred yards could be revetted in this way daily and the Company soon began to obtain good results, a section carrying out from 70 to 110 yards daily, according to the amount of trench widening and deepening involved.

The employment by the enemy of instantaneous fuzes and the excellence of their 5·9-in. and heavier calibre shells at this period, together with their great accuracy of fire, resulted in the need for alternative artillery positions and the construction of good deep dugouts for artillery as well as for important headquarters. Engineer assistance was, therefore, afforded to the artillery in greater measure than formerly.

During the 3½ months the Company was in this sector, headquarters and all four sections were in dugout shelters near St. Martin-sur-Cojeul, two sections being employed in the forward zone and two sections on the divisional reserve lines and back work (baths, gas, protection of the Hindenburg Line tunnel, hutting, etc.).

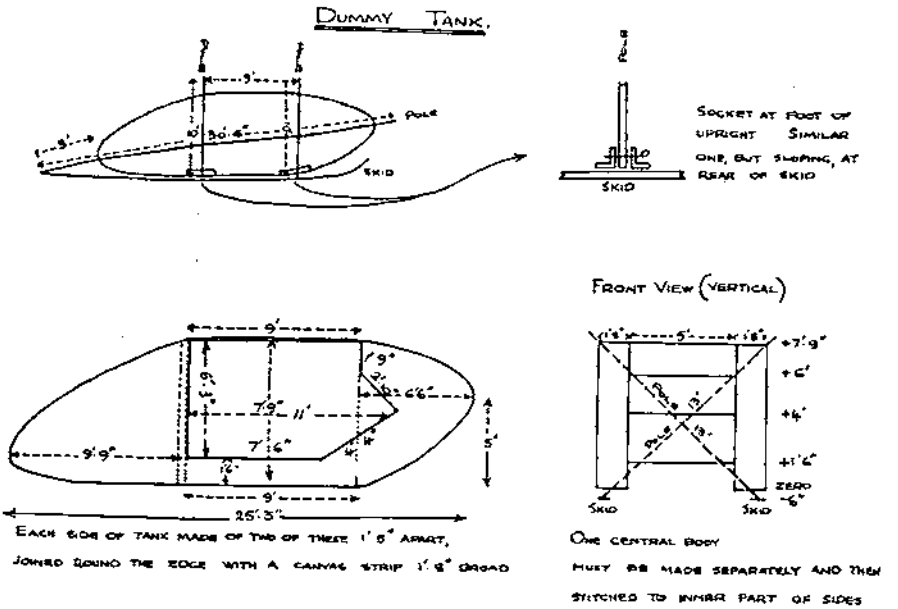
On the night of the 10th July, 2nd-Lieut. C. W. S. Littlewood, M.C. (No. 3 Section), was killed by a direct hit from a field gun shell. The loss of this gallant and efficient officer was much deplored.

During August the O.C. acted as C.R.E., Capt. J. B. Glubb acting as O.C. Capt. Glubb was severely wounded by a shell on the night

of the 1st September, when with the transport taking material up to a forward dump ; 2nd-Lieut. H. A. Baker, M.C., became A./Captain in his place.

Total casualties during this period amounted to 1 officer killed, 1 officer and 8 other ranks wounded.

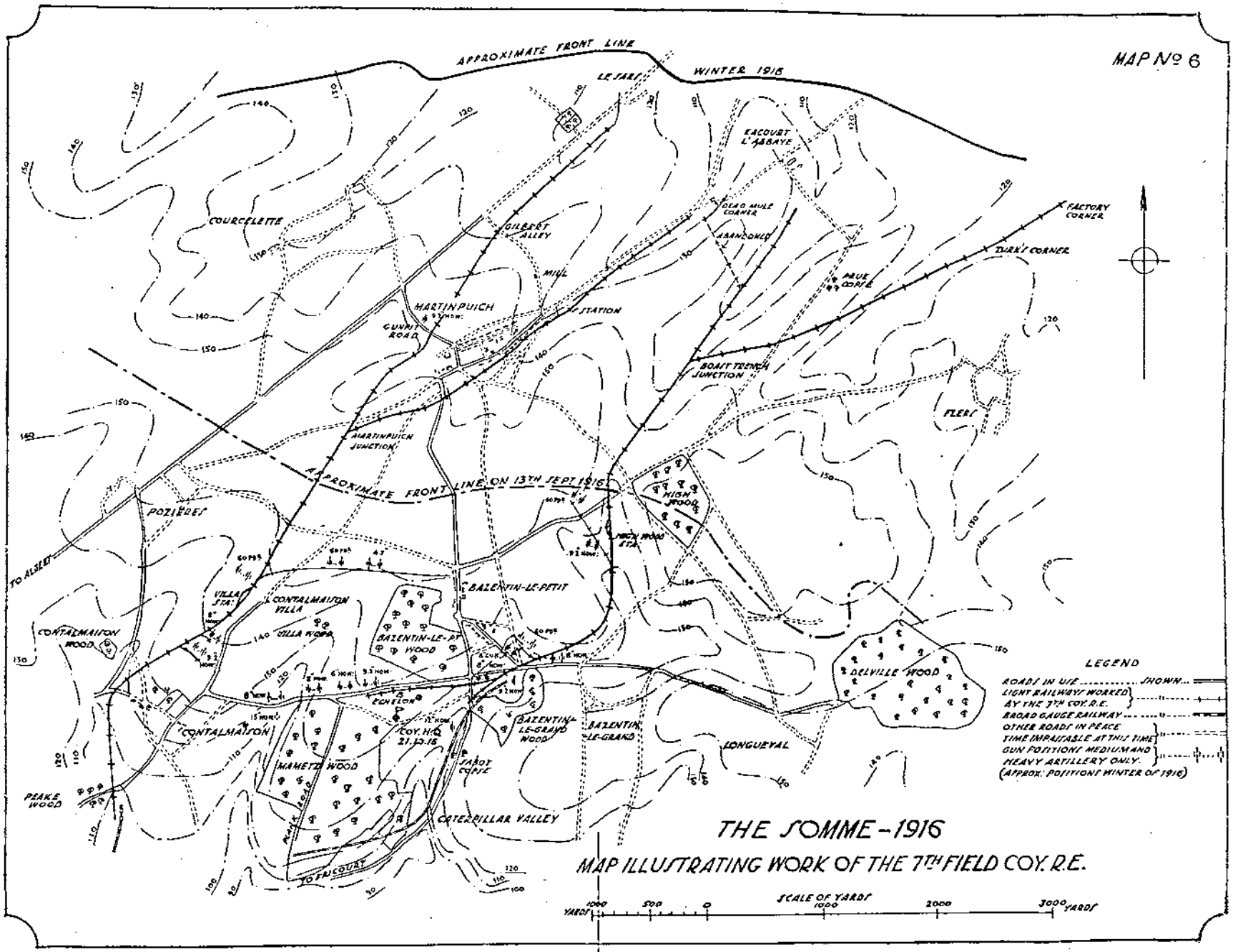
A notable occurrence during this period was an extensive and carefully planned raid carried out by the 50th Division on the 15th September, on a frontage of about 1,200 yards in the neighbourhood of Fontaine-lez-Croisilles and to a depth of about 600 yards. Massed artillery barrages rapidly crossed this area and then enclosed it on two sides—thermit shell being plentifully used. A barrage of massed



machine-guns enclosed the third side, whilst three companies of the 9th D.L.I. attacked, accompanied by small engineer demolition parties (furnished by the 7th Company) whose special function it was to destroy eleven important deep dugouts, (headquarters, etc.) whose exact position had been located from aeroplane photographs. Two dummy tanks and a large number of dummy figures exposed to a flank of the frontage attacked served to disperse the enemy's retaliation.

A replica of the working drawing for the dummy tank is shown.

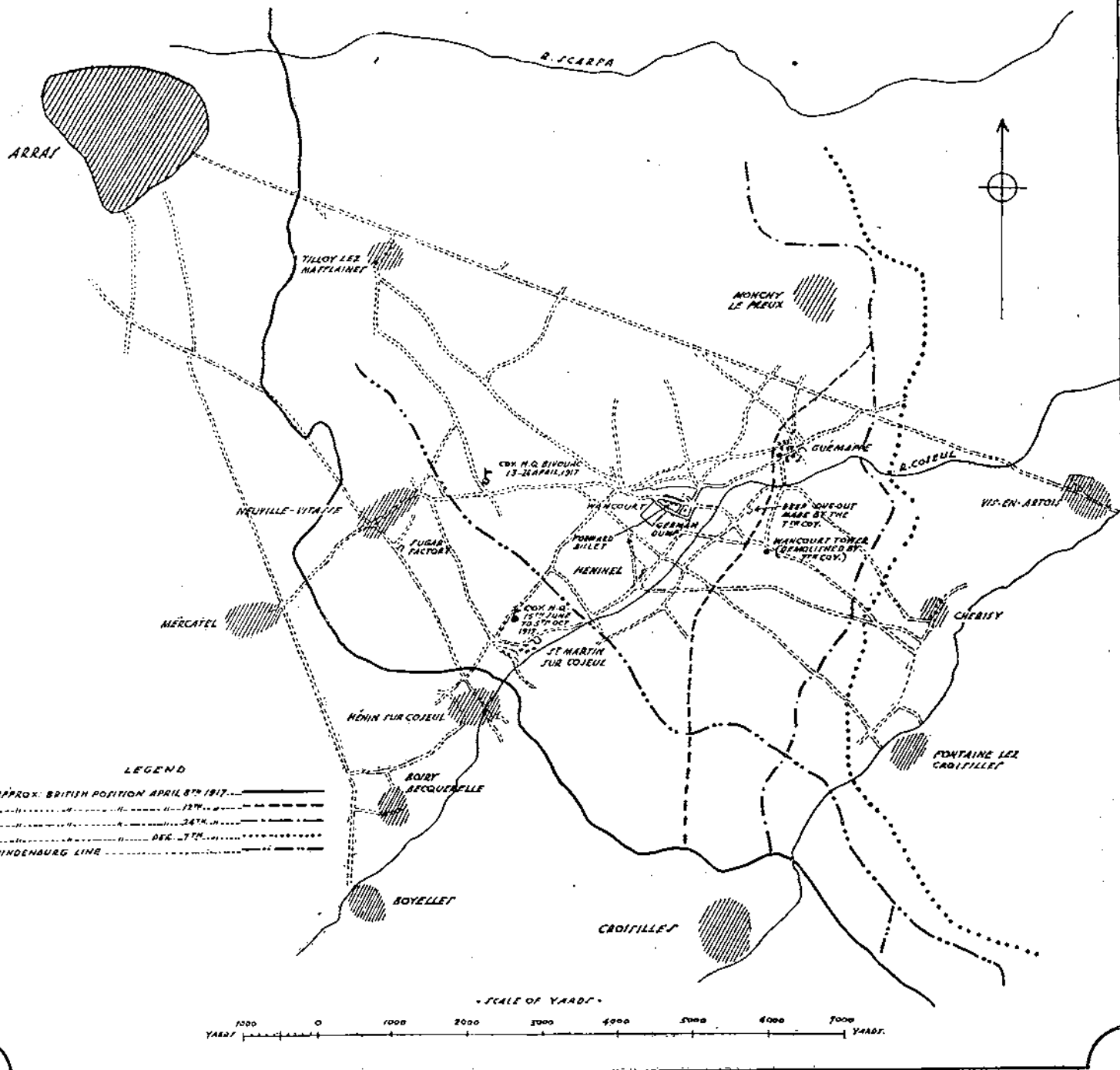
The storm burst at 4 p.m. on a fine afternoon when "the line" was very quiet. The operation was completely successful; the enemy suffered heavy casualties, all dugouts being dealt with by means of heavy Stokes bombs with 4-in. time fuzes, thrown by sappers down the entrances, followed by G.C. charges being exploded


MAP No 6
APPROXIMATE FRONT LINE WINTER 1916
LE SARS
COURCELETTE
GILBERT ALLEY
MILL
MARTINPUICH
GUNPIT ROAD
STATION
MARTINPUICH JUNCTION
APPROXIMATE FRONT LINE ON 13TH SEPT 1916
POZIERES
TO ALBERT
CONTALMAISON WOOD
CONTALMAISON VILLA
VILLA WOOD
BAZENTIN-LE-PETIT
BAZENTIN-LE-PT WOOD
ECHELON
CONTALMAISON
COY. H.Q. 21.12.16
MAMETZ WOOD
MAMETZ ROAD
PEAKE WOOD
CATERPILLAR VALLEY
TO FRICOURT
BAZENTIN-LE-GRAND WOOD
BAZENTIN-LE-GRAND
YARDY COPSE
LONGUEVAL
DELVILLE WOOD
HIGH WOOD
FLERS
BOAST TRENCH JUNCTION
FACTORY CORNER
TURK'S CORNER
ABLE COPSE
DEAD MULE CORNER
ABANDONED
ECOUST L'ABBAYE
LEGEND
ROADS IN USE ..... SHOWN...
LIGHT RAILWAYS WORKED BY THE 7TH COY. R.E.
BROAD GAUGE RAILWAY .....
OTHER ROADS IN PEACE TIME IMPASSABLE AT THIS TIME
GUN POSITIONS MEDIUM AND HEAVY ARTILLERY ONLY. (APPROX. POSITIONS WINTER OF 1916)
THE SOMME - 1916
MAP ILLUSTRATING WORK OF THE 7TH FIELD COY. R.E.
SCALE OF YARDS
1000 YARDS 500 0 1000 2000 3000 YARDS

MAP No 7

• BATTLE OF ARRAS 1917 •

• MAP ILLUSTRATING WORK OF THE 7TH FIELD COY. R.E. APRIL–OCTOBER •



a few steps down each entrance. The spectacle was impressive, the German infantry being seen to scatter and to suffer severely in a futile attempt to escape.

No. 2 Section, under 2nd-Lieut. Rebbeck, was detailed to furnish the engineers' raiding party, which consisted of four small parties, each of 1 N.C.O. and 2 sappers. Each party had a definite set of objectives. 2nd-Lieut. Rebbeck, Corporals Matthews, McClaren, Munro, Park, with 8 sappers (selected from No. 2 Section volunteers), with a small infantry carrying party, furnished the personnel. This party spent from the 10th to the 14th living with the companies of the D.L.I. and practising the operation with them on a dummy position taped out to scale in a back area. Of the 17 G.C. charges carried, 14 were used to good effect, 13 dugout entrances were destroyed and one charge was used to cut German wire where incompletely cut by artillery. Three of the dugouts destroyed were certainly occupied at the time by the enemy, who in two instances tried to fight their way up. The N.C.O's and sappers were armed with revolvers and in these cases used them with good effect. The engineer party returned after forty minutes' brisk work and with various "souvenirs." Sappers Rogers and Harman of this party were wounded.

The O.C. 9th D.L.I. reported to the G.O.C. 151st Brigade that the engineers' task was uniformly well done, 2nd-Lieut. Rebbeck and Corporals Matthews, McClaren, Munro, Park, and Sapper Ferry receiving special mention. Rebbeck was awarded the Military Cross, Corporals Matthews, 2nd-Cpl. D. Munro, Lce.-Cpl. J. Park the Military Medal.

The work of constructing and operating the dummy tanks and figures was carried out by No. 1 Section, under Capt. Baker and Lieut. Pottle respectively. The tank was made of canvas on wooden framework to a design by Capt. Bourne, R.M.A., and was drawn over 200 yards of open ground by windlass from a camouflaged pit.

The success of the dummy tanks was proved by the fact that the German report of the raid mentions tanks as having been employed against them, and the effectiveness of the dummy figures by his erroneous report of the frontage of attack.

One object of the raid was to straighten out a portion of our front line. This was achieved, but some days afterwards the highly incensed enemy succeeded in retaking some of his lost trenches, and for weeks afterwards the "line" was very disturbed.

GOMIECOURT (5TH TO 17TH OCTOBER).

Meanwhile the British offensive in Flanders (3rd Battle of Ypres) had opened in July and was still being developed. The 50th Division was relieved by the 51st (Highland) Division on the 3rd/4th October,

the 7th Company handing over to the 400th (Highland) Field Company and marching to Gomiecourt (12 m.), where it underwent 12 days' useful training, etc., before marching to Bapaume (11 m.) for entrainment for the north.

Detraining at 8 a.m. on the 18th at Esquelbecq it marched to Crochte, on the 20th to Seinenbuck (4 m.), 21st to billets 3 m. east of Proven (16 m.), 22nd to Singapore Camp (3 m.), 23rd headquarters and two sections to Elverdinghe (dugouts near the Château) and two sections to the XIV. Corps dump at Ondank.

THE THIRD BATTLE OF YPRES (ELVERDINGHE AND BOESINGHE, 23RD OCTOBER TO 31ST DECEMBER, 1917).

Map II.

The 24th and 25th were spent in establishing a 50th Division R.E. dump with lorry approaches, etc., at Boesinghe, the work being visited by the C.E. 5th Army (Major-General P. G. Grant, C.B.).

On the 26th a general attack was delivered by the 1st French Army, 5th Army and 2nd Army. The 50th Division attacked the German defences on the south-eastern skirts of Houthulst Forest and suffered heavily from enemy machine-gun fire from numerous concrete " pill boxes " which, constructed in depth and well concealed, had escaped destruction by our artillery.

Throughout this fighting the 7th Company was employed mainly on back works and came in for little advanced work. The fighting was of a particularly trying nature as the whole flat area between the Yser Canal and Houthulst Forest, in depth four to five miles, was a mass of flooded shell holes traversed by three streams, whose crossing places were continually subject to gas-shell fire. Miles of trench-board track were required to give access to the advanced infantry entrenchments. A long period of wet weather coupled with continuous fighting had turned the whole area into a vast swampy desolation, all natural drainage being destroyed. The attacking troops fought under the most difficult and depressing conditions.

The main engineer problem, as in the Somme battle, consisted of the maintenance and extension of communications (trench-board paths on piles and trench tramways) and the provision of splinter-proof shelters. During this period the numerous hostile aeroplanes regularly and effectively bombed hutments, billets and horse-lines by night, causing much protective work to be undertaken in the way of splinterproof screens and shelters.

On the 50th Division being relieved the Company remained in this sector until the end of November, being employed mainly on the preparation of engineer stores (trench-boards, etc.), making shelters, dugouts, hutting of all sorts, stabling for artillery horses (light iron and timber roofs, with 6-ft. revetted splinterproofs between

stables). During November, 51 such stables were constructed by the Company (with the co-operation for one week of two sections of the 500th Field Company), taking in all 1,750 horses. A./Capt. Baker acted as O.C. during November, whilst the O.C. acted as C.R.E.

On the 1st December the Company proceeded from Elverdinghe to Inglinghem, rejoining the 50th Division in the Eperlecques rest area for a week's training, and returned to Elverdinghe on the 10th December.

THE YPRES SALIENT—PASSCHENDAELE SECTOR (10TH DECEMBER, 1917, TO 22ND FEBRUARY, 1918).

On the 11th December the 50th Division took over this sector of the Ypres salient from the 33rd Division. The 7th Company was located in huts on the north side of Ypres and worked on this sector for the next 2½ months.

The sector included the ruins of Passchendaele village on a ridge overlooking Roulers and formed an important salient in the British lines. As good communications did not exist within two miles of Passchendaele, their provision (trench-board tracks, tramways and plank roads) formed the first work of the Company, together with the development of organized defences in depth (" lines " of concealed strong-points with dugouts and wire), and splinterproofs for the supporting battalions of the advanced brigade. The numerous massive concrete pill-boxes captured from the enemy solved the problem of headquarters for all units. Much of the area was on rising ground, in marked contrast to the area opposite Houthulst Forest, and except for the torn and friable nature of the soil, lent itself readily to the construction of earthworks. But the ground was so shell-torn that extensive piled trench-board tracks were essential for communication.

During the first few weeks two sections were entirely employed on these tracks, an average daily progress of 240 yards of double-boarded and wire-covered track being made. Good progress was also made with the 60-cm. tramline which was carried forward to within 1,000 yards of Passchendaele. Single trench-board track reached Passchendaele by the end of December. The enemy shelled these tracks intermittently but with little effect. By January the total length of trench-board tracks and forward plank roads in the Division's area amounted to 15 miles.

With the assistance of small infantry working parties the Company constructed six strong-points (with wire, open machine-gun emplacements and shelters, each for a garrison of one platoon) forming the Haarlen Switch line. Other work included the adaptation of concrete pill-boxes for use as aid posts and dressing stations, the construction of an artillery observation post in the ruins of Passchendaele

village at a point—the highest in the salient—whence an extensive view could be obtained of the German back area and the villages of Roulers, Comines, etc., and the construction (under camouflage) of a heavy trench-mortar emplacement with concrete bed, dugouts, ammunition store, etc. Expert advice and camouflage of all kinds were forthcoming from the Corps camouflage officer.

A party of six American engineer officers spent a week with the Company in December. These officers were much impressed by the nature of the country over which the attacks of the past few months had been made, and by the extensive work required on communications in this area. They were very keen and out to learn, and their visit was much appreciated by the Company.

On the completion of the forward communications two sections were employed in constructing large strong-points (each for a garrison up to one company) on the " Army Line " in the neighbourhood of Wieltje. These were occupied as part of the front line system in March, 1918, when the Ypres Salient was greatly contracted.

Returning to this sector after ten days spent in the rest area at Eecke the Company worked much as before and between the 11th and 22nd February converted the magazine at Ypres into a protected main dressing station to take 96 cases.

Casualties on this sector amounted to four sappers wounded.

Sapper W. Abbott was awarded the Belgian Croix de Guerre.

On the 6th February Major J. A. McQueen, D.S.O., M.C., quitted the Company on appointment as C.R.E. 50th Division, *vice* Lieut.-Colonel H. Rathbone, D.S.O., invalided, A./Capt. H. A. Baker, M.C., being appointed O.C. with the acting rank of Major. 2nd-Lieut. H. A. Benson joined and was posted to No. 3 Section.

(To be continued.)

Note.—With reference to the two groups of officers and N.C.O's of the 7th Field Company, R.E., published in the June *R.E. Journal*, the missing name in the group taken at Pont de Nieppe is " Second-Lieutenant E. Bayley," and that in the group taken at Shorncliffe is " Corporal R. Mitchell."

MOGHALSERAI GOODS YARD, EAST INDIAN RAILWAY.

By CAPTAIN R. GARDINER, R.E.

ON the railway map of India, at a distance of about 400 miles from Calcutta, and half-way between that place and Delhi, will be found a place named Moghalserai. The map will show four lines converging on this place, and it will also be seen that to reach any place in the United Provinces or the North-West of India one has to pass through Moghalserai.

The East Indian Railway, which is the railway on which Moghalserai is situated, is fortunate enough to run through the main great coalfields of India, situated in Bengal, and Bihar and Orissa. The Barakar, Raniganj, Jherriah, Giridih and Bokhara collieries supply most of the coal used in India and all that destined for use in the United Provinces, Punjab, North-West Frontier Province, and to a certain extent the Central Provinces and Bombay, is carried for a part of the distance by the East Indian Railway.

The figures for coal carried by the four largest railways during 1928–29 are :—

Railway.	*Tons carried.*	*Freight.*
Bengal Nagpur	6,327,500	Rs. 1,73,51,200
G.I.P. Railway	1,269,900	Rs. 54,94,000
North-Western	1,048,200	Rs. 36,45,500
East Indian	12,454,800	Rs. 5,50,73,300

On account of its geographical position and the bottle-neck caused by the four converging lines, Moghalserai has always been one of the main points at which the marshalling of wagons has been done, both in the " up " and the " down " direction. (" Up " is from Calcutta towards the Punjab.)

At Moghalserai there are two completely separate yards, one for each direction of traffic, and this article is intended to give a description of the construction, lay-out and working of the recently completed new " up " yard.

The " down " yard was remodelled in 1922 and finally completed in 1924, with a gravity hump over which the marshalling was carried out. In September, 1925, the work of remodelling the " up " yard was commenced.

Up to that time there had been a separate yard for the traffic from each of the two lines coming into Moghalserai from the east. In

order to allow "down" goods trains for the Grand Chord line to reach that line, a junction was made at the exit from the "down" yard and a new link opened joining the Grand Chord at Ganjkwaja Station. All Grand Chord passenger trains, both "up" and "down," were also diverted to this route, and the old route used solely for "up" goods trains. (See Plate, Fig. 2.)

The general design of the two yards, "up" and "down," is similar, but owing to the fact that the two old yards were situated partly on the site of the new "up" yard, the construction work and the actual changing over from the old to new required careful consideration and organization, and a cut-and-dried programme. The design of the "up" yard was also affected by the fact that the traffic to be dealt with was practically 100% loaded, and that there were many more destinations to which through loads had to be made up, *i.e.*, Ghaziabad, Agra, Cawnpore, Jubbulpore, and Lucknow and Moradabad; whereas in the downward direction most of the traffic was empty coal-wagons which are sent to two or three big centres in the coalfields whence they are distributed to the various individual collieries.

Figure 2 shows the general lay-out of the whole station, with both old and new yards. Figure 3 shows the lay-out of the new "up" yard in more detail as actually completed. It will be seen that this yard is made up of the following separate portions :—

(*a*) *The Receiving Yard.*

The entrance to this portion is at Junction Cabin, thus enabling trains from both the main line and the Grand Chord to be received. The lay-out allows trains from both lines to enter the yard at the same time, and this portion of the yard is controlled from Junction Cabin and is fully interlocked. In this section trains are received, the train engine detached and sent to shed, the wagons examined, the shunting pilot engine attached and the wagons pushed over the hump.

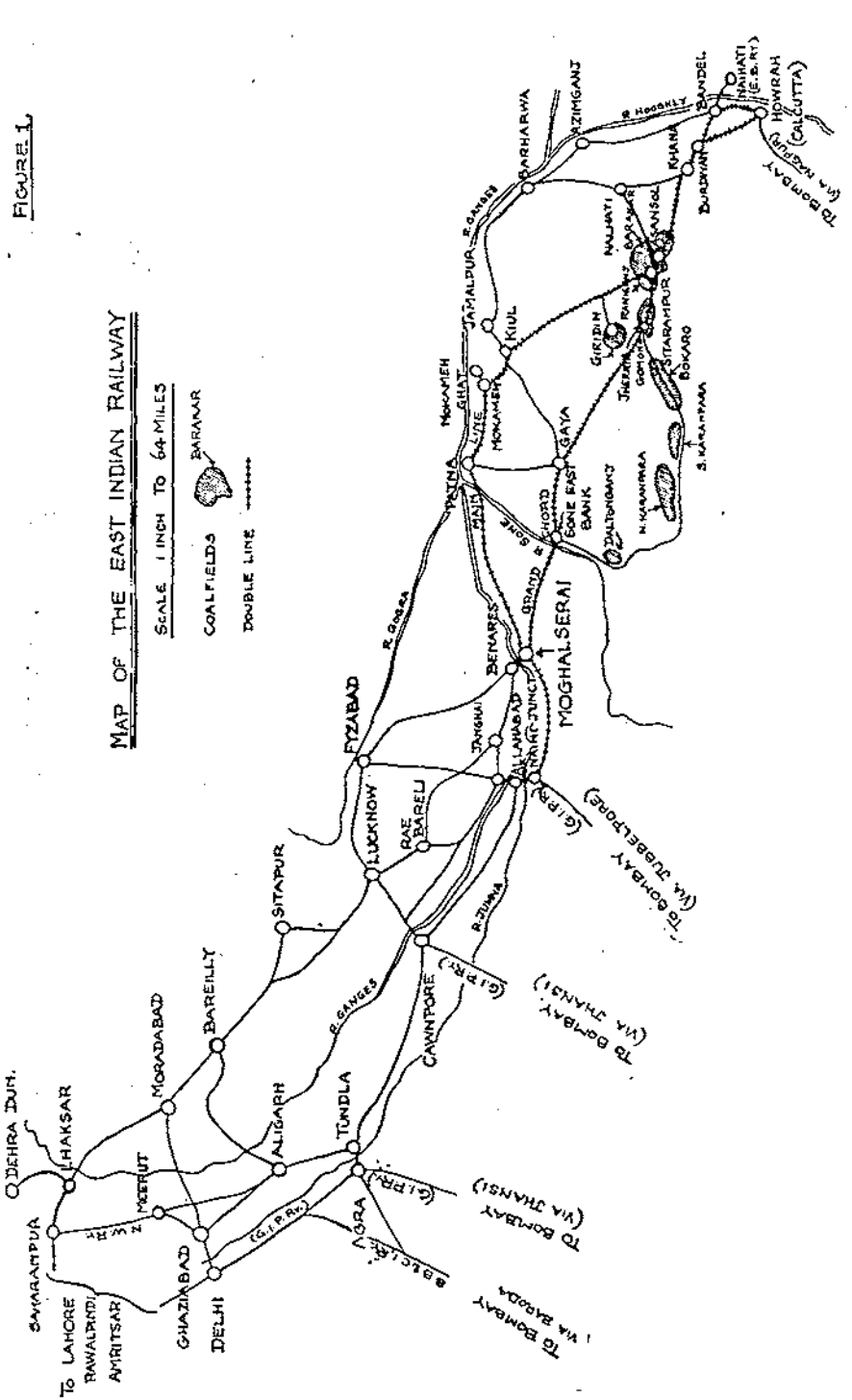
(*b*) *The Classification Yard.*

This at present consists of 13 classification lines and a line for damaged vehicles. Room has been left to allow a further six lines to be laid when traffic requires. In this yard the wagons roll down from the hump and are put on to the different lines according to their different destinations. Any wagons marked as damaged by the carriage and wagon staff in the Receiving Yard are put on to the line kept for such vehicles, and from there are taken direct to the sick lines for repairs.

(*c*) *Sorting Yard.*

This also takes off from the hump, and has at present six lines. Into this yard are put such wagons as will be made up into trains

FIGURE 1.


MAP OF THE EAST INDIAN RAILWAY
SCALE 1 INCH TO 64 MILES
COALFIELDS
DOUBLE LINE
BARAKAR
DEHRA DUN.
SAHARANPUR
LHAKSAR
MEERUT
MORADABAD
BAREILLY
GHAZIABAD
DELHI
ALIGARH
TUNDLA
AGRA
SITAPUR
LUCKNOW
RAE BARELI
FYZABAD
CAWNPORE
ALLAHABAD
JHANSI
BENARES
MOGHALSERAI
PATNA
GAYA
KIUL
JAMALPUR
BARHARWA
ZIMGANJ
BANDEL
HOWRAH (CALCUTTA)
BARDWAN
KHANA
SITARAMPUR
BOKARO
GIRIDIH
JHERIA
NAJHATI
R. GANGES
R. SONE
R. HOOGHLY
R. JUMNA
R. GOGRA
TO LAHORE RAWALPINDI AMRITSAR
TO BOMBAY (VIA BARODA)
TO BOMBAY (VIA JHANSI)
TO BOMBAY (VIA JUBBELPORE)
TO BOMBAY (VIA NAGPUR)

other than through loads. For instance, wagons whose destinations are stations between Moghalserai and Lucknow.

(*d*) *Sorting Grid.*

This continues from the Sorting Yard and is connected to it over a small hump. In this grid the wagons from the Sorting Yard are marshalled into their correct station order. (Through loads are merely made up into a train of so many wagons, which are sent on to the next Marshalling Yard, the wagons being in no special order. Wagons for stations between Moghalserai and the next Marshalling Yard are made up into separate trains and in these the wagons must be arranged in station order, those for the first station being next to the engine and so on.)

(*e*) *The Carriage and Wagon Repair Yard or Sick Lines.*

This, as already stated, has a separate connection from the hump. There is also a connection to the bottom end of the Classification Yard which enables vehicles damaged in the course of hump shunting to be sent to the sick lines without interrupting the work at the hump, and similarly to draw repaired wagons from the sick lines. In this yard there are facilities for enabling ordinary repairs to be carried out, such as changing wheels, axle boxes, buffers, springs, draw-bars, etc. There is also a platform at which wagons can have their loads transhipped. Compressed air is available, thus enabling pneumatic drills and riveters to be used. A 5-ton crane has also been provided for unloading heavy stores.

(*f*) *Departure Yard.*

The Classification Yard and the Sorting Grid lead to this yard, there being a separate connection from each. Here trains drawn out from the two yards named are examined again for damages, vacuum tested, and finally dispatched.

(*g*) *Transfer Lines.*

These take off from the Receiving Yard just before the hump. On them vehicles for transfer between the "up" and "down" yards are placed. Tracks are also provided for oil tank wagons and other vehicles which it is not permitted to shunt over the hump, and also brake vans.

(*h*) *Engine Escape Line.*

This leads from the Receiving Yard and enables the incoming train engines to be sent direct to shed without being held up in the yard.

Construction.

The work on the yard was commenced in September, 1925. The earthwork in connection with the hump was considerable, and service lines were laid between the borrow pits and the site. By the autumn of 1927 most of the earthwork had been completed, and the laying of the permanent way was in progress. The track used was second-hand bull-headed steel rails of 85- and 88½-lb. section on new sleepers in all except the Sorting Yard and Grid and the transfer lines. In these, second-hand bull- and double-headed rails were used on second-hand sleepers. All points and crossings with the same exceptions as above were new 90-lb. R.B.S. section. A great deal of the second-hand track utilized had to be taken up from the old yards, and therefore certain sections could not be completed until the old yards were put out of use.

The buildings connected with the yard were (*a*) a Yard Master's office, a three-storied building close to the hump and giving a good view over the whole yard. (*b*) A point lever cabin at the hump. (*c*) "Goomties" (or small ground cabins) at the Receiving Yard and Sorting Yard. (*d*) An office and store for the sick lines. (*e*) An extension to Junction Cabin to allow the extra levers for the points belonging to the yard to be added, and (*f*) a running room (or rest room) for the guards of incoming trains. These were all straightforward buildings and call for no comment.

Two ashpits were built and two water columns erected, together with storage tanks in each case.

By September, 1928, all work was completed except that which had to be done after the old yards were put out of use.

The first stage in this part of the work was the dismantling of the old goods shed and the bringing into use of the new one. The old shed was situated in the centre of the new Departure Yard. (See Fig. 2.) This change-over completed, it was then possible to complete the Departure Yard.

The second stage was to put out of use the old main line yard, and, with the materials released thereby, complete the Sorting Yard and Grid and other lines. To do this entailed the bringing into use of the completed portion of the new yard, and this was carried out on the 1st July, 1929. The trains from the Grand Chord continued to be sent to the old Grand Chord yard for a short time, but it was soon found that there was sufficient accommodation for them also in the completed portion of the new yard. At that time of year the traffic is at its lowest, and this accounted for being able to do this. Meanwhile, the old main line yard was being dismantled and the remaining lines in the Classification Yard and the sick lines laid.

The dismantling of the old Grand Chord yard was postponed for

some time afterwards, as it was considered by the traffic department that it was advisable to have it available in case there was a breakdown in the new yard. In the autumn, however, this necessity not having arisen, the link from Ganjkwaja was taken up and used in the engine escape line.

As an example of the varied nature of the problems that cropped up from time to time, the following is cited. The only end-loading ramp in the whole of Moghalserai was at the old goods shed, and by an oversight a new one had not been provided at the new goods shed or elsewhere. This was not realized until just prior to the dismantling of the old shed. Actually the ramp was seldom used, there being a very occasional motor and departmental engineering plant, such as a portable boiler or compressor. To provide for loading or unloading the former until such time as a permanent ramp had been constructed a temporary one of ashes was built behind a convenient buffer.

About two weeks after the old ramp had been demolished the P.W.D. sent along a steam-roller to be loaded. An enterprising attempt to do this from the temporary ramp resulted in the vehicle sinking 2 feet into some soft ground, and thereby blocking for a whole night three of the departure lines. Finally it was necessary to requisition the 30-ton breakdown crane from the loco. shed.

WORKING.

Prior to the opening of the yard there was some doubt as to the grades on the hump, and in order to test them practically wagons of different types and with varying loads were put over. The grades of the hump at that time were as shown in Figure 5 (line a — a). As a result of these tests it was thought that the grades were too steep, and prior to opening they were slightly altered to those shown in line b — b. Later these were again modified to those shown in line c — c.

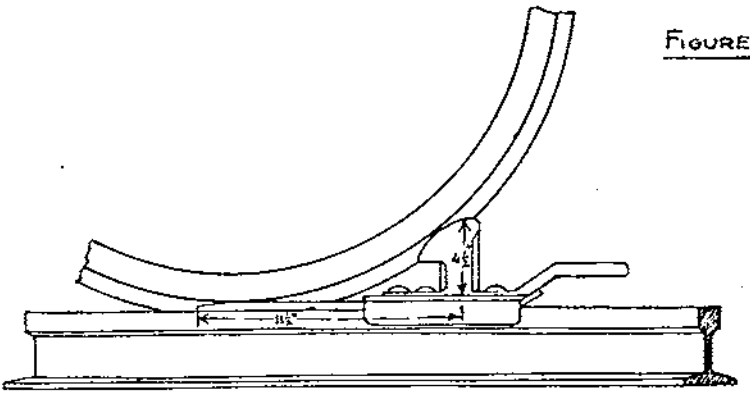
During the hot weather a very strong west wind blows during the day, and as the yard is sited due east and west, this has an undoubted retarding effect on the wagons, particularly lightly-loaded covered ones. In the winter, however, due to the cold, the vehicles all run more sluggishly, and so probably the net result is about the same, and this appears to have been borne out in practice.

Although the " down " yard had been in operation several years, the conditions in the " up " yard were so different that for the first few weeks the working was scarcely all that was to be desired. The big problem that had to be dealt with was the retarding of the wagons as they came off the hump. As a train is built up the wagons have a shorter and shorter distance to run, and it is, therefore, most

necessary to brake them and prevent successive wagons crashing down into the rear of the slowly lengthening train.

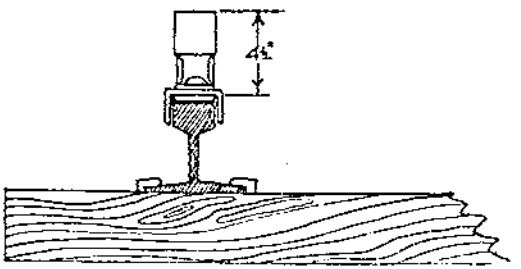
In the " down " yard, owing to the traffic being, as previously stated, nearly all empties, it was found sufficient to post a brakesman on each line in the Classification Yard, and he manipulated the side brakes of the wagons as required. In the " up " yard, however, this method was found to be of no use. The average wagon loaded with coal weighs something over 25 tons on Indian railways, whilst

FIGURE 4.



SKETCH OF SKID.

NOT TO SCALE.



occasionally 4-wheeled wagons weighing 45 tons gross had to be dealt with.

For this yard, therefore, retarding slippers or skids were issued. The first pattern used was made locally on the engineering workshops from a pattern obtained from the North-Western Railway. Any scrap metal available was utilized in their manufacture. Figure 4 is a sketch of this pattern. Later, when the question of the continued supply of these articles arose, a type was supplied by a Calcutta firm.

This yard is not at present of such a size as to warrant the installation of a mechanical type of retarding gear.

Immediately after the opening the daily bill for damage caused by rough shunting over the hump amounted to anything from Rs. 300 to Rs. 800. This was directly due to the staff concerned being reluctant to use the skids and attempting to pull up the wagons by the old method of applying their brakes alone. In some cases when the man came to apply the brake he found it out of adjustment, and the vehicle then continued unchecked until it crashed into the rearmost wagon of the train, and, if loaded with coal, throwing a large amount of it out, not to mention the breaking of buffers, axle boxes and so on. In order to evolve some definite method in the Classification Yard it was arranged to carry out a special test over a full 24 hours, and go thoroughly into all the difficulties that had arisen.

One fault in the design of the yard made itself felt from the first day, and that was the omission of an avoiding line round the hump, from the Classification Yard. In cases of mis-shunting it is necessary to send the engine over the hump and pull out a certain number of wagons in order to reach the wagon required. If this number is, say, 30, the engine will not be able to pull the load back over the hump, and it is necessary to make two movements, greatly delaying the work. An avoiding line would have got over this difficulty, but unfortunately the summit of the hump and the first point of the Classification Yard are so close to one another that there is not sufficient room to put in the line.

On opening the yard it was also found that the engines up till then used at Moghalserai were not powerful enough to push the loads from the Receiving Yard up over the hump, even with assistance, and it was necessary to transfer more powerful locomotives there.

COMMUNICATION AND SIGNALLING.

At the entrance to the Receiving Yard the points and signalling are fully interlocked and controlled from Junction Cabin. The other end of the Receiving Yard is controlled from a "goomtie," whilst trains actually humping are controlled by a 3-colour light signal on the hump, operated from the hump "goomtie." Red on this signal indicates "stop," yellow "push forward slowly for humping," and green "all clear" in cases when a movement over the hump other than shunting is desired.

The Classification Yard points are controlled from the Hump Cabin. There is an indicator controlled from the hump "goomtie" which indicates to the switchman in the cabin on to which line the different cuts are to be put. In the "goomtie" there is a board in which is a row of sockets numbered with the number of the lines in the Classification and Sorting Yards. The operator is provided with a statement showing the destinations of the wagons on the train

No. 1.—View from Junction Cabin looking west. On the right are wagons standing in the "Down" Departure Yard; next the quadruple main running lines: on the left centre the entrance to the "Up" Receiving Yard.

No. 2.—View from the Yard Master's Office looking east towards Junction Cabin, (right background). On the right is the Receiving Yard. In the centre is the re-packing and re-checking shed and platform where van goods trains are dealt with, whilst in the background are wagons standing in the "Down" Departure Yard.

No. 3.—View looking west from the Yard Master's Office over the Hump. On the right are wagons standing on the Transfer Lines with the sidings for special wagons behind them. In the centre is the Hump with the Hump "goomtie" and signal. To the left of the "goomtie" is the Classification Yard cabin and between the two the Classification Yard lines. To the left of the Cabin is the Sorting Yard.

Moghalserai new 'up' goods yard 1-3.

No. 4.—View looking west from the "Up" Departure Yard towards Moghalserai Station, which is in the centre background. On the right are the lines leading to the "Down" Receiving Yard; in the centre are the four main running lines, and on the left the engine escape line and the exit lines from the "Up" Departure Yard.

No. 5.—View of the Yard Master's Office.

No. 6.—View of the Classification Yard and on the right the transfer lines and sidings for brake vans and special wagons.

Moghalserai new 'up' goods yard 4-6

being dealt with. As the train goes past him he places a "jack" in the appropriate socket, and on doing this a disc falls across a correspondingly numbered hole on an indicator in the Cabin, and a bell commences to ring. The switchman sets the required levers and then presses a button, which stops the bell ringing in his cabin and gives a ring in the "goomtie."

There is no interlocking provided, and the switchman has to be very much on the alert when work is heavy to see that :—

(i) he does not start moving his levers for the line asked for before the previous cut is clear,
(ii) he completes moving his levers before the cut reaches the points,
(iii) wagons are not fouling the crossings over which the cut is to go.

The points at the bottom end of the Classification and Sorting Yards are all trailable and worked by hand levers. This avoids any chance of having points burst open by wagons which have been allowed to run too far.

The points at the entrance to the Departure Yard are worked from a "goomtie" close by, and two ground disc signals control the actual movements. The points at the exit from the Departure Yard are again trailable.

Staff.

The staff who are responsible for the working of the yard are as follows :—

General.

Station Superintendent. He is responsible for the working of the whole of Moghalserai.

Yard Master. He is responsible to the Station Superintendent for the working of the two Goods Yards.

Assistant Yard Masters. One of these is in charge of each of the yards and is responsible for the actual details of the work. They do an eight-hour shift.

Receiving Yard.

Train Examining Staff, who, on the arrival of a train, examine it for hot axle boxes and damages and mark up such wagons.

Number Takers, who take down the numbers of the wagons and their destinations, and one of whom is responsible for giving the statement required by the hump gunner when humping the train.

Hump.

Head Gunner, who is in charge of the cutting up of the train and controls its movements with the hump signal.

Porters, who uncouple the wagons either individually or in groups according to the directions of the head gunner.

Classification Yard.

Shunting Porters, who under a head porter are responsible for retarding the wagons.

Train Examining Staff, who further examine the stock for damages due to rough shunting or other causes.

Departure Yard.

Train Examining Staff, who make a further examination for damages, and after connecting up the train test the vacuum. (Nearly every goods train in India runs fully vacuum-braked.)

CONCLUSION.

As an indication of the effect of the opening of the new yard, the following statistical figures are given :—

Period.	*No. of wagons dealt with*	
	Per shunting hour.	*Per Rs. 15 wages.*
1929-30, April to Sept. ..	17·2	100·8
1929-30, Oct. to March ..	20·2	117·0
1930-31, April to Sept. ..	19·1	111·5
1930-31, Oct. to March ..	24·4	138·0

Comparisons should be made between the corresponding periods of each year, as October to March is the busy season and also the cooler one. The results do not compare with those obtained in similar yards in Europe, but it must be remembered that the labour available cannot be compared either, nor in most cases the climate. The work when done properly is arduous, especially when done in the heat of the day, when everything made of metal becomes almost too hot to hold.

FIGURE 3

MOGHALSERAI "UP" GOODS YARD

(EAST INDIAN RAILWAY.)

NOT TO SCALE.

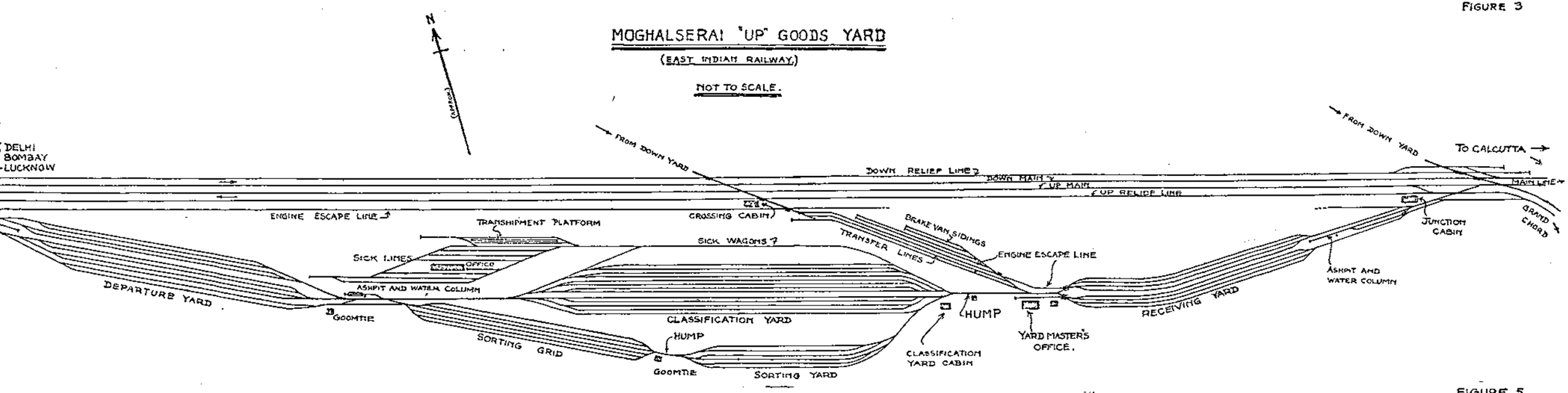


FIGURE 2.

GENERAL LAYOUT OF GOODS YARDS AT MOGHALSERAI

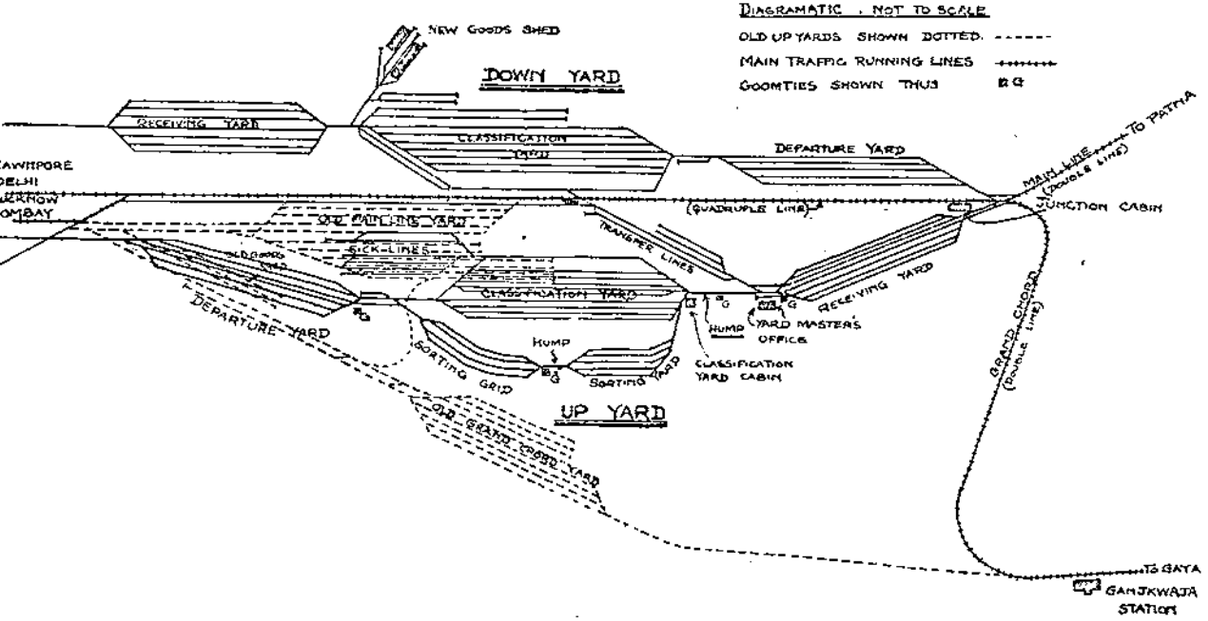
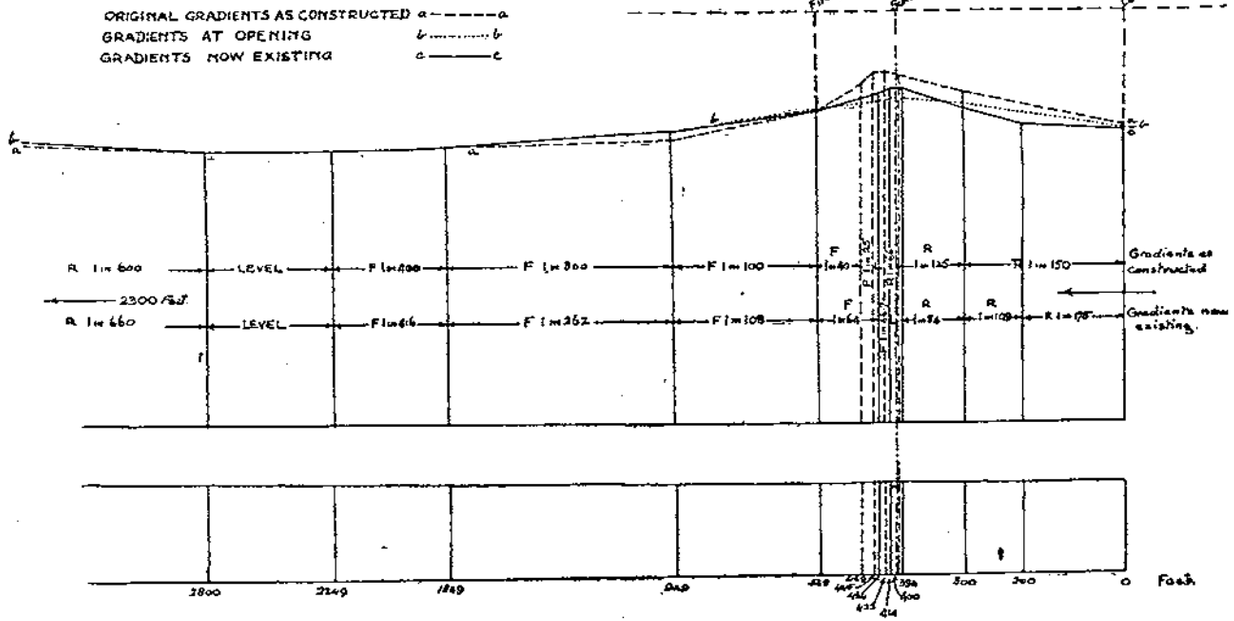


FIGURE 5.

MOGHALSERAI UP YARD

SECTION OF HUMP

NOT TO SCALE.



NOTES ON THE ACRE.

Based on the Maps of THOMAS LANGDON, *made for Corpus Christi College, Oxford, 1605 to 1616.*

By CAPTAIN D. R. MARTIN, R.E.

THIS paper is an attempt to determine, first, whether the furlong or the acre is the fundamental unit of area. Its thesis thus provides a link connecting historical and cadastral studies: for while accuracy of measurement is the essence of survey, the size and function of the acre has long been discussed amongst historians.

The fundamental unit, whatever its ultimate origin may have been, was certainly very closely connected with agriculture; but its exact dimensions remained variable until a standard was fixed by the formation of the Statute Acre in the reign of Edward I.

Secondly, as a side product of the above investigation, the accuracy of one of the early cadastral surveyors is examined with not unsatisfactory results. This examination, though a side product, is a necessary preliminary to the investigation, since it would be manifestly illogical to base conclusions upon data obtained from an unreliable source. It is also felt that no apology is needed for its inclusion, the standard of accuracy attained by a surveyor of three hundred years ago being of interest for its own sake.

There is no special reason why Thomas Langdon should be singled out from a number of other good surveyors, and he attains the prominence here assigned to him through a series of accidents. In the years 1605–6 and 1615–16, he made 47 plans of their property for the president and scholars of Corpus Christi College, Oxford. These are still in the possession of the College.

The Ordnance Survey has, of late years, been lent a number of old property maps for the purpose of photographing them, and amongst those recently lent were the above 47 plans of Thomas Langdon.

There is little internal evidence from these plans as to the survey methods employed by Langdon, though, as is shown in Appendix I, it is extremely unlikely that he employed the compass. He clearly was accustomed to do field work for a time and then retire to his headquarters to make the fair drawing; we have numbers of plans dated the same month—too many to represent the labour of that month alone—and then an interval followed by another batch of

plans. For example, we have 10 plans dated November and December, 1605, then 4 plans dated April, 1606, then 6 plans of September and October, 1606, and 1 plan of December, 1606.

In the year 1607 he made some plans for Brasenose College, Oxford, with which we are not here concerned, except to deduce therefrom that he was an independent surveyor, engaged now by one employer and now by another.

In April, 1615, his name again appears on plans for Corpus Christi, but now coupled with that of a young surveyor, Henry Wilcocke; three of the plans of that month are "drawn by Henry Wilcocke with the help and direction of Thomas Langdon," and two emanate from Henry Wilcocke alone. For all the 15 plans of June and November, 1615, we find both Langdon and Wilcocke taking responsibility, while in May, 1616, one plan is drawn by each and two are unspecified.

Many interesting human touches can be gleaned from these plans; for example, in 1605–6, Langdon puts his name to 13 plans out of 21, while in 1615–16, the name is given on 22 plans out of 26; in 1605–6, on only one plan is the scale stated in words as well as drawn, while in 1615–16 the scale is very frequently stated in words. In short, the old surveyor is careful to bring up the young one in the way he should go, though he himself does not always live up to his precepts.

In the marginal notes, Langdon uses mediæval script, though he always employs Italian script on the body of the plan; we find him still doing this in the latest plans. Wilcocke, however, appears always to use Italian characters.

The plans are beautifully executed and embellished with all the colours of the rainbow, but what endears them to the surveyor is the manner in which every plot states its area in acres, roods and perches. The series has a pleasing air of verisimilitude, and seemed to offer a fruitful field for the surveyor as distinct from the antiquary.

Examining these plans as surveyors, it is not our province to comment on the prevalence of strip cultivation in some areas or of normal-looking fields in others, nor even to linger over the attractive field names; we must confine our attention to the facts of mensuration.

The majority of the plans are on the same scale of 20 perches to 1 inch. The R.F. is thus 1/3960; one is, however, 1/4752, and a few 1/2376.

THE SIZE OF THE ACRE.

In the *Geographical Journal* for October, 1930, Sir Charles Close traced the variations in length of the English mile, and showed how the number of furlongs in the mile varied. Does this variation extend to the acre also? Or, rather, was Thomas Langdon's acre the same area as ours, and did he apply the same meaning to its subdivisions?

To determine if his table of measurements was 40 perches = 1 rood, 4 roods = 1 acre, we may first observe that in his areas he seems never to write more than 3 roods or more than 39 perches. This is strong presumptive evidence that he used the subdivisions in the same sense as we do to-day. Further evidence is, however, forthcoming, for in a number of cases he gives on his plans a list of areas and totals them ; the addition has been tested in 23 instances, and in 19 of them he is perfectly correct, a result which could not be attained if his tables differed. The four cases in which his addition is incorrect may be dismissed here, as, although they are pertinent to the discussion of his accuracy, they have no connection with his table of measures.

Having established the fact that 40 perches = 1 rood, 4 roods = 1 acre, was as true to Langdon as it is now, it is possible to add together areas given on his plans to determine his area for any particular piece of land. A good number of his boundaries are still to be found upon the Ordnance Survey 1/2500 plans, and in numerous instances an area can be found completely bounded by features which still exist. It is, therefore, possible to check Langdon's acreage by that shown on Ordnance Survey plans.

Seventeen of these areas were tested in this manner, as shown in Table 1. The total area is 409·961 acres according to the Ordnance Survey and 393·134 acres according to Langdon. The difference is only 4·1%, and it is safe to conclude that Langdon's acre was substantially the same as that of the present day.

The word "substantially" is used advisedly since there have been minor alterations in the length of the standard yard. The oldest preserved standard is that of Henry VII., and it is 35·963 inches ; the effect of any minor difference of this order would be completely swamped in errors of survey.

An acre of a different size was undoubtedly known to Langdon, for, in the later plans, wherein he is associated with Wilcocke, not only is the scale of 20 perches to 1 inch given, but it is specifically stated that they are "made by the measure of xvj foote and an halfe to the pole." Data from the earlier plans have been included in the seventeen test areas and are in general agreement with the conclusion that Langdon's acre was the same as ours.

Whether this indicates knowledge of an acre of different *precise measurements* is, however, uncertain, for on some of the 1605–6 plans, he uses "ac" as the contraction to denote a strip. In order to avoid confusion, I shall always refer to this acre by its mediæval Latin name "acra," reserving the word acre for the fixed area of 220 yards by 22 yards known to us.* We shall return to the acra later.

**Note.*—I have carefully refrained from using the term "customary acre" for the acra, to prevent any confusion with F. Seebohm's book, *Customary Acres and Their Historical Importance.* Whatever the customary acre may be, it seems to bear little resemblance to the actual "acra."

LANGDON'S ACCURACY AS A SURVEYOR.

In the previous section it has been noted that in 4 addition sums out of 23 Langdon's arithmetic is at fault; the error in 2 cases is plus and in 2 cases minus. There is no internal evidence to show whether these are errors due to incorrect copying figures from rough notes on to a fair drawing, or due to faulty arithmetic.

Whatever the cause may be, these discrepancies show a carelessness in the handling of figures which discounts his accuracy as a surveyor, for similar errors may well occur in his calculations of the areas shown upon his plans. (Of course, the moral of this is—always have your calculations performed by two independent computers, lest you should be found wrong in three hundred years' time.)

To revert to Langdon, it remains to be seen whether his inaccuracies are mainly topographical or arithmetical; for this purpose seven cases were tested upon a plan in which the fields were comparable in size with those now existing; the number of Langdon's parcels required in this plan to compare with the identical area on the Ordnance Survey sheet varying from 1 to 3. This example was chosen as it gives Langdon a *prima facie* better opportunity to show his worth than he would have in cases where he is dealing with a number of strips of a couple of roods or so each.

To eliminate scale errors due to distortion, both of the parchment and of the bromide paper copy, the conversion factor from square inches to areas was deduced from 1 parcel in which Langdon's area is within 1% of the Ordnance Survey area. The errors in the remaining 6 cases are mainly topographical in 3, mainly arithmetical in 2, and both combined in 1, as is set forth in Table 2.

Another illustration of the degree of accuracy attained by Langdon is given by the map showing his work and that of the Ordnance Survey superimposed. This is a very searching test to apply and he comes out of it with considerable credit. Here we may safely leave the map to speak for itself, reserving comments upon it for Appendix I.

Judging Langdon by *modern* standards, he cannot therefore be given a high position either as a topographer or as a computer. Let us, however, remember that he was one of the pioneers of cadastral surveyors, and give him due credit for his achievement. All things considered, it is remarkable that his errors in area only range from −9·5% to +3·5% when compared with Ordnance Survey standards.

THE FURLONG.

Having obtained an idea of Langdon's accuracy we can proceed to see what, if anything, can be gleaned from him with regard to the furlong.

From the *Oxford English Dictionary* we learn that the word by

derivation means furrow long. It is then defined as being originally the length of the furrow in the common field, which was theoretically regarded as a square containing 10 acres; it accordingly varied with the acre but was usually understood to be 40 poles. As early as the ninth century it was regarded as the equivalent of the Roman stadium = 1/8th of the Roman mile.

It is also given its meaning as a superficial measure of an area of land a furlong each way, containing 10 acres; but its sole authority for this is *Rees. Cycl.*, 1819, neither old enough nor modern enough for our purpose.

The *Encyclopædia Britannica* (13th Edition), Vol. XXVIII, page 484, tells us little about the furlong as a measure of area, but tells us much about the yard. Up to the fifteenth century the commonest building foot was 13·22 inches, whence the old yard was 39·66 inches. This old yard was suppressed by law in 1439. From this old yard the old furlong is reconstructed; but the argument employs the present length of the furlong as an approximate value for the old furlong. The old furlong is stated to be 200 times as great as the old yard (2 yards = 1 fathom, 10 fathoms = 1 chain, 10 chains = 1 furlong), namely, 7,932 inches. We may here pause to note that, given this as correct (and the reconstruction is not very convincing),* the difference between the old furlong and that of the present day is only 0·35%, a negligible quantity as regards our deductions from Langdon.

Fowler, in his modern work on the Strip Map of Oakley Reynes, is more cautious; his statement is: "*Furlong* (*quarentena, cultura*). In its original application two opposite sides of a Furlong (a division of the Open Field) measured a furlong of some 220 yards. But by the XVI. century the word was used for almost any subdivision of the Open Field, regardless of its shape and size." This definition leaves open the question of size for the period before the sixteenth century.

Can Langdon tell us anything? His plans show us strip cultivation in profusion, so we can make many measurements of the furrow length. In doing so, it is well to take strips only where they

* The *Encyclopædia Britannica, loc. cit.*, states: "We can restore then the old English system of long measure from the buildings, the statute of prohibition (of the old yard), the surviving chain and furlong, and the old English mile shown by maps and itineraries, thus:—

foot	3 = yard	2 = fathom	10 = chain	10 = furlong	10 = mile
13·22	39·66	79·32	793	7932	79320."

No authority is given for the statement that 10 fathoms = 1 chain, 10 chains = 1 furlong. For such a radical change from our present-day tables, further and weighty authority is required. If such authority exists, it should be placed on record.

At the present day, 22 yards = 1 chain. In this reconstruction it is assumed that the chain of to-day is substantially the chain of the past, and that the number of yards comprised in it was altered in accordance with that of the yard itself.

Our forbears seem on occasion to have been decimally minded, witness the 10-man unit, the hundred for administration, and the old mile of 10 furlongs; but such rare instances do not, in themselves, warrant the conclusion that any general decimalized system was normal.

are fairly uniform in width and not complicated by natural features such as brooks or copses.

District.	*No. of measurements.*	*Max. Poles.*	*Min. Poles.*	*Average Poles.*
West Henreth (Berks) ...	16	36	25	30
Mapledorewell (Hants)	20	55	27	39
Hayeford (Oxford) ...	35	52	27	35
Hayeford (Oxford) ...	27	47	21	32

In the last case the open field was a particularly square one, uncomplicated by natural features ; it is therefore given separately, as being particularly suited for natural development.

If every furrow be measured for Langdon's map of Mapledorewell the variation is from 14 to 55 poles, the mean of the 537 measurements being 34·8 poles, as is shown in Table 3. The map facing page 100 in Seebohm's work shows the furrow of the customary acre in this district to be 232 metres, or 46 poles. The merest glance at Table 3 suffices to show the lack of connection between the theoretical furrow length of the customary acre and the actual measured lengths. Not only is the mean of the measured lengths far below the theoretical furrow but only 69 out of the 537 actual furrows are as long as, or longer than, the theoretical 46 poles.

According to Langdon the answer to the length of a furrow is highly indeterminate. He has, however, a very different story to tell when we ask him what is the size of a furlong. True, it is only in West Henreth and Tackeley that he actually designates area as " Furlonges," but elsewhere many furlongs may be recognized with certainty.

A list of the areas of furlongs is given in Table 4. Now it must be remembered that the furlong has its roots in the early days of Saxon settlement, and is not a unit of precise measurement, but a unit connected with the labour of ploughing ; it may thus be expected to have a certain similarity to the Chinese *li* which is not merely a unit of distance, but has a factor depending on the difficulty of travel, the length of 10 *li* in the plains being very different from the length of 10 *li* along rugged mountain paths.

It must also be remembered that Langdon is not the ideal surveyor who never makes a mistake. A latitude of 10% in area is, therefore, by no means a large allowance to make in the search for the original furlong.

Consider the furlongs in West Henreth first, where 20 out of the 26 areas given are actually called furlongs. (Here let it be said that a few parcels are omitted as their bounds seemed rather indefinite, or there seemed to be danger of their areas being affected by the intrusion of homesteads ; the areas of these parcels were not totalled

at all, and I do not yet know whether they would come under my rule or not.) Out of the 26 areas, 16 are within 10% of an even multiple of 5 acres. Without stretching the limits overmuch, 5 of the defaulters can be reconciled by a cautious joining of furlongs. If two adjoining furlongs have strips running the same way and are not separated by a path or other well-defined feature, encroachment of one on the other in the course of centuries is relatively easy and they may be tentatively joined, the sum being tested by the 10% rule.

Of the 5 remaining furlongs, 3 respond to other treatment. Gore Furlong has a pronounced balk separating 2 to 3 acres from the remainder; this has every appearance of being a later accretion recovered from waste land; the older furlong contains about 10 acres. Under Smallway has a path (Middle Waye) running into its side at right angles and then breaking off; if this were continued, the larger portion of the two into which Smallway would be divided is 9 ac. 0 r. 24 p. Porteway Furlong has a curious kink in it, and an area of about 2 ac. 3 r. lies north of the ancient Porteway track, leaving about 9 ac. 0 r. 29 p. south of it.

Similarly, in Mapledorewell, Hants, where, however, no areas are actually called furlongs, 17 come under the 10% rule, 3 more come into it by addition, and 4 are recalcitrant. This area is much affected by natural features and some discrepancies may well be due to later recoveries from waste lands.

In Tackeley, Oxfordshire, 8 out of 15 named parcels, (6 of which are called furlongs) come within the rule, and 2 of the remainder may be brought under the rule by stretching. In Hayeford, Oxon, 11 come within the rule and 9 are outside; but of these 9, two can be discarded as they are portions of "Farmer's New Close" and are, therefore, comparatively modern additions; none of the 20 are actually called furlongs.

When the larger parcels are considered the 10% rule is definitely lenient; for example, of the sizes between 20 and 25 acres, all but those between 22 and 22½ acres come under the rule. Let it be tightened up and our attention confined to those parcels lying between 4 and 12 acres. The number of parcels in the various categories are:—

	Within the 10% rule.	*Come under the rule by accretion.*	*Recalcitrant.*
West Henreth (Berks) ..	8	5	2
Mapledorewell (Hants) ..	9	1	2
Tackeley (Oxon)	5	1	4
Hayeford (Oxon)	11	–	7
Totals ..	33	7	15

Now if the size of a furlong was a pure matter of chance, and if, as Fowler states, it was used " for almost any subdivision of the Open Field," then, for areas from 4 to 12 acres, only 3 furlongs out of 8 would be within 10% of either 5 or 10 acres. Contrast this with the fact that 3 out of 5 actually come within the 10% limits, and that a plausible excuse may be made for a third of the remainder.

If we confine our attention to the areas between 4 and 12 acres actually called furlongs on the plans, we find that 7 come within a 10% rule, 6 come under it by accretion, and 1 is outside.

It is thus irresistibly borne in on the enquirer that the early seventeenth-century furlong was roughly some multiple of 5 acres. If this be doubted, try a 10% range on a 6-acre unit in West Henreth, and it will be found that for areas from 4 to 14 acres only 6 out of 20 would follow the rule, the number which one would expect were the size of the furlong a matter of chance. Even this measure of agreement is only attained by the fact that the difference between 5 and 6 is not vast, especially when allowing a 10% variation in each case.

Contrast this definite answer of Langdon's regarding the area with his impossibly vague answer to the length of the furlong. This strongly supports the antiquaries who contend that the area is the original unit, the length being a later derivative.

The furlong to Langdon, in 1605, is thus a multiple of an original unit of roughly 5 acres ; whether this unit is the original furlong, or a half-furlong, we know not ; if the original was 10 acres there is nothing incongruous in the name " furlong " at a later date being attached to a half-furlong when it is attached to a conglomeration of three furlongs : the argument, therefore, carries us no farther.

THE ACRA.

The *Oxford English Dictionary* gives an imposing list of derivations for the word acre, stretching back to Latin *ager*, Greek ἀγρος, and Sanskrit *ajras* (= plain). It states that it was originally " open country, untenanted land, forest, then with the advance in the agricultural state, pasture land, tilled land, an enclosed or defined piece of land, a piece of land of definite size, a land measure."

The second meaning is given as " a definite measure of land, originally as much as a yoke of oxen could plough in a day ; afterwards limited by statutes 5 Edw. I., 31 Edw. III., 24 Hen. VIII., to a piece 40 poles long by 4 broad (= 4,840 sq. yds.) or its equivalent of any shape." Ellis is quoted as writing in 1882 that normally it was understood to consist of 32 furrows of a plough, a furlong in length.

In the third meaning, we find it given as a lineal measure, an acre length = 40 poles, and an acre breadth = 4 poles. We may, how-

ever, note that the first quotation given for this is *circa* 1380, whilst the earliest statute fixing the acre as of these dimensions is 1277.

Turning to Langdon's acra, we find that, in Oxfordshire, the area of the strip varies enormously, just as the length of the furrow varied. For example, in the plan of Tackeley, the area of the acra varies from 1 r. 7 p. to 1 ac. 0 r. 6 p. in the main body of the Open Fields. A few isolated strips which bear every appearance of being later additions recovered from waste lands are even larger, one of these called " Longe Acre " is 1 ac. 1 r. 24 p. In order to avoid overstressing the disparity in size, these freaks are omitted in Table 5, the sign* being used to indicate such omission.

The multiples of the acra are freely used, such notes as *ij*^{ac}Ed. Standerd, Parsonage *V*^{ac}, *V*j^{ac} B. Tippinge, occurring frequently. A sub-multiple, the demi-acra, is also strongly in evidence, and the sign " 1^{ac} Di " for 1½ acra sometimes appears. In one place, in Marston, we get the " 1 yard "† for the ¼-acra. In view of these facts, a theory that the original acra was disguised by later application of the term to its multiples and sub-multiples would seem untenable.

When the width of the acra is studied there is a much greater measure of agreement. Even without making measurements it is easy to see by eye that in wedge-shaped furlongs the width of the acra is roughly constant throughout.

Attempts to determine the width of the acra by measurements on the single strip would involve errors both from Langdon's plotting and from my own measurements. I have, therefore, measured a number at a time, noting, however, by eye in each case that these were roughly the same width, so that division would give a reasonably correct determination of the width of each.

Individual results are given in Table 6 and these are summarized along with the data regarding area in Table 5.

In Tackeley, the width of the acra varies from 2·50 to 3·30 poles, the mean of 123 acra being 2·90 poles; here, again, a couple of isolated cases on the outskirts have been omitted, it would obviously have been fallacious to include these two acra each of 4·5 poles when no others were found greater than 3·3 poles. Such instances are shown in Table 6, but omitted from Table 5, in which the * sign indicates an omission. In this parish the ratio in area of the largest to the smallest acra is 3·53, while the ratio in width of the widest to the narrowest is merely 1·32. Care was taken to include the largest and the smallest areas in the blocks whose widths were determined, and a definite effort was made to discover the widest and narrowest acra so that the picture drawn in the tables might be reasonably correct.

The tables must now speak for themselves, though, in order to

† *Note.*—The old English " gyrd " generally accepted as being a perch in length

include a third Oxfordshire parish, measurements of even a ½-acra had to be made in Marston, since Corpus only owned isolated property there. In this county the area ratio of the acra is 4·70, whereas the width ratio is only 1·76; and the average width of 608 acra is 3·10 poles.

The only other county in which Langdon states the number of acra is in part of Berkshire. Here, in West Henreth, we find the area of the acra as well as the width shows a fair measure of constancy. In order to attain this constancy, cases had to be disregarded in which large blocks of six or more strips belonged to one individual, for it seemed as if in these instances the holder did what he liked and ploughed his land in as many, or as few, strips as he pleased; such, at least, seemed the most rational explanation of a variation not to be found in the lands divided between many holders.

CONCLUSIONS REGARDING THE FURLONG AND ACRA.

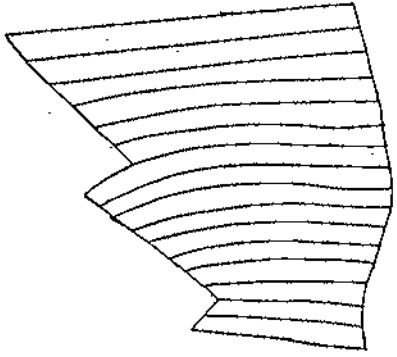
It has been generally supposed by antiquaries that the acra was the fundamental unit of area, and that the furlong is merely a derivative formed by the addition of a number of acra, usually regarded as 10 acra, though a unit of 5 acra is sometimes given. From the evidence given above, it appears that *the furlong was the fundamental unit of area*, though we must disabuse our minds of any idea of precise measurement entering into its composition; the acra was the name given to the strip, and the number of the acra in the furlong varied within wide limits.

This is made more clear by the sketches below showing actual furlongs according to Langdon. Cowebridge furlong is a more typical furlong than the other two, as can be readily seen from the map reproduced, though such irregular shapes as the others are by no means rare. In spite of this irregularity in shape, there is a reasonable constancy in the size of the furlong, but the number of acra contained in the furlong varies from 6 to 13 in these examples.

When the size of the acre was standardized by Edward I. its dimensions were given as 220 yards by 22 yards. This standardization doubtless based itself upon a conventionalized strip derived from local custom in some part of the country where the width of the acre was normally 4 poles. The length of the furrow had already been given a conventional meaning as early as the ninth century (see the quotation from the *Oxford English Dictionary* given on p. 475).

To understand this more fully we have to consider the method of ploughing the strips. It is well known that the strip was hump-shaped, and that this was the outcome of ploughing along the ridge, then turning sharply back with an adjoining furrow, then adding a furrow on the farther side of the first running the same way, and so

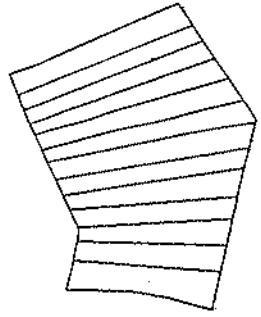
TACKELEY (OXON.)



Longe furlong
(Weste Fielde)

A double furlong:- North Part 6acra = 4ac, 1r, 13p.
South Part 10acra = 4ac, 3r, 14p

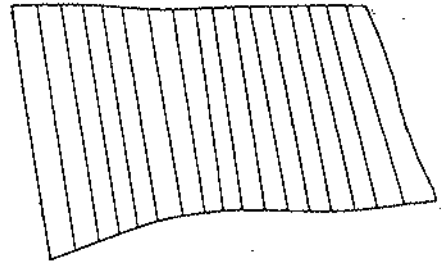
TACKELEY (OXON.)



Milnepath furlong
(Southe Fielde)

13acra = 5ac, 1r, 4p.

WEST HENRETH (BERKS.)



Cowebridge furlong
(Claye Fielde)

A double furlong:- 17acra = 10ac, 0r, 15p.

expanding in a series of whorls, the earth always being turned upwards towards the central ridge.

A rough constancy in the width of the original strip might be expected from a local custom as to the number of furrows on either side of the ridge. Here we may recall the quotation from Ellis, in 1882, given in the *New English Dictionary*, that it was understood to consist of 32 furrows, a statement possibly true in some part of the country. Even in the same locality the width of a constant number of furrows would vary with the soil, the furrows being deeper and hence wider in some places than in others.

The Oxfordshire constancy in width rather than in area throws considerable doubt on the generally accepted theory that the acra was originally the amount ploughed by a team of oxen in a day. Is it really possible to discover this area with any accuracy? Perhaps it can be estimated from the area ploughed by a horse in a day, bearing in mind the difference in construction between mediæval and modern ploughs (with its influence on the width of the furrow) and the fact that the pace of the pack ox is about two-thirds that of the pack horse.

The surveyor has, however, extracted his meat out of Langdon's maps and had better leave the rest to the antiquary. He alone can decide whether the evidence is consistent with the thesis of Seebohm's *Customary Acres and Their Historical Importance*. The main argument on which this book rests, to wit, the persistence of the Celtic field system of Romano-British times under the Saxon settlers, has been definitely disproved by modern researches. This short investigation into the acra shows that it bears little or no resemblance to the customary acres, and indicates that these latter may well drive their roots into the past to a comparatively shallow depth, being merely local derivatives of the furlong. The statute acre is probably merely a customary acre of some particular region taken by law and promoted to a position of ascendancy throughout the realm.

APPENDIX I.

SOME NOTES ON THE MAP REPRODUCED.

The map represents part of Langdon's map of West Henreth reproduced on his scale; upon it is superimposed a portion of the Ordnance Survey 1/2500 sheet reduced to the same scale. Owing to the absence of colour, the reproduction does scant justice to the appearance of Langdon's finished article, some of the broad bands of wash being rendered merely unsightly.

It is from a photograph which was left absolutely untouched, except for the deletion of a small portion of his highly ornate scale, and there-

fore it faithfully reflects any defects due to the photography of his many-hued plan on a wet plate.

Langdon originally drew this map on a scale of 1/3960, and the scale of reproduction is approximately the same; but only approximately, for it faithfully reproduces any distortion which the parchment has undergone during the course of over three centuries. Any slap-dash method of reducing the Ordnance Survey 1/2500 plan to a scale of 1/3960, and attempting to fit this over Langdon's work, would have been grossly unfair to the pioneer surveyor, so the following method was employed.

An impression was taken on tracing paper from the zinc printing-plate made from the photograph of Langdon's plan. The camera was then set up for a reduction of the Ordnance Survey plan to approximately the correct scale and the tracing paper impression was laid upon the focussing screen; adjustments to the amount of reduction were then made until it was deemed that the fit between the two maps was as good as possible; the photograph was then taken.

The Ordnance Survey reduction has been altered only by the change in position of those parcel numbers and areas which merely served to obscure details.

Some of the discrepancies between the two maps may be attributed to a change in the course of streams, especially in the stream flowing into the Rushe Brooke between Ox Leas and Meade Leas; a further cause may well lie in the possibility that distortion of the parchment may be unequal in different directions. It is, however, morally certain that a portion, perhaps the major portion, of the discrepancies lies in Langdon's errors. The general agreement between the two plans is, however, such as to do Langdon great credit.

An interesting point is the divergence between the sheet lines of the two maps. One's first thought is to suspect that it gives the magnetic variation in 1605. Such, however, is not the explanation, for it is known that the magnetic variation was about 8° to 10° east (see the diagram in *Watson's Physics*, page 631), while that deduced on the above assumption would be about 11½° west. This disregard for the points of the compass makes it extremely unlikely that Langdon employed that instrument in his method of surveying. The true explanation may possibly be that he drew his plan in the most convenient way to come on his sheet of parchment and added approximate points of the compass; how approximate these points can be, is shown by some of his other plans in which he transposes north and south, and in one case even north and east!

This conclusion is probably unshaken even when it is noted that, in some of his plans, Langdon draws a compass rose to show the orientation. From a check on these it is found that the north point is within a couple of degrees of true north, not magnetic north. This compass rose is found on his Leicestershire plans for Brasenose College in 1607, and in the Eynsford plans of the Corpus Christi series in April, 1615; it does not appear in most plans, including those of later date, such as those of November, 1615, so its appearance is rather haphazard. It thus leaves little scope for an argument that it might indicate a change of method, and the introduction of the compass into his field kit.

APPENDIX II.

TABLES.

TABLE I.

COMPARISON OF LANGDON'S AND ORDNANCE SURVEY AREAS.

O.S. Catalogue Number.	O.S. 1/2500 Plan.	Date of Langdon's Survey.	Reference Letter for Area.	O.S. Area, Acres and Decimals.	Langdon's Area, Acres and Decimals.	Error.	Per-centage Error.
329A	Berks, 14·8	Sept., 1606	A	38·424	36·107	−2·317	−6·0
,,	,, ,,	,, ,,	B	22·090	22·187	+0·097	+0·4
330A (a)	,, 28·1	Oct., 1606	A	0·401	0·344	−0·057	−1·4
,,	,, ,,	,, ,,	B	62·159	62·056	−0·103	−0·2
,,	,, ,,	,, ,,	C	31·716	31·125	−0·591	−1·9
330A (b)	,, 46·1	,, ,,	A	12·102	11·706	−0·396	−3·3
,,	,, ,,	,, ,,	B	13·501	13·782	+0·281	+2·0
340A (b)	Hants, 25·3	June, 1615	A	76·193	70·056	−6·137	−8·0
332A	,, 51·11	Nov., 1615	A	20·609	19·094	−0·515	−2·5
,,	,, ,,	,, ,,	B	23·013	23·819	+0·806	+3·5
,,	,, ,,	,, ,,	C	16·111	14·850	−1·261	−7·8
,,	,, ,,	,, ,,	D	24·910	22·534	−2·376	−9·5
,,	,, ,,	,, ,,	E	20·660	18·894	−1·766	−8·5
,,	,, ,,	,, ,,	F	21·742	21·531	−0·211	−1·0
,,	,, ,,	,, ,,	G	15·180	13·762	−1·318	−8·7
,,	,, ,,	,, ,,	H	4·973	5·125	+0·152	+3·1
,,	,, ,,	,, ,,	I	6·177	6·162	−0·015	−0·2
			Totals ...	409·961	393·134	−16·827	−4·1

Notes.—(1) Ordnance Survey areas are plan areas reduced to sea level, Langdon's areas are probably surface areas; if his accuracy was equal, his areas should, therefore, be the greater.

(2) Sir Charles Close has suggested that a contributory cause to disagreements in area may lie in the following. Property boundaries frequently do not coincide with natural features, such as hedges, etc., the actual boundary being so many feet from the centre of the feature. Presumably this was the case 300 years ago, though Langdon gives no clue to it on his plans. It is possible that Langdon's computations of area were made to the property boundary and not to the natural features.

TABLE 2.

SOURCE OF LANGDON'S ERRORS.

O.S. Catalogue No. 332A.

O.S. 1/2500 Plan. Hampshire 51·11.

Surveyed by Thomas Langdon, November, 1615.

A= Arithmetical Error. T=Topographical Error.

Reference Letter for Area.	Langdon's Name for Area.	Langdon's Area.	Ordnance Survey Area.	Langdon's Area Recomputed. (Scale factor deduced from Area F.)	Main Source of Error.
A	Greate freese	19·094	20·069	19·016	T
B	Little freese & Delve Close	23·819	23·013	23·166	A
C	Newlandes	14·850	16·111	14·692	T
D	Bosterne Hill	22·534	24·910	24·259	A
E	Barnesdale	18·894	20·660	19·222	T
F	Chaulk Crosse & Leydanes	21·531	21·742	21·531	—
H	Woade Mead	5·125	4·973	6·083	T & A

TABLE 3.

LENGTHS OF FURROWS IN MAPLEDOREWELL (HANTS).

O.S. Catalogue No. 334B.

All the furrows on the plan were measured.

Length in Poles.	Number of Furrows.	Length in Poles.	Number of Furrows.	Length in Poles.	Number of Furrows.
14	2	28	18	42	20
15	5	29	12	43	19
16	5	30	13	44	15
17	5	31	26	45	12
18	3	32	28	46	21
19	5	33	15	47	13
20	7	34	18	48	4
21	7	35	25	49	5
22	13	36	26	50	9
23	11	37	18	51	3
24	8	38	28	52	9
25	14	39	30	53	1
26	18	40	18	54	2
27	14	41	10	55	2

Total: 537 furrows. Average length: 34·8 poles.

Seebohm's figure for the furrow length of the customary acre in North Hampshire is 232 metres = 46 poles. There are no customary acres given by him, except Anglesey and Carnarvon, with a furrow of under 36 poles.

TABLE 4.

AREA OF FURLONGS.

Symbols: x = within 10% of 5 acres. ⊙ = comes under rule by accretion.

WEST HENRETH, BERKS. O.S. Catalogue Nos. 329 A and B.

Parcel.	Area.	Symbol.	Parcel.	Area.	Symbol.
Wickes F. ...	19.0.21	x	Under Smallway ...	13.1.2	
Cowe Drove F. ...	20.1.33	x	Gallowe F.	13.3.12	x
Farther Rushe-brooke F. ...	9.3.12	x	Barcowe F.... ...	16.1.0	x
Rippen F. ...	4.1.29	⊙	Broade landes ...	14.0.21	x
Claye Piece ...	9.3.32	x	Ten acre F. (west of path)	11.2.23	⊙
Downehilles F. ...	8.1.16	⊙	Do. (east of path) ...	10.3.10	x
Area north of Under Raineborough ...	5.1.24	x	Portewaye F. ...	11.3.29	
Under Raine-borough F. ...	5.1.24	x	Area south of ten acres	11.3.35	
Raineborough F.	5.2.03	⊙	Ten acre F. (Southe Fielde)	15.3.39	x
Cowebridge F. ...	10.0.15	x	Area north of Park F.	9.1.3	x
Briar Bushe F. ...	12.2.24		Park F.	9.3.9	x
Gore F.	12.3.18		West F.	31.3.33	x
			East F.	30.1.30	x

MAPLEDOREWELL, HANTS. O.S. Catalogue No. 334B.

Code Letter.	Area.	Symbol.	Code Letter.	Area.	Symbol.	Code Letter.	Area.	Symbol.
A	10.1.22	x	J	21.2.4	x	S	15.0.27	x
B	5.2.38		K	14.1.1	x	T	11.2.35	
C	12.1.10		L	17.1.16	⊙	U	4.3.30	x
D	15.0.33	x	M	17.0.10	⊙	W	4.2.24	x
E	4.1.38	⊙	N	6.0.0	⊙	X	10.3.15	x
F	15.3.18	x	P	9.3.17	x	Y	17.2.18	
G	15.0.18	x	Q	9.0.19	x	Z	5.1.37	x
H	27.3.26	x	R	15.2.35	x	d	10.2.11	x

Note.—A print marked with the above code letters is stored at the Ordnance Survey to facilitate check as to the validity of the presumed division into furlongs.

TABLE 4 (*cont.*).

TACKELEY, OXON. O.S. Catalogue No. 343A.

Area of the numerous strips belonging to Edward Standerd, yeoman, estimated from those of the adjoining strips belonging to Corpus Christi College.

Parcel.	Area.	Symbol.	Parcel.	Area.	Symbol.
Clay F.	3.1.16		Fishers F.	7.2.15	
Longe F.	9.0.27	x	Shorte over ...	9.3.21	x
Stonyborrow ...	8.2.28		Longe over ...	16.2.36	
Sandes	4.2.34	x	Under whitehill hill	5.0.10	x
Foreshooters ...	7.3.19		Longe F.	20.3.21	x
Glyden-herne ...	12.0.21	*	Shorte F.	21.3.4	x
Milnepath F. ...	5.1.4	x	Leaes acres ...	5.3.24	

* Glyden-herne has internal evidence of an accretion of 3 acres.

HAYEFORDE, OXON. O.S. Catalogue Nos. 341 A and B, 342 A and B.

(Furlongs measured between 4 and 12 acres; none are named by Langdon.)

Area.	Symbol.	Area.	Symbol.	Area.	Symbol.	Area.	Symbol.
11.1.0		6.0.0		9.0.20	x	6.1.10	
4.2.4	x	5.2.16		4.2.24	x	4.3.38	x
8.3.0		4.2.31	x	7.2.18	*	5.0.4	x
5.2.16	x	4.3.11	x	12.2.28	*	4.2.32	x
4.1.17		5.1.24	x	5.2.34		5.0.6	x

* These two parcels are beside two fields called "Farmer's New Close" and are, therefore, probably comparatively modern accretions from the waste.

TABLE 5.

SUMMARY OF AREAS AND WIDTHS OF THE ACRA.

O.S. Catalogue No.	Parish.	County.	Areas.			Widths (poles).			Average Width.	No. of Acra Measured.
			Max.	Min.	Max./Min.	Max.	Min.	Max./Min.		
343A	Tackeley	Oxon	1.0.6*	1.7	3.53	3.30*	2.50	1.32	2.90	123
341A	Hayeforde	,,	1.1.3	2.4	2.42	3.87	2.50	1.55	3.14	106
341B	,,	,,	1.1.11	1.26	3.20	4.25	3.00	1.42	3.41	82
342A	,,	,,	1.0.6	1.33	2.22	4.25	2.42	1.76	2.97	146
342B	,,	,,	1.0.10	2.2	2.08	3.75*	2.75	1.36	3.11	108
348A	Marston	,,	1.0.24	1.20	3.07	4.20*	3.00	1.40	3.30	26
348B	,,	,,	1.1.20*	2.0	3.75	4.00	3.17	1.26	3.48	17
Oxfordshire			1.1.20	1.7	4.70	4.25	2.42	1.76	3.10	608
329A	West Henreth	Berks	3.36*	2.3	1.68	3.86*	3.00*	1.29	3.32	171
329B	,, ,,	,,	3.16*	2.14	1.45	4.00*	2.83	1.42	3.32	91
Berkshire			3.36	2.3	1.68	4.00	2.83	1.42	3.32	262

* A few anomalous instances have been omitted in these cases since their inclusion would give a false impression. The necessity for these omissions is referred to in the text.

TABLE 6.

MEASUREMENTS OF THE WIDTH OF THE ACRA. (SUMMARIZED IN TABLE 5.)

Number of Acra.	Width Poles.	Average Poles.
Tackeley (*Oxon*). *No.* 343*A*.		
10	30	3.00
8	22	2.75
10	28	2.80
8	22	2.75
4	12	3.00
10	33	3.30
10	30	3.00
10	33	3.30
9	25	2.80
10	29	2.90
12	30	2.50
6	17	2.80
6	22	3.15
10	24	2.40
123	357	2.90
Omitted :—		
2	9	4.50
Hayeforde (*Oxon*). *No.* 341*A*.		
10	31	3.10
10	31	3.10
8	31	3.87
8	21	2.62
12	30	2.50
10	34	3.40
10	36	3.60
6	19	3.16
8	24	3.00
6	21	3.50
10	35	3.50
8	20	2.50
106	333	3.14
Hayeforde (*Oxon*). *No.* 341*B*.		
10	35	3.50
12	40	3.33
6	22	3.66
8	34	4.25
13	40	3.08
12	36	3.00
6	18	3.00
6	23	3.80
9	32	3.55
82	280	3.41
Hayeforde. *No.* 342*A*.		
4	17	4.25
7	27	3.86
10	29	2.90
12	30	2.50
10	26	2.60
16	43	2.69
12	29	2.42
10	34	3.40
12	35	2.92
12	40	3.33
14	37	2.64
5	16	3.20
10	33	3.30
12	33	3.08
146	433	2.97
Hayeforde. *No.* 342*B*.		
12	34	2.83
8	26	3.25
15	45	3.00
8	31	3.75
12	43	3.58
8	22	2.75
8	25	3.12
6	19	3.16
12	33	2.75
9	28	3.11
10	30	3.00
108	336	3.11
Omitted :—		
8	51	6.37
Marston (*Oxon*). *No.* 348*A*.		
½	2.2	4.4
½	2.0	4.0
½	2.0	4.0
1*	3.8	3.8
1*	3.7	3.7
½	2.0	4.0
7	21	3.0
1½	4.8	3.2
1½	5.4	3.6

* Suspected error of Di ac. instead of 1 ac.

TABLE 6 (*cont.*).

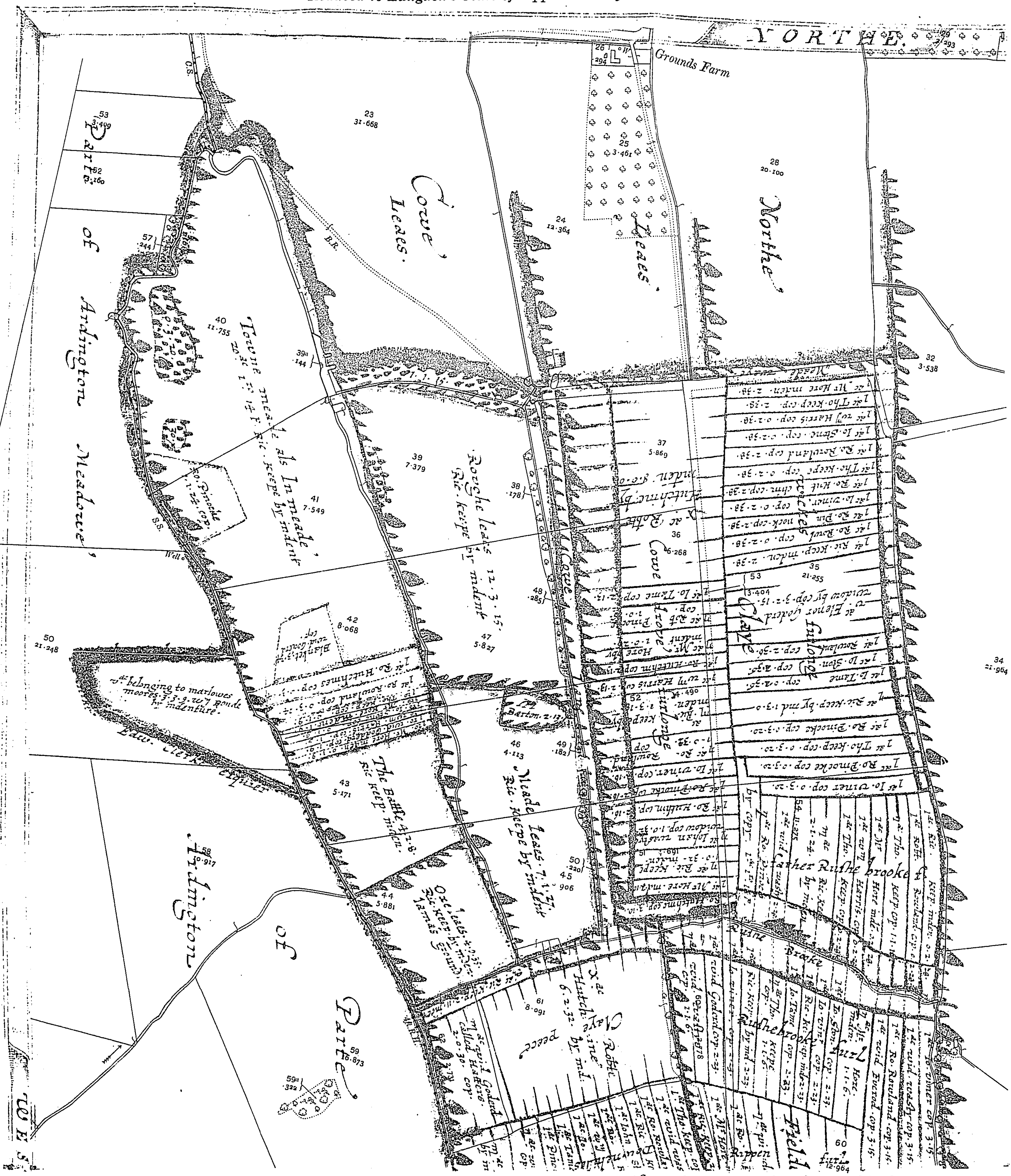
Number of Acra.	Width Poles.	Average Poles.
Marston (Oxon). No. 348A (cont.).		
6	18	3·0
1	3·9	3·9
5	17	3·2
26	85·8	3·3
Omitted :—		
4	8	2·0
Marston (Oxon). No. 348B.		
3	9·5	3·17
1	3·4	3·40
2½	10	4·00
1½	5	3·33
1½	5·2	3·40
1	3·8	3·80
½	2·0	4·00
½	1·8	3·60
3½	11·2	3·34
1½	5·4	3·60
½	1·8	3·60
17	59·1	3·48
West Henreth (Berks). No. 329A.		
10	33	3·30
10	33	3·30
10	35	3·50
9	33	3·33
10	32	3·20
4	15	3·75
8	24	3·00
7	21	3·00
8	25	3·12
7	27	3·86
11	33	3·30
10	30	3·00
10	31	3·10
9	30	3·33
5	18	3·60
6	23	3·83
3	11·5	3·83
5	17	3·40
9	29	3·22
10	35	3·50
10	33	3·30
171	568·5	3·32
Omissions (see text) : —		
10	42	4·20
10	26	2·60
7	25	3·57
6	30	5·00
West Henreth. No. 329B.		
7	25	3·57
6	23	3·83
5	20	4·00
10	37	3·70
7	22	3·14
10	31	3·10
12	34	2·83
12	38	3·17
10	34	3·40
12	38	3·17
91	302	3·32

Omissions—several large blocks not measured after experience with 329A.

Part of West Henreth (West Hendred Berkshire) according to Langdon, 1605.

Part of Ordnance Survey 1/2500 Berkshire XIV. 8. 1912 Edition.

Reduced to Langdon's Scale of Approximately 1/3960.



Ordnance Survey Catalogue Number 329a (part of)

ANNUAL TRAINING OF FIELD COMPANIES OF DIVISIONAL ENGINEERS.

By CAPTAIN E. H. T. GAYER, R.E.

PART I.

QUESTIONS are so frequently asked regarding the methods and programme of annual training of Divisional Engineers, that it might be useful to many to compile this information into a short article. It is by no means intended to lay down that the policy advocated here is necessarily the best, but experience has shown that training carried out on these lines does produce good results, though doubtless it might be improved in many ways.

In the last paragraphs are given some of the chief difficulties which affect training as a whole.

The annual training is normally divided into two periods :—

1. The Individual Training Period, October 1st–March 31st.

This period is preliminary to

2. The Collective Training Period, April 1st–September 30th.

These dates should be taken as a guide, not as a hard and fast rule.

INDIVIDUAL TRAINING PERIOD.

This is divided into two main categories :—

1. Technical Training. 2. Military Training.

Of necessity, there must be a more definite dividing line between Technical and Military Training during the Individual Training Period, than during the Collective Training Period, when every endeavour is made to introduce a tactical aspect into all technical work. Though, as is shown later, there are Technical and Military Trainings days in every week.

Technical Training.

1. The main object of technical training is to improve skill at trades, in practically all of which, at present, the standard of the

Royal Engineers is low, and most markedly so in the house-building trades. The ideal at which to aim is the production of a tradesman who compares favourably with his pre-war counterpart in civil life, both in skill and in speed of application.

The method adopted is twofold :—

(*a*) By Divisional Engineers Workshops (instructional and productive) run centrally.

(*b*) By allotment from Chief Engineer through C.R.E. Works Districts of certain suitable works to C.R.E. Divisional Engineers.

From the unit point of view, it is, in many ways, desirable that each Field Company should teach and practise its own men at their trades. This necessitates duplication of teaching and supervising staff and limits the scope of work which can be undertaken. Better results can be obtained by centralizing Technical Training as follows.

2. The entire personnel of the Divisional Engineers available for technical training are placed at the disposal of Officer i/c Workshops (*e.g.*, O.C., " A " Field Company). Certain N.C.O's and men are selected by him as permanent Workshops staff and instructors. Officer i/c Workshops is responsible for teaching all trades and examining men for promotion to higher rates.

In a station where there are more than one Divisional Engineers and possibly other R.E. units as well, it is convenient to organize Workshops as follows :—

A. One Workshops for men of all units, for such trades as Fitter, Fitter Drivers, Electricians, Engine Drivers and Blacksmiths.

B. Divisional Workshops for the building trades for each Divisional Engineers (men of these trades from other R.E. units are taught in the Divisional Workshops).

3. The various works allotted to the Divisional Engineers (see para. 1 (*b*)) are controlled by O.C. " B " Field Company.

The personnel he requires to carry out and supervise the works will be provided by Officer i/c Workshops. Such work as doors and frames, windows and frames, are provided for the works by the Officer i/c Workshops, therefore close co-operation between Officer i/c Works and Officer i/c Workshops is essential.

If the Works and Workshops are both placed under the control of one Field Company Commander, the control of training in trades and productive output will undoubtedly be simpler, but the Company Commander concerned will be rather overburdened. This is, however, probably the better system.

The more productive work that is undertaken and expected from Divisional Engineers, the less trade instruction will the pioneers and Class III tradesmen receive; they will be employed chiefly in "devilling" for the more skilled.

In order to maintain the balance between trade training and productive output the technical training might be run on a two-year cycle. The first year trade instruction should receive priority, the second year productive work.

4. After the Companies' early-morning parades, men fall in on a Regimental Workshops parade, by Workshops, in trade groups, and move to their works under orders from Officers i/c Workshops and Works.

5. In order that full value may be obtained from the works allotted to Divisional Engineers, the following points should be taken into consideration.

(*a*) The type of work must be suitable for the workmen and supervising staff available. The limiting factor is usually the small establishment of bricklayers, and the very low standard of this trade.

(*b*) The preliminary work of design, order and delivery of stores must be undertaken in sufficient time to prevent delay on the work when once begun.

Design and quantity estimating may be admirable training for young officers, but unless it is undertaken many months beforehand, to allow radical alteration by C.R.E. Works District, great delay to the progress of the work, and the training of men, may be caused. This means that the officer must make his designs, etc., during the height of the Collective Training Season, when he is sufficiently occupied with other work.

(*c*) Continuity and completion of work are essential.

To ensure these, hours of work must be continuous and not split up by "meal-breaks."

Working days must be whole days.

Time spent in moving to and from work sites, and in taking up and laying down tools must be reduced to a minimum.

As far as possible the interruptions due to recreational training and furlough must be foreseen.

Brickwork and concrete which are affected by frost must be pushed on at top speed from the start.

Supervising N.C.O's must work on the same job from start to finish.

(*d*) It must be remembered that only Classes I and II tradesmen derive really valuable instruction in their trades when employed on these works. The Class III man will spend 90% of his time doing coolie work for the more skilled man; he is better employed in the workshops.

(*e*) If too large or ambitious a work is undertaken, it may be unfinished at the end of the Individual Training Season. This is bad for morale. It can be finished by employing civilian labour in certain trades to work alongside sapper labour. This has much to recommend it, as the sapper can see how the civilian works, and will usually gain experience from his superior skill. Or, *faute de mieux*, by continuing "works" into the Collective Training Season, when it will linger in a moribund condition for weeks, inadequately supervised, unless other training is cut down.

(*f*) Experience shows that it is rarely practicable to undertake a Works job of a cost greater than £1,500, unless it be of a very simple nature.

6. An imaginative example of the ideal work to be undertaken is:—

A large cricket pavilion, with several rooms and two storeys.

Foundations and ground floor..	Concrete.
Up to plinth level	Brickwork.
Walls	Wooden between pillars.
Fireplaces, chimneys and reinforcing arches over doors and windows	Brickwork.
First floor	Wooden.
Doors, windows, roof	Any type.
Drainage, electric light, sanitation	Any normal type.

Military Training.

It is considered essential that a proportion of time be devoted to Military Training subjects throughout the Individual Training Season. It acts as a mental and physical stimulus, constitutes a change, is undertaken on a half-day which would be worthless as a "works" day, and avoids too long a period of continuous Military Training later which tends to become monotonous.

1. *General System.* Until Christmas, Saturday mornings are Military Training periods, *i.e.*, about 40 ¾-hour periods are available. With this in view, the Field Company Commander should draw up a

progressive programme, confined to the elementary parts of squad drill, weapon training, gas and physical training, and an occasional simple tactical scheme for N.C.O's, probably on a sand table.

It is a moot point whether more beneficial results can be obtained by squadding men, according to their capabilities, or by retaining the section organization. If the former is adopted the men may gain, but the chain of command and automatic working of the machinery of the unit will suffer.

These Saturday morning programmes are very liable to alteration through unforeseen events, and should therefore be elastic and cover limited ground.

After Christmas, starting about January 20th, when men return from annual furlough, the period of Military Training is most conveniently extended to all day Fridays and Saturday mornings, thus avoiding a break in the " works " week.

Concurrently with this after Christmas the junior and senior N.C.O's' cadre classes take place. First, for four weeks on Mondays to Thursdays, inclusive, junior corporals, lance-corporals and would-be lance-corporals are trained in drill, weapon training, physical training, map reading and R.E. reconnaissance schemes, under centralized arrangements. These N.C.O's are then available to teach their men on Fridays and Saturdays what they have learnt during the week. At the end of the junior N.C.O's' cadre class the whole unit should be fairly proficient in squad drill. Second, the senior N.C.O's' cadre class, for senior corporals, lance-serjeants and serjeants, begins immediately after the junior N.C.O's' class finishes, and is run on similar lines for five weeks. By the end of this time, about 25th March, the unit is ready to start Company Drill, and other subjects have reached a similar stage of development.

From about April 1st (the beginning of the Collective Training Season) three weeks is spent on continuous Military Training, now including gas and tactical schemes. These two subjects are not taught in the cadre classes, firstly on account of the limited time available, and secondly it is considered that these subjects can be better taught within the unit.

It would be of great advantage if N.C.O's' cadre classes could be extended to embrace the Annual Fieldworks Course, or each Field Company could run a potted Fieldworks Course, for its N.C.O's during the latter half of the Individual Training Season, and take them through the course proposed for the Collective Training Season. At present this is not possible, until a pool of N.C.O. instructors, other than those withdrawn from Field Companies, is available for Divisional Workshops and supervision of Divisional Works.

2. *Drill.* Drill, unless done well, is positively harmful. The time which can be reasonably devoted to drill is restricted : if good results are to be obtained, the drill syllabus must not cover too wide

a field. It is thought that a high standard can be obtained by organization on a sound basis and a limited programme. To be more explicit, great attention must be given to :—

Good marching ; steadiness on parade ; clear and accurate words of command ; checking of faults.

These are the foundations for good drill. If these have been achieved it is only necessary for the unit to be able to carry out the more common evolutions of drill really well ; if occasion arises there would be no difficulty in teaching the more unusual movements.

3. *Weapon Training.* On the whole the standard is fairly high and calls for little comment. One or two Hythe-trained N.C.O's per Field Company and at least one Hythe-trained officer in Divisional Engineers are desirable.

4. *Tactical Training—N.C.O's.* Here again the time available is very limited, and the tactical knowledge required from a R.E. N.C.O. in war time must be the primary consideration. Royal Engineers will not be used in an infantry capacity except in an emergency. It would seem that the tactical knowledge of the Field Company Section serjeant might be confined within the following limits :—

1. Knowledge of the principles of local self-protection both on the move and at rest.
2. A fairly detailed knowledge of the principles of defence in mobile and static warfare.

Officers.—A series of some half-dozen tactical and technical exercises for officers is run by C.R.E. during the Individual Training Season, assisted by "C" Field Company Commander, who is free from trade training responsibilities.

4A. *Reconnaissance.* This subject, which is a very important part of R.E. work in war, does not always receive the attention which it merits.

Preliminary reconnaissances, which must be accurate, will frequently be undertaken by N.C.O's. It is essential that they are trained in peace on sound lines, and preferably on similar lines throughout the Corps for reconnaissance, for

Water Supply.	Railways.
River Crossing.	R.E. Stores.
Roads.	Demolition of Bridges, etc.

Whenever practicable, *pro forma* should be used.

N.C.O's must be capable of producing legible, concise reports in tabulated form, supplemented by neat, simple sketches.

The art of elementary drawing and the correct use of paper, pencil and indiarubber needs careful attention. No one can produce a neat sketch using a 5B pencil and with dirty hands. Few senior N.C.O's have been taught these elementary facts early in their career.

5. *Education.* This is run under centralized arrangements for all classes, and is also controlled by " C " Field Company Commander, with a staff of qualified instructors drawn from the three Field Companies.

6. *Courses.* The Individual Training Season is the most suitable time to send officers and N.C.O's on courses such as small arms school, chemical warfare, though frequently courses must be fitted in throughout the year as opportunity offers.

7. *Leave.* To obtain the best results from the system of Individual Training as outlined, Divisional Engineers must take leave *en bloc*, approximately between 20th December and 20th January.

8. *Mounted Personnel.* Training during the Individual Training Period is restricted to daily exercise and instruction in, and rigorous supervision of, horse and stable management. It may be found necessary to train dismounted personnel in mounted duties during this period.

The type of man who makes the best field company driver is not the Weedon-trained horseman. The first and foremost qualifications must be a thorough, sound knowledge of the care and turn-out of horses and harness, both in stables and on the line of march, backed up by sufficient knowledge and character to control the rider and draught horse, across country and in traffic.

Collective Training Season.

April 1st—September 30th.

In making out a forecast for the Collective Training Programme, social and sporting events such as tattoos, horse shows and various rifle meetings must be considered. Collective Training starts with three weeks' intensive Military Training as already described in para. 1; the general system of Military Training.

1. From approximately April 20th until May 4th the whole period is devoted to weapon training and the firing of annual musketry (rifle and A.A. Lewis gun). All men must pass tests of Elementary Training as laid down in *Small Arms Training*, before firing on the ranges.

2. It has also been found that if all men pass tests of Elementary Training in Fieldworks before Fieldworks proper begins, about the beginning of May, that delay to the whole unit while elementary groundwork is imparted to the dullards is avoided.

These tests have been evolved locally and briefly are as follows :—

Knowledge of all common knots and lashings.
Use of the Field Level.
The ability to define in simple language the more common definitions on pages 1–5, *Manual of Fieldworks* (*All Arms*).
A thorough knowledge of names and use of all articles used in various types of demolitions.
Wiring Drill, etc.

These tests are usually carried out during March and April.

They are particularly useful for filling-up periods allotted to drill and outdoor weapon training, in wet weather, when no drill shed is available.

3. *Fieldworks.* Fieldworks are the main theme of the whole Collective Training Season, with breaks for Brigade and Divisional Training and manœuvres.

It is realized that it is not possible for each Field Company to carry out the whole syllabus of Fieldworks in one year, and the system adopted is that the Divisional Engineers carry out all subjects in one year, and that each Field Company works on a three-year cycle, during which it carries out all subjects twice. Certain subjects must be carried out each year by all Field Companies, such as :—

Field defences (as part of an organized tactical scheme if possible) ; demolitions ; watermanship (the foundation of pontoon bridging) ; pontoon bridging ; Martel girder bridging ; use of spars ; trestle and kapok bridging ; obstacles.

Subjects which must be included in the 3-year cycle twice :

Tubular scaffolding ; mining ; roadways ; decauville railway ; pile driving ; camps and water supply ; suspension and tension bridges ; bridging expedients ; crib piers and steel cubes ; mechanical appliances, as occasion offers ; tree felling.

An adequate Fieldworks Ground is a *sine qua non*. Here should be built accommodation for stores, to avoid endless wasted time in drawing and returning stores.

A bridging pit, explosives magazines and a bursting chamber are other desirable attributes on the Fieldworks ground.

It is found that more value can be obtained from bridging camp if the elements of watermanship and pontoon bridging are learnt locally, prior to camp. It should be understood that extreme speed

in and rigid adherence to the exact forms of pontoon drills is not an end in itself. Men may be perfect at these drill movements but singularly unskilful in manœuvring boats and rafts in difficult conditions of wind, tide and weather.

4. Whenever possible Field Companies are sent into camp for such purposes as :—

1. Constructing Camps for Infantry, etc.
2. Field Defences.
3. R.E. work on private estates. Most valuable training can be obtained, and work done which is not dismantled, often of a nature that could not be found in the station. Any work that involves organization of labour on a fairly large scale, is first-rate training for officers and N.C.O's.

5. *Co-operation with Other Arms.* This is encouraged whenever possible, and should not be confined to the Collective Training Season, *e.g.* :—

1. Field Defences Schemes.
2. R.A.F. Co-operation. By aerial photography, flights for R.E. N.C.O's, etc.
3. Brigade Training, Divisional Training and Manœuvres. Camps, water points, etc., frequently have to be constructed.
4. Attachments to and from Other Arms. To obtain real value from these they should not be of shorter duration than one month. The "attachee" must be given command of a real job.

If Formation Commanders can be induced to include a bridging operation in their tactical schemes, Field Companies can perform bridging operations by day and night with improvised motorized pontoon or other bridging trains, thus obtaining more realistic training than in bridging camp, where the practical difficulties of transporting the correct stores to the site in the order in which they are wanted are not usually brought out.

Other work for R.E. on combined training is mainly demolition schemes, anti-tank mine-laying schemes, construction of tank obstacles and water supply (mobile and stationary).

6. *Miscellaneous.* As soon after manœuvres as possible, casuals' musketry takes place, and Q.I. Examinations on the year's Field-works Course are held. The annual "housemaiding" preparatory to the inspection of the Divisional Commander is also undertaken, as this inspection is usually made soon after the end of the Collective Training Season.

7. *Mounted Personnel.* Riding and driving drill are carried out early in the Collective Training Season.

Route marches and movements to camps are invaluable for conditioning horses for Divisional Training and Manœuvres and for turning the driver into a handy man.

GENERAL.

1. Owing to the all too frequent changes of officers, N.C.O's and men, and the small Peace Establishment of a Field Company, R.E., many economies in instructors can be made and repetition of work saved, by centralizing certain items.

In this way the services of the few highly trained personnel in each Company can be made available for all, *e.g.*,

Horse Exercise in the I.T. Season is run divisionally, thus reducing the number of N.C.O's required to supervise this.

Where one or more Divisional Engineers is concentrated, it is essential that the system of training is similar throughout, it is also highly desirable that certain matters of routine and procedure be the same in each unit, *e.g.*,

Dressing of tool-carts.
Turn-out of men, horses and vehicles.
March discipline. If one Field Company in a Divisional Engineers allows its men to smoke on the march, and the others do not, men may be disgruntled.

On the other hand, in order to avoid the disadvantages of over centralization and to gain the advantages of the independent Field Company, it would be excellent if all the Field Companies of the four Divisional Engineers could each take its turn for a year or two in the one Field Company station.

2. It will not be out of place to mention some of the chief problems in connection with the training of his unit, with which the Field Company Commander has to contend.

Undoubtedly the greatest difficulty is the incessant movement of officers, N.C.O's, and men owing to the general roster principle. It is practically impossible to train all of them at once. The average stay of an officer, N.C.O., or man in a Field Company is about 18–21 months. For the first twelve months the officer and N.C.O. is of no use as a " trainer," unless he has had previous experience, which is rarely the case.

This lack of continuity is most marked in all forms of training, particularly when a unit is employed on Works. The majority of all ranks in a unit are new to their job, every year, with a resultant loss of efficiency and slowing up of the rate at which men work. One of the most crying needs is to teach N.C.O's and men to work

without wasting time. Greater stress should be laid on the necessity of finishing work within a given time. Knowledge should be imparted to all concerned from the outset, that overtime must be put in if necessary, unless delay is caused from circumstances beyond the control of the individual responsible for carrying out the work.

3. Intimately connected with the lack of continuity is the want of a real chain of responsibility throughout the unit, resulting in a failure of the assured smooth working of the internal machinery of the unit. The Section Commander and the N.C.O's of his section must be made responsible for the welfare and instruction of all their men in every detail at work and at play, with the possible exceptions of instruction at trade and education.

The section organization should be the foundation of the training of the Field Company, even though the difficulties of maintaining it, owing to the low establishments and incessant changes of personnel, are many.

At present it seems that units work efficiently largely on account of the almost superhuman efforts of a few outstanding personalities, rather than by the well-ordered and concerted efforts of all the officers and N.C.O's. Officers must not do the work of N.C.O's. This leads to overworking the officer, and a complete lack of a sense of responsibility in the N.C.O.

With our existing system of the general roster for all ranks, the proper chain of command and definite allocation of responsibility is so very essential. Once attained, even though it take a year or more, the efficiency and ease with which the unit will work will increase rapidly. The knowledge that he is in complete charge of his work will bring out the best (or worst) in a N.C.O., and he will learn his job quicker and better than by any other method. If a Section Commander is absent, rather than transfer temporarily a senior N.C.O. from one section to another the charge of that section should be left to a junior N.C.O. It is part of the duty of the juniors to know what the responsibilities of their immediate seniors are, and to be able to carry them out in their absence. Too much stress cannot be laid upon this, whether the unit be a Field, Fortress, Survey, Railway, etc., Company. The subject of " Responsibility of N.C.O's," and all that it entails, should be of prior importance in the annual training programme, day in and day out.

A SMALL SURVEY IN IRAQ.

By LIEUTENANT A. J. H. DOVE, R.E.

GENERAL.

IN October, 1930, it was found necessary to make a survey of a small area lying between the River Euphrates and Lake Habbaniyah, with a view to the possible construction there of the new air base required by the terms of the 1930 Anglo-Iraq Treaty.

TOPOGRAPHY.

The area consisted of a plateau about two miles wide, falling sharply away on the north to the River Euphrates (flowing at that place in a general west to east direction)—a bend of which lay about two miles from the plateau edge—and also falling sharply on the south to the lake, about half a mile away. Westwards the plateau fell away in a jumble of small valleys, and joined a low ridge running out towards Ramadi. Eastwards the plateau extended with little variation for some miles. The general height was about 120 feet above the river and the lake. The plateau itself appeared to the eye to be almost dead flat. North and south the edge was precipitous in places, but a line of levels could be run with care up the majority of the small valleys leading to it.

REQUIREMENTS OF THE SURVEY.

The requirements were :—

(*a*) A map of the plateau extending about three miles eastwards from the western edge on a sufficiently large scale for individual buildings to be sited, and drainage, irrigation and water supply systems marked out. For this it was important to determine the extreme limits of the plateau up to which buildings could safely be sited.

(*b*) To determine the relative heights at that time of the river and the lake, and to obtain a plan and cross-section of the most promising route for a water supply pipe-line. The heights were to be connected to the Survey of India datum.

(*c*) To show on the map the most promising lines for approach roads to the plateau from the riverside, on which lies the main Bagdad–Ramadi–Damascus road, and from the lake, in sufficient detail to enable approximate estimates of cost to be prepared.

Preliminary Considerations.

The party available consisted of two R.E. officers, one R.E. serjeant, and eight entirely untrained Arab coolies.

The time available for the survey was three weeks, though this was in the end extended by four days.

It was found that the Iraq Survey Department had recently covered the area with a triangulation, and could supply the co-ordinates and heights of about a dozen points, mainly intersected. To complete the horizontal framework five further points were intersected or resected.

Scale Decided On.

It was decided to work on a scale of 600 feet to the inch, and to contour the plateau at two-foot vertical interval as far as the edge. Road approaches, route of pipe-line, etc., were to be shown at ten-foot vertical interval, with interpolated five-foot contours where required to show the shape of the ground more clearly.

Framework.

A good deal of trouble was soon caused by the vertical framework. In the first place, no station marks could be found at the intersected points, which consisted of cairns of earth about three feet high. One peg, a wooden one about eight inches long, shaped rather like a parsnip, was found at a main trig. station, and a telegram to Bagdad produced the information that the intersected points had no station marks, the heights being given to the ground-level of the cairns.

Meanwhile a line of levels had been run along one edge of the plateau connecting two of the extreme trig. points, only to disclose a large error in the heights. A check ring round the main plateau area, however, closed with a very small error, and the discrepancy was finally found to be a slip in the computation of the trig. heights. Meanwhile the "parsnip" had been taken as datum, and the work proceeded, using the check line as the main vertical framework.

Detail Work.

(*a*) *General.*

The close contour interval necessitated the contours being fixed instrumentally, and the short time available meant that the contours

would have to be plotted with the least possible delay. This precluded any use of chain survey methods, and a trial was given to the combination of level and stave with plane-table and alidade.

(*b*) *On the Plateau.*

The method of working found most satisfactory on the plateau was to fix the position of the level on the plane-table, and then locate points on the contours with the stave, marking the stave position on the plane-table by using the alidade for direction and the stadia hair readings on the level for distance. The chief difficulty was to locate the contours. The fall was so small, some twenty feet in two miles, that it was quite impossible in most places to see which way the ground sloped. Even after a fortnight's practice the ground frequently seemed to the eye to be sloping the wrong way. Points on contours had to be determined in some cases not more than twenty feet apart, or else it was found that the contour disappeared, and much time was lost in picking it up again.

Very little difficulty was experienced in finding the position of the plane-table, as a three-point resection was possible in most places. It was found that much time, however, was saved by working along the lines from beacon to beacon, or working from a resected point towards a distant beacon. One point fixed on such a line was sufficient. The level was aligned each time between the back beacon, or, where that was invisible, between the back position of the stave and the forward beacon. Distances were read off the stadia hairs and proved quite accurate enough. Cross-cuts and check resections produced no plottable error, and a line measured by the stadia hairs between two beacons 4,000 feet apart gave an accumulated error of only ten feet when compared with the trig. distance.

Where it was not possible to run between beacons use was made of the compass, but it was found advisable to resect not less often than every third station.

(*c*) *The Plateau Edge.*

More intricate work was the determination of the plateau edge. Work had to be rigidly curtailed when the necks between valleys became too narrow or too uneven for buildings to be sited on them, and consequently the final map presented rather an unfinished appearance.

(*d*) *Off the Plateau.*

The most difficult part of all was the work on the possible road approaches. Once the plateau was left behind no fixed points could be seen till one reached, in one direction the lake, and in the other the vicinity of the Bagdad–Ramadi road.

By working as far as possible along a straight line on a distant point direction could be preserved, while the stadia hair readings kept the distance correct. By swinging the whole traverse on to a resection at the far end a sufficiently satisfactory result was obtained. Time did not admit of much in the way of checking, but areas where work overlapped agreed with each other within narrow limits.

Beacons.

It has already been mentioned that the Iraq Survey points consisted of cairns of earth about three feet high. Thanks to a fairly constant mirage these stood up extraordinarily plainly. The only difficulty was that there were numerous cairns which were not trig. points, so it was necessary to beacon the points it was desired to use.

To save weight the beacon used consisted merely of a 14-foot length of ¾-inch angle iron, stayed with wire in three directions, set up at an angle of about 60° over the trig. point, and surmounted by a white flag about 3 feet long and 2 feet 3 inches wide.

These beacons did not prove satisfactory. Except when the light was very suitable even the flags were invisible to the naked eye at any distance over half a mile. Fortunately, this did not prove a very serious drawback, as the beacon could always be picked up with the level, and the alidade set on the cairn beneath.

It appeared, however, that in such a country a flag would be better red, not white. The most suitable form of beacon in the circumstances would probably have been an angle iron tripod about five feet high swathed in red calico, which could have been stood on top of the cairn and removed bodily when it was required to set up an instrument over the point. The top of a double-pole tent was found to make a very satisfactory intersected point.

General Remarks.

(*a*) The methods adopted seem to be the quickest under the circumstances. The reliance placed on the stadia hairs of the level was fully justified.

(*b*) A plentiful use was made of small wooden pegs for temporary level marks. They were left as levelling proceeded about every quarter of a mile, and enabled rapid checks to be made whenever any discrepancies appeared.

(*c*) A moderately heavy level was found quicker to use, except on a very still day, than a light one. A 30-inch by 24-inch plane-table with solid legs was found easier to work with than a smaller size, or one with collapsible legs. The additional weight involved was more than counterbalanced by the ease of working.

(*d*) The "height of instrument" method of booking levels was found quicker and less liable to errors than the "rise and fall" method. When contouring, only the back and forward station readings were booked, unless an intermediate peg was being put in. The readings of all three hairs were recorded. The stadia hair readings were subtracted mentally to find the distances of intermediate points, which were immediately plotted on the plane-table and the staff moved on.

For the first week's work there were no level books; works dimension books were used, and were found quite convenient. They were ruled as follows:—

Back. Intermediate. Forward. Ht. of Inst. Red. Level. Remarks.

Distances and peg numbers were inserted in the remarks column.

(*e*) A Morris six-wheeler was found a very useful addition to the party, and saved much time and labour in transporting beacons, and in allowing the party to utilize all the hours of daylight on the ground.

CONCLUSION.

Vertical air photographs of the area were taken during the course of the survey. Comparison with the map showed that the plateau edge had been plotted generally with accuracy. It was possible to fill in details which there had not been time to survey from enlargements of individual negatives, and it is considered that much time could have been saved in the field had enlargements of portions of the ground, such as the plateau edge, been available when work commenced. Once one or two reference points had been fixed on each print, much of the plateau edge could have been transferred direct to the plane-table sheets, and would have only required checking on the ground.

TREES, BRANCHES AND LEAVES.

By LIEUTENANT G. V. MICKLAM, R.E.

FAR be it from an army officer to become an "office wallah," a harasser of clerks, and a soul-destroying methodist, whose very ink-pots and pens must toe the line across his desk.

Far be it from him, on the other hand, to be the casual soul who allows a letter to blow where it listeth, hoping he will never see the thing again. He will be sadly disappointed. There is a special devil allocated by Satan to prompt Higher Command to ask awkward questions about that particular letter months after it has been forgotten and/or put away in the dustiest corner of the office annexe.

Since letters must be put somewhere, it has become common practice to make them up into files, to put these files into cardboard boxes, and to range the cardboard boxes upon shelves. It is obvious, therefore, that great care and forethought are required in classifying this ever-increasing budget of live, dying and dead correspondence, so that a letter dealing with any particular matter can be produced on request without delay. This simple chain of events is, of course, well known to the reader. It may not be realized, however, how difficult it is in the early stages to prevent a classification from developing the most bewildering complexities. And so it comes about that it is not unusual to receive an official letter bearing some such reference as the following :—

G.M.2./Gen/F.5230.

Although such a reference, no doubt, adequately fulfils its purpose in office routine, and is significant enough to filing clerks who are familiar with it, it is open to question whether a greater simplicity could not be attained in army correspondence. These days of super-specialization have evolved men known in the commercial world as "business doctors." When called into consultation, the "doctor" will probably work out as his first task a scientific classification of the correspondence of the company or corporation. He can only arrive at this in its entirety, however, after a prolonged and meticulous study of that correspondence. Obviously, therefore, if a member of the staff itself happened to have made himself master of the main principles of system, he would have the advantage over the expert in that he could more quickly formulate the classification, being already conversant with his company's correspondence and its general

tendency. Further, he is on the spot to keep the classification on the correct lines during its infancy. Finally, experts are expensive luxuries. Let us see, therefore, to what extent we can be our own "doctors."

MAIN PRINCIPLES.

The main principles of a scientific classification may be summarized as follows :—

1. Each file contains nothing but the papers strictly relating to the particular subject with which the officer is dealing.
2. It contains every relevant paper about that subject.
3. It is clear of all "dead" matter, this having been automatically shed from it at the right time, just as a tree sheds its leaves in the appropriate season.
4. The system is immediately workable, at a pinch, by any individual who may be called upon to replace the records clerk.
5. It is impersonal, the lines being already laid down *in advance*, with a definite place for everything, and everything in its place.

Following out these principles, we can now outline as an example the :—

GENERAL IDEA FOR CLASSIFICATION OF THE CORRESPONDENCE OF THE H.Q. OF A COMMAND.

It will be of great assistance to use the simile of Trees—Branches—Leaves.

A Tree is a main subject, and must be so chosen as to be comprehensive, yet entirely unconnected with any other subject in the command archives.

Examples :—

1. General Questions.
2. Arms and Ammunition.
3. Buildings and Accommodation.
4. Transport.
5. Movements.
6. Training.
7. Supplies and Equipment.
8. Legal Matters.
9. Personnel.
10. Miscellaneous Matters.

It is seen that we have now planted an embryo forest of some ten trees, allotting to each a distinctive whole number. Each of these

independent subjects divides into its natural Branches, for example :—

2	ARMS and AMMUNITION.
·1	General Questions.
·2	Indents.
·3	Issues.
·4	Returns and Empties.
·5	Storage.
·6	Inspections.
·7	Etc.
·8	Etc.
·9	Etc.
·10	Miscellaneous Matters.

Fig. 1. "Branch" card (*white*).

The next step is to subdivide these Branches and to furnish them with Leaves. We may select "Issues" for illustration :—

2·3	ARMS and AMMUNITION. Issues.
/1	General Questions.
/2	To 1st Infantry Brigade.
/3	To 3rd Infantry Brigade.
/4	To 1st Battalion R.T.C.
/5	To R.E. Depot.
/6	Etc.
/7	Etc.
/8	Etc.
/9	Etc.
/10	Miscellaneous Matters.

Fig. 2. "Leaves" card (*salmon*).

The fact that file No. 2·3 has now been subdivided into Leaves means that file No. 2·3 has ceased to exist as a "folder" by itself. Every document in 2·3 has now found a home in a subdivision, or Leaf file, such as 2·3/2.

Thus, a letter from the R.E., stating that 32 rounds of ball ammunition issued to them were "dud," obviously goes into file 2·3/5, and the outside of the file itself would be marked :—

File No. 2·3/5.
ARMS AND AMMUNITION.
Issues.
To R.E. Depot.

If, as a consequence of the above letter, a circular memo was sent to all units of the command, asking for a report on the condition of

their issues of ammunition during the month concerned, this memo would go into file No. 2·3/1 (General Questions).

It is as well to explain at this juncture the essential difference between the two files "General Questions" and "Miscellaneous Matters." General questions, on the specific subject concerned, are such as affect the whole command. They are of *permanent importance*, being in the nature of orders, rulings, enquiries, etc., to which there will almost certainly be reference at some future time. "Miscellaneous" is the file containing odds and ends of matters equally concerning the whole command, but which have *no permanent importance*. It is really a delayed-action waste-paper basket. There are, therefore, a general and miscellaneous file for each subject throughout the classification.

Taking for further illustration the subject of "Training" (Tree No. 6), the following might be considered as typical Branch and Leaves cards :—

6	TRAINING.
·1	General Questions.
·2	Technical.
·3	Physical.
·4	Tactical.
·5	Courses of Instruction.
·6	Command Lectures.
·7	Defence against Gas.
·8	Etc.
·9	Etc.
·10	Miscellaneous Matters.

Fig. 3. (*White card.*)

The Leaves of one of these Branches—"Technical," for example—might be set out thus :—

6·2	TRAINING. Technical.
/1	General Questions.
/2	Of R.T.C.
/3	Of R.E.
/4	Of R. Signals.
/5	Etc.
/6	Etc.
/7	Etc.
/8	Etc.
/9	Etc.
/10	Miscellaneous Matters.

Fig. 4. (*Salmon card.*)

Again, let us take the subject of "Personnel":—

9	PERSONNEL.
·1	General Questions.
·2	Roll.
·3	Pay.
·4	Promotions and Appointments.
·5	Discipline.
·6	Records of Service.
·7	Confidential Reports.
·8	Medical.
·9	Etc.
·10	Miscellaneous Matters.

Fig. 5. (*White card.*)

9	PERSONNEL.	
·11	Personal files.	Colonels and above.
·12	,, ,,	Lieutenant-Colonels.
·13	,, ,,	Majors.
·14	,, ,,	Captains.
·15	,, ,,	Lieutenants.
·16	Etc.	
·17	Etc.	
·18	Etc.	
·19	Etc.	
·20	Etc.	

Fig. 5A. (*White card.*)

It is seen that card Fig. 5A is simply the continuation card of Fig. 5, and is, of course, placed immediately behind the latter in the index cabinet drawer. Of the above Branches, we select at random No. 9·14, and expand it into its Leaves :—

9·14	PERSONNEL. Personal files. Captains.
/1	General Questions (fallow).
/2	Jones, R.
/3	Smith, A.
/4	Kent, G.
/5	Brown, B.
/6	Green, A.
/7	Black, G.
/8	Robinson, S.
/9	Etc.
/10	Miscellaneous Matters (fallow).

Fig. 6. (*Salmon card.*)

And so, as far as necessary, with all the other Branches.

EXAMPLES OF INDEXING.

A letter from War Office *re* promotion of Captain R. Jones should go into file No. 9·14/2 (NOT into 9·4, which takes only questions about promotion in general).

A letter from the command to War Office, suggesting an alteration in the scale of fines for drunkenness, bears reference No. 9·5, and the carbon copy goes into that file. This assumes that no subdivision into Leaves has been found necessary in the case of this file.

A letter from War Office asking for the confidential reports of all officers in the command should be placed in file No. 9·7.

A request from the Royal Tank Corps for authority to suspend technical training during the month of March for that arm will be put into file 6·2/2, and the reply will bear that same file reference.

It may be observed from these examples that files do not invariably subdivide. To assist users of the card index, small ticks or other distinguishing marks are placed near the right-hand edges of the white cards, against such files as have subdivided.

GENERAL REMARKS.

Such a system of division and subdivision of subjects as now emerges makes it possible to identify not only every separate file but also every individual letter in that file. Consequently the usual method of letter identification, *i.e.*, the addition of a consecutive number to the ordinary reference, entailing the employment of "Inward" and "Outward" correspondence registers, is unnecessary. The file number becomes also the letter reference number, and the day's mail is dealt with so much the more expeditiously.

A further advantage derives from the analysing property of the scientific classification, differentiating as it does between permanent and ephemeral matter. When the time comes to clear the archives of such ephemeral matter, selection is simple. Thus is the Forest swept of its dead Leaves.

The facility of expansion should be noted. The Forester might plant, let us say, 100 Trees, though such a number would only be required by a correspondence as vast and diverse in character as that of a War Office. Each of these Trees could grow 100 Branches and each Branch bear 100 Leaves. Thus our three-element symbol 1·1/1, in its simplest expression, would have already expanded to 100·100/100, providing one million entirely dissociated and yet scientifically-grouped subjects, each with a distinctive file reference number: this on a straightforward numerical basis as against a formula of mixed symbols.

The appositeness of the simile Trees—Branches—Leaves can perhaps now be appreciated. Such an appalling medley as 1,000,000

different subjects would be utterly hopeless to handle, from the point of view both of the incoming and outgoing mails, and of the correct indexing and filing of them, unless a first great segregation, implicit in the classification, existed. To use another simile, this first "filter" is the Tree. The records clerk asks himself, "To which particular Tree of the Forest does this letter in my hand belong?" —and, as he does not expect pears to grow upon apple-trees, he is unerringly led to select the correct Tree. Looking down the card he comes upon the appropriate Branch of that Tree, forming the second great segregation or "filter," the third being the Leaves card, where he finds the exact subject to which the letter in his hand belongs.

Arrangement of the Card Index and Dossiers.

As is generally known, the complete system involves :—

1. A card index with a set of guide cards, on each of which is inscribed a subject. These are arranged in *alphabetical order*. Behind each subject guide comes the relative white card bearing the ten or more main divisions of the subject. Behind this come the various salmon cards in numerical sequence, each bearing the subdivisions of the subject.
2. A set of four-drawer vertical filing cabinets, in which the dossiers are filed in strict divisional and subdivisional *numerical* order.

This is obviously the simplest and most practical system that can be devised for both filing and finding, the latter being the acid test of a good classification.

Its Use in the Past.

It may not be without interest to mention that a system of classification on these lines was worked out for, and used by, the Australian Army Headquarters in Cairo during the War. It is also extensively used in various departments of the Egyptian Government, with native clerical labour, and has been found very satisfactory.

Effect on Office Organization.

It is beyond the scope of this article to discuss the large subject of office organization, but it would be as well to stress the fact that no upsetting or drastic changes are involved by substituting a filing system such as is outlined above. If anything, the day's routine would tend towards greater simplicity.

It will already have been realized that by the time a correspondence subject is subdivided down to Leaves, the files themselves each

contain a minimum number of letters. Hence the file itself can and should circulate in the departments, complete with the last letter received or the carbon copy of the last letter dispatched.

Advantages:—

(*a*) Contents are kept clean, and are safeguarded during circulation.

(*b*) A particular document wanted at any moment is more easily recognized and selected when attached to its designating file.

(*c*) Immediate reference to previous correspondence is possible, and probably a swifter decision is taken.

(*d*) Owing to (*c*) above, there is no need to call for the file, wasting the time of the officer, a clerk, and possibly an orderly.

(*e*) There can be independent and simultaneous working of several officers on an identical Tree, each officer having a separate Leaf file before him. The chances of any two requiring the same Leaf at the same time are remote.

It is not, perhaps, generally realized that the laborious posting of inward and outward registers—delaying by, perhaps, an hour the submission of the inward mail to the various officers—has very seldom, if ever, served its primary object of tracing a lost letter. At most, it tells a department that, not being lost in transmission from outside, the letter reached as far as the records clerk. It does not locate it in the department when lost. Moreover, a letter attached to a file circulates more safely than one which floats about office desks detached. A whole file is never blown silently out of a window, nor does it flutter to the floor or into a waste-paper basket unnoticed. System abolishes these registers, which are looked upon as more of a false security than a safeguard. Letters are simply date-stamped in, and placed on their appropriate files. No organization can guard entirely against a careless or malicious clerk, and system, therefore, restricts itself to ensuring expeditious working. The less time correspondence is kept hanging about, the less chance there is of careless handling.

CONCLUSION.

The foregoing affects to be no more than a skeleton classification. It is hoped, however, that sufficient has been said and illustrated to enable anyone interested in the subject to work out for himself the complete classification of his departmental correspondence, should he consider it desirable.

DESERT ROADS.

By CAPTAIN F. C. T. NOAKES, R.E.

AT the conclusion of the article on the mix-in-place method of road construction in *The R.E. Journal* of June, 1932, the experiment with this type of road construction in Egypt was mentioned.

The object in carrying out this experiment was to find a suitable material which will easily mix with sand to form a fairly hard surface, which will wear well without excessive upkeep, and be suitable for the passage of pneumatic-tyred traffic over soft desert country.

When operations are taking place in a desert country the problem of providing for the needs of traffic over a surface of loose sand presents special difficulties. During the Great War the British advance into Palestine through the sandy tracts of the Sinai Peninsula proved a laborious task, very difficult, and called for all the ingenuity of the Royal Engineers.

Numerous methods of making desert roads were tried, the most satisfactory being wire netting. This type of road partly solved the problem, as only very light car traffic could pass without seriously damaging the wire surface. Enormous maintenance gangs were always necessary for general upkeep and repairs.

The following account of the recent experiment by the Shell Oil Company of Egypt on the desert road near Mena goes into the construction of this road in a great deal more detail than the article on mix-in-place roads, and should prove interesting in view of the great difficulties experienced during the war.

The experiment was carried out on a section of the Fayoum desert road at point 55 kilometre just beyond the Great Pyramid at Mena, and approximately one kilometre of the softest section of the road was chosen. Hitherto only small experiments with Shell products had been carried out in this country, in this type of work.

Not until the " caterpillar tractors and graders " were brought to Egypt was a mechanical demonstration such as this made possible.

Briefly, the method employed consisted of spraying a bituminous solution (asphalte) and mixing it into the sand by means of a " grader " pulled by a " caterpillar tractor," the actual mixing being done by the large curved blade of the grader, which rolls the material over and over, breaking up and distributing any lumps, and distributing the oil evenly throughout the material.

Laboratory tests of the existing road surface were found to be as follows, average of two samples :—

Passing	200	..	4·84%	Passing	30	..	8·99%
,,	100	..	17·82%	,,	20	..	17·82%
,,	80	..	7·06%	,,	10	..	12·31%
,,	50	..	12·59%	Retained	10	..	14·14%
,,	40	..	4·43%				

Asphalte used 4·07% by weight (*i.e.*, sand 95·93%); applied in three coats.

The experiment consisted of three operations carried out as follows :—

1st Operation.

The sand was brought in from the sides of the road by the grader until sufficient material had been obtained to give an average thickness of 4″ over the entire road width.

2nd Operation.

The material was then spread flat and sprayed with Mexphalte solution (F. 60), an oil by-product produced at the Suez refinery.

The caterpillar grader then went up and down the road turning the sand over and over until it was well mixed.

This operation was carried out three times as follows :—

1st application		F.60	..	2·48	kgs.	per	M²	of	road.
2nd	,,	F.60	..	2·22	,,	,,	,,	,,	,,
3rd	,,	F.70	..	2·22	,,	,,	,,	,,	,,
Total		..	..	6·92	,,	,,	,,	,,	,,

These solutions were heated to 140°–150° F. and applied by means of spraying machines, under a pressure of 30 lb. per square inch. The grade machine with the blader followed after each spray and bladed the material six times between each application.

3rd Operation.

The material was then spread by the grader to an even thickness over the road surface and left to traffic compaction—no roller being used.

PLANT.

The machinery actually used for the experiment was all that was available in the country, viz. :

One 30-h.p. caterpillar tractor with 9′ blade grader.
One 10-h.p. caterpillar tractor used for hauling sprayers.
Three Bristowe's bitumen sprayers (really only suitable for macadam roads).
Cost P.T. 2 per square metre.

The experiment covered a week, but as on some days only three hours' work was done, it was obvious that the road could have been completed in much less time, and the following is suggested as a suitable team :—

4 30-h.p. caterpillar tractors with 9' blade graders.
1 15-h.p. combined tractor-grader motor patrol.
1 motor sprayer.
6 tank lorries capable of spraying if necessary.
2 Diesel rollers—3-ton.
4 bitumen boilers in reserve.

Reserve tankage for road oil could always be improvised.

It is estimated that the above unit could complete 10,000 M² in one day working two shifts.

Cost P.T. 1·2 per square metre.

MATERIALS.

Actual.	*With plant suggested.*
14 tons Mexphalte solution F.60.	70 tons Mexphalte solution F.60.
160 gallons benzine.	50 gallons benzine.
8 gallons oil.	500 gallons kerosene.
800 kilos coal.	25 gallons oil.
Area 2,000 M² = P.T. 5·29 per M².	400 kilos coal.
	Area 10,000 M² = P.T. 3·9 per M².

N.B.—This mixture is for desert sand. Soil containing large percentages of loam or Nile mud, as Mariut area or Tel el Kebir–Ismailia road, would require up to 10% more bitumen, or up to 9% increase in material costs.

LABOUR.

Actual.	*With plant suggested.*
2 mechanics, 6 days.	1 foreman mechanic, 4 days.
1 blader, 6 days.	3 mechanics, 4 days.
1 supervisor, 7 days.	2 grader men, 4 days.
2 sprayer men, 3 days.	1 roller driver, 4 days.
2 firemen, 3 days.	2 lorry drivers, 4 days.
1 *reis*, 7 days.	1 supervising engineer, 4 days.
3 semi-skilled, 7 days.	2 *reis*, 4 days.
12 unskilled, 7 days.	1 fireman, 4 days.
2 semi-skilled, 14 days, to maintain shape while under traffic copaction.	6 semi-skilled, 4 days.
	18 unskilled, 4 days.
	4 semi-skilled, 14 days, to maintain surface whilst under traffic compaction.
Area, 2,000 M² = P.T. 1·605 per M².	Area, 10,000 M² = P.T. 0·334 per M².

SUMMARY OF COSTS PER M².

	Actual.	*With plant suggested, based on 250,000.*	
Plant (half-depreciated)	P.T.2 (Estimated)	P.T. 1·2	P.T. 2·4
Plant (fully depreciated)	—	—	P.T. 3·9
Materials	P.T. 5·29	P.T. 3·9	P.T. 0·334
Labour	P.T. 1·605	P.T. 0·334	
	P.T. 8·895	P.T. 5·434	P.T. 6·634
10% unforeseen	—	543	663
10% contractor's profit	—	543	663
Total per M²	P.T. 8·895	P.T. 6·520	P.T. 7·960
Per kilometre x 5 m.	L.E. 444·75 per kilometre x 5 m.	L.E. 326	L.E. 398

Based on 2 years' depreciation of plant completing 1,000,000 M² or 200 kilometres, the plant costs would be

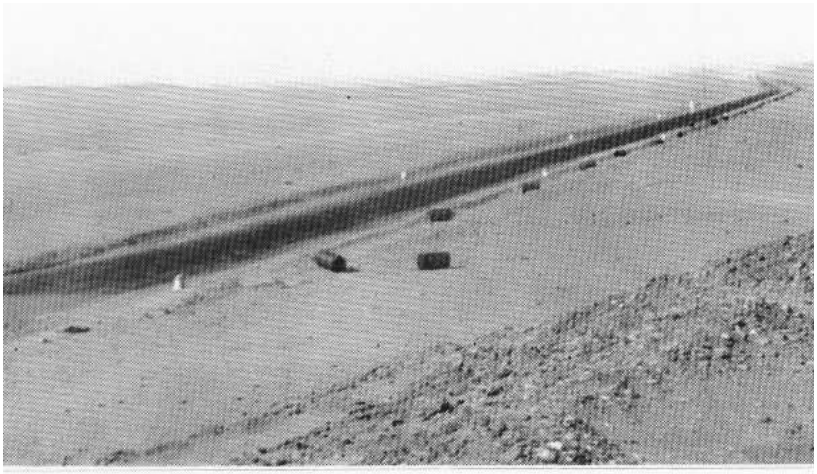
Material	6	mm. per M²	
Labour	39	,, ,, ,,	
	3·4	,, ,, ,,	
	48·4	,, ,, ,,	
Unforeseens	4·9	,, ,, ,,	
Contractor's profit	4·9	,, ,, ,,	
Total	58·2	,, ,, ,,	

Or L.E. 291 per kilometre.

First blading, after first application of the asphalt.

Final blading, preparatory to spreading of mix.

Desert roads 1-2



General view of the finished work.

Vehicles used in a heavy traffic test of finished work.

Desert roads 3-4.

Result.

Pneumatic-tyred traffic was allowed on the road immediately after the third operation—this traffic included the exceptionally heavy Fayoum 6-wheeler buses carrying up to 35 passengers.

All traffic was confined to one-half of the road for the first month, so that the same tracks only were used, and the road has stood up to it remarkably well—the surface after this period just shows the track marks.

General Remarks.

In spite of minor delays inevitable with men working with strange machinery and the construction of a comparatively new type of road such as this one, the experiment was a complete success, and is undoubtedly a great step forward in the direction of making cheap routes for traffic over a desert.

Similar roads have been extensively developed in California on roads built for moderate traffic, *i.e.*, 400–800 vehicles per day, and even after four or five years' experience a definite opinion has not yet been formed as to the maximum economic traffic limitation.

All that can be said at present is that such surfaces laid four or five years ago are still in a perfectly good condition, and give every appearance of having a further life of five years and possibly longer.

As a desert road for the passage of pneumatic-tyred vehicles and for troops marching it is considered to be most serviceable, as it gives a little to the feet and does not pick up in hot weather.

It warrants serious attention where a military road over very soft sand is necessary.

The cost of this one kilometre length of road, five metres wide, is estimated at approximately £300.

The upkeep is expected to be very small and will possibly only mean patrol blading once a week over the whole length of road.

It will be seen that this type of road has passed the experimental stage, and can now be accepted as one of the standard forms of low cost construction, especially for desert work.

Quick setting is a desirable feature from a military point of view, and a desert road constructed to take light traffic and troops over it at once, surely warrants careful study.

Numerous methods of roadmaking for soft sand have been tried in the past, such as brushwood, wire netting, mud, etc. They all have one great disadvantage—that of having to transport the whole of the road materials—a very serious tax on transport and the enormous cost of upkeep in time and labour.

In view of the large amount of experience gained in desert roads in other parts of the world, foreign machinery is well in advance of

British in suitability for this type of work—such machinery is not existent in U.K.

The experiment is the outcome of lengthy laboratory tests, as different kinds of sand require different solutions of oil.

Practically all the experience has been gained in countries where the bulk of the traffic is rubber-tyred. The action of steel-tyred traffic on such types of road may be somewhat destructive in time, especially during the first few days, *i.e.*, before the road crust has been properly formed. It remains to be seen whether intensive maintenance during this stage will overcome the difficulty in question.

It may be that the determining factor will be the proportion of rubber-tyred to steel-tyred traffic, for it is the former that develops the road crust. The one great point to remember is that the surface of the road should be kept free from ruts for the first few days until the hardening process is complete.

Traction could always be supplied in peace-time training by (*a*) Tank Corps or other mechanical units using caterpillar traction; (*b*) hire of commercial tractors during non-ploughing seasons. They could be requisitioned in war-time.

Remarks concerning costs show the necessity for at least two caterpillar lorries or vehicles capable of carrying a load of sand over almost any desert or virgin soil surface. It is presumed these are already available in normal Army motor transport equipment.

Experiments on short lengths can always be carried out entirely by hand with pouring cans, shovels and rakes.

There are several variations in soil and proportions of bitumen in the Fayoum road stretch which needs an intensive traffic test to select the sections with greatest wearing capabilities. In actual execution the final adjustment of theoretical proportions was done by slight additions of sand and/or bitumen gauged by the behaviour of the mix under wheels of the grader itself. After the traffic test we shall carry out analyses of various portions of the surface to establish the exact proportions present.

It will be necessary to repeat the traffic test in winter, because portions which look ideal in present temperatures may be too dry in winter.

It is very probable that a mixture suitable to all the year round will appear fat in the summer and slightly lean in winter during the first year and until it is settled down to final compaction.

Maintenance in the first year may, therefore, require light sanding in summer and light refreshing with road oil in winter.

Dunes are unstable because sand is wind-driven, and therefore the particles are of practically uniform size. *Wadi* bed sand is similarly liable to have been sorted out by water into deposits of particles of uniform size and therefore unstable.

Except on very rare occasions it is normally possible to find fine

sand, loam or soil near such deposits of coarse sand or *vice versa*, enabling a stable mixture to be made locally. The probability of necessity for treatment of short lengths in this manner involves the maintenance of lorries capable of hauling loads over sand dunes, etc.

Training. Instruction in the use of the blading machine can be combined with useful work in the levelling-off of sand and gravel areas for aircraft landing, parade grounds, football grounds, etc. In fact, it is estimated that in countries where the climate precludes the use of fatigue parties for this purpose and involves expense in native labour, definite saving of money could be combined with training R.E. and mechanical units in the use of the grader on dry sand or soil. The construction of oil-treated runways for aeroplanes would produce very real economy in wear and tear of the flying machines, and could therefore form the basis of training in mixes.

Traffic Control. The success of this method is entirely dependent on traffic control during the first few days to give accurate traffic compaction.

The first two days must be confined to six-wheeled, balloon-tyred vehicles and this period must be prolonged until primary compaction is complete, if there are not sufficient vehicles to do this in two days. Drivers must be taught to drive on the high ridges between ruts. If they can be taught to drive in echelon, working from side to centre, results will be improved. After the first two days all pneumatic-tyred traffic can pass. Under such traffic the road will then harden up rapidly. High temperatures and frequent pneumatic-tyred traffic will rapidly harden it up to bear almost any vehicle, but the time which must elapse cannot be laid down. Guns with wide iron tyres similar to Mena sand carts would be of great assistance to consolidation, but the time which must elapse before they can be allowed on will again depend on circumstances.

Conclusion.

There is no doubt that (*a*) the ease with which the road was laid, (*b*) the transport of such small amount of material, and (*c*) the absurdly short time before traffic was on it, make this type of road interesting from the point of view of potential military operations over desert countries, and present a practical solution to the problem of rapid desert road construction.

LIEUTENANT-COLONEL JOHN BY—A BIOGRAPHY.

By HAMNETT P. HILL, K.C., *Ottawa.*

(Reprinted by kind permission from *The Engineering Journal*, the Journal of the Engineering Institute of Canada.)

[This account of the connection of the Corps of Royal Engineers with the foundation of Ottawa, and the building of the Rideau Canal, an early link in the through navigation to the Great Lakes, will be of special interest at this time. The Imperial Economic Conference sat in the Government buildings erected on the site of the Sappers' barracks, and an agreement has recently been reached between Canada and the United States on the question of developing the navigation to the Lakes. An account of the construction of the Rideau Canal appeared in *R.E. Professional Papers*, Vol. I, 1837, written by Lieut. E. C. Frome, R.E.—EDITOR, *R.E. Journal*.]

LIEUTENANT-COLONEL JOHN BY, of the Royal Engineers, should be remembered in Canada as the officer sent out by the British Government in charge of the construction of the Rideau Canal in 1826, and as the founder of the little village of Bytown, now the City of Ottawa.

Lieut.-Colonel By came of a family which had been, for many years, associated with the Custom House in London. His grandfather, John By, resided in Archbishop's Walk in the parish of St. Mary Lambeth, and held a situation as Chief Searcher in the Custom House in London. He had four sons, John, George, Charles and William, all of whom resided in Archbishop's Walk, and all of whom held situations in the Custom House in London, and all of whom are buried in the churchyard of St. Mary Lambeth. His second son, George, married Miss Mary Bryan and had three sons and several daughters, Lieut.-Colonel John By, the subject of this sketch, being his second son. The eldest son, George, obtained a position in the Custom House in London, and his younger son, Henry By, was a broker in London.

Lieut.-Colonel John By was born in the year 1779 and was baptized in the parish church of St. Mary Lambeth. After passing through the Royal Military Academy at Woolwich, he obtained his commission as 2nd-Lieutenant in the Royal Artillery on 1st August, 1799, but changed his allegiance to the Royal Engineers in December of the same year. His further commissions were dated: 1st-Lieutenant, 18th April, 1801; 2nd-Captain, 2nd March, 1805; 1st-Captain,

24th June, 1809; Brevet Major, 23rd June, 1814; and Lieutenant-Colonel, 2nd December, 1824. After serving at Woolwich and Plymouth, he came, in August, 1802, to Canada, where he was stationed for nine years at Quebec. While there, he had much to do with building and extending the fortifications and also was the officer in charge of the construction of a canal that was built at the Cedars on the St. Lawrence river. In January, 1811, he was sent to Portugal and served in the Peninsular War, taking part in the sieges of Badajos in May and June of that year. He was later recalled from the Peninsula and placed in charge of the works at the Royal Gunpowder Mills at Faversham, Purfleet and Waltham Abbey, a position he occupied with great credit from January, 1812, until August, 1821, when, owing to reductions made in the establishments of the army, he was placed on the unemployed list. While employed in the powder mills, he designed a bridge on the truss principle for a span of 1,000 feet, and constructed a model of it, which is in the possession of the Royal Engineers* at Chatham. A description of the bridge appeared in the *Morning Chronicle* of 14th February, 1816.

During the war of 1812–15, the difficulty and expense of protecting the settlements in the western part of the province of Ontario were very great, and in addition there was the constant apprehension that an army from the United States might be thrown across the St. Lawrence river at any point and effectually prevent troops and supplies going up the river into Lake Ontario to take part in hostilities in the western part of the province. The War Office in London decided, in order to render the necessary protection, that a back-water route away from the United States' boundary should be obtained, and accordingly it was decided to improve the navigation of the Ottawa river to the foot of the Chaudiere Falls, and to utilize the Rideau river and the Cataraqui river to obtain access from there by water to Lake Ontario.

By was selected as the officer in charge of the work on the latter two rivers and in the summer of 1826 came to Canada for this purpose. His instructions were to design and carry out a military water communication from the outlet of the Rideau river into the Ottawa river to the outlet of the Cataraqui river at Kingston.

The country was then in a state of wilderness and unexplored, the only mode of progress being by canoe. On his arrival in Canada he surveyed the route and proceeded with the work. The survey plans and estimates, sent to the Home Government in the spring of 1827, were approved, and By was directed to push forward the work by contract as rapidly as possible without waiting for the usual annual appropriations of money.

The Earl of Dalhousie had, in 1823, purchased from Colonel Hugh Fraser, of Three Rivers, a block of land fronting on the heights over-

* This model has disappeared.—[Editor, *R.E. Journal.*]

looking the Ottawa river and extending from the Chaudiere Falls to the Rideau river. Lieut.-Colonel By was instructed to subdivide this area into lots and to form a village. This he did, and the village became known as Bytown. He made his headquarters there and built himself a house in what is now known as Major's Hill Park. Two companies of Sappers and Miners were sent from England, and barracks were built on the present site of the Parliament buildings.

The canal was opened for navigation in the spring of 1832, when the steamer, *Bumper*, was able to pass from Bytown to Kingston.

By's instructions were to complete a water communication having a uniform depth of five feet. This was obtained by the erection of dams at various places across the Rideau river, which, in some cases, backed up the water and drowned out small rapids for miles above them. Locks were built to enable boats to pass through the various dams. The same procedure was followed on the Cataraqui river. This required the construction of forty-seven locks, with a total lockage of 446½ feet. The intention of the War Office originally was to build the canal solely for military purposes, but on By's insistence it was altered to permit navigation for mercantile purposes and the locks were increased from the original small size of a width of 20 feet to a width of 33 feet and to a length of 134 feet instead of 100 feet.

The War Office had undertaken the project on a report which had been prepared by Mr. Samuel Clowes, an engineer who had been appointed by the Upper Canada Government to make reports on various waterways. Clowes had estimated that the cost of the improvements would be £145,802. By, shortly after his arrival, reported that it would be impossible to do the work for this figure and that it would cost at least £400,000. His first report to the War Office set out a detailed estimate of cost amounting to £475,000. Owing to changes and unexpected difficulties and the necessity of various additions, the ultimate expenditure was in the neighbourhood of £800,000. During the progress of the work, the attention of the British Government was called to the expenditure and two investigations were held. Both investigations resulted in laudatory references to Lieut.-Colonel By's efforts and approval of the spirit of economy practised by him, but criticism was directed by the Parliamentary Committee to the manner in which the War Office had instituted the work. In the spring of 1832, on the receipt of By's annual report of expenditure and estimate of the amount needed to complete the work, the Lords of the Treasury directed that Lieut.-Colonel By should be ordered to return to England, that he might be called upon to afford such explanations, in regard to the greatly-increased cost, as the Lords of the Treasury might consider necessary. On his return to England, By appeared before a third Committee of the House of Commons. The Committee, while admitting that the work had been carried out with care and economy and had been well

Lieut- Colonel John By. Royal Engineers,(1779-1836)

ENTRANCE TO RIDEAU CANAL AT BYTOWN.
An early view of the first eight locks of the canal from a print in the Public Archives of Canada.

Entrance to Rideau Canal

performed, concluded their report with a strong expression of regret at the excess expenditure over the estimate and the Parliamentary Votes.

By, who had expected high commendation, including knighthood, on the completion of this magnificent work in so short a time and under so many difficulties, and at a cost by no means extravagant, felt himself extremely ill-used and never recovered from his disappointment. It must be conceded that By was a victim of circumstances and politicians. Every commission and committee of the House of Commons had approved of the work, in some cases highly praising him, and in other cases expressly excepting him from any criticism. Every engineer who had gone over the work had approved of it. During the whole progress of the work not one word of disapproval had emanated from the Ordnance Board, under whom By was carrying on the undertaking. A scapegoat, however, had to be found to satisfy the politicians and By was allowed, by the military authorities, to bear this stigma. No one can read the letters and reports in the Government Archives at Ottawa without sympathizing with By in the disappointment he suffered and the indignation he felt.

Sir Richard Bonnycastle, in *The Canadas in* 1840, says, "If ever man deserved to be immortalized in this utilitarian age, it was Lieutenant-Colonel By. In an unexplored part of the country, where the only mode of progress was the frail Indian canoe, with a department to be organized, workmen to be instructed and many difficulties to be overcome, he constructed a truly remarkable work."

Lieut.-Colonel By was married twice. His first wife was Elizabeth J. Baines, who died shortly after the marriage. He subsequently married, on the fourteenth day of March, 1818, Esther, the daughter of John March, of Harley Street, London, by whom he left two daughters, Esther, who married, in 1838, the Hon. Percy Ashburnham, the second son of the third Earl of Ashburnham, and Harriet Martha, who died unmarried.

After his return to England, owing to failing health, he was placed on the unemployed list and retired to his estate near Frant, in the county of Sussex, and there died on February 1st, 1836.

On his tombstone is engraved the following:

"Sacred to the Memory of Lieutenant-Colonel John By, Royal Engineers, of Shernfold Park in this Parish, zealous and distinguished in his profession, tender and affectionate as a husband and a father, charitable and pious as a Christian, beloved by his family and lamented by the poor. He resigned his soul to his Maker in full reliance on the merits of his Blessed Redeemer on the first of February, 1836, aged 53 years, after a long and painful illness brought on by his indefatigable zeal and devotion in the service of his King and Country in Upper Canada. This stone is erected by his afflicted widow in remembrance of every virtue that could endear a husband, a father and a friend."

THE CALCULATION OF BIVOUAC AREAS.

By CAPTAIN V. DYKES, M.B.E., R.E.

THE PROBLEM.

THE official manuals give little information concerning the areas required for the bivouacs of all the various units in the Service, except in the case of one or two of the commonest. With establishments constantly changing and new units being from time to time evolved, this is only to be expected. The problem of estimating these areas, however, frequently arises, particularly in connection with peace training when land has to be hired in advance.

METHOD OF APPROACH TO A SOLUTION.

In the attempt to work out some simple system of calculating the necessary areas for all sorts of units, careful note was taken of the areas occupied by the units of the 1st Division on manœuvres in 1930, and during the Concentration in 1931 when all units were at war strength. Figures were also taken at other times whenever a suitable opportunity offered. As a result, certain "basic figures" have been obtained, as described below, for the various types of units. These figures were actually used in allotting bivouac areas for the 1st Divisional Concentration in 1931, though plenty of extra space was allowed to give a margin of error, as it was not certain to what extent the figures could be trusted. The actual areas which units took up for themselves on the ground, however, worked out very close to the calculated areas.

SYSTEM OF "BASIC FIGURES."

The system employed is to make an over-all allowance of so many square yards per "representative individual" in the unit. The representative individual is the man in dismounted units, the horse in mounted units, and the vehicle in mechanized units. These basic figures are worked out so as to allow for all "overheads," such as spaces between sub-units, cooking-places, headquarters, messes, officers' bivouacs, transport lines, etc. Naturally the results obtained are only very approximate, but great accuracy is not required. The system does at least enable an immediate answer to be given, with some degree of confidence, to questions such as—"Is there room for

a field brigade and a field park company in this field ? " The figures are not intended for use in actually laying out a bivouac area in detail.

The " basic figures " arrived at for calculating bivouac areas are as follows :—

Infantry	15 sq. yds. per man (officers and other ranks).
Dismounted units, such as R.E., R.A.M.C., with a higher proportion of transport	25 sq. yds. per man (officers and other ranks). .
Cavalry and Artillery (horsed) ..	50 sq. yds. per horse.
Mechanized units	120 sq. yds. per vehicle.

These figures give a comfortable bivouac with reasonable spaces between sub-units. Like all formulæ they must be intelligently applied, *e.g.*, awkwardly-shaped ground will necessitate greater area being given. Moreover, if a unit's establishment is very low, the area given by the figures will be rather small, since the " overheads," referred to above, will be comparatively high. The figure for mechanized units is perhaps on the generous side, but it allows for wet weather when the ground gets very badly cut up if areas are too cramped. On page 528 is given a comparative table showing the calculated areas and the average areas actually occupied by units of various types and strengths.

General Application.

Similar sets of figures on the same system are very useful for quick estimation of areas required in any other form of accommodation, such as standing and hutted camps or unfurnished hirings, wherever a considerable amount of such work has to be done. The figures, however, must be worked out according to local conditions in each case.

A Royal Engineer officer is frequently expected to be able to answer off-hand, on a preliminary reconnaissance, questions as to the approximate accommodation-capacity of any given area, and a few figures of this sort, which are easily carried in the head, do enable him to make a reasonably close estimate. Quite a considerable error is not a serious matter in such a reconnaissance, as in practice a good allowance for contingencies is always made, and speed rather than close accuracy is usually desirable. To try and answer such questions by pure guesswork, however, is very dangerous, while the delay involved in working out a scheme in some detail would make rapid reconnaissance impossible.

Unit.	Numbers in Bivouac.			"Basic Figure" (sq. yds.).	Average of Actual Areas Occupied (sq. yds.).	Calculated Area (sq. yds.).	Remarks.
	Personnel (all ranks).	Horses.	Vehicles.				
Infantry Bn.	450 830			15	7850 12900	6750 12450	
Field Coy., R.E. (horsed) ...	79 256			25	2125 6844	1975 6400	
Field Ambulance	224			25	5400	5600	
Provost Coy.	49			25	1000	1175	
Cavalry Regt.		150 577		50	8500 32200	7500 28850	
Field Bde., R.A.		827 410		50	40100 22000	41350 20500	
Light Bty., R.A.		75 131		50	3000 6600	3750 6550	
Field Coy., R.E. (mech.) ...			33	120	2250	3960	Bivouacs actually rather cramped.
Field Park Coy., R.E. ...			40	120	4875	4800	
Ordnance Mobile Workshop ...			20	120	1200*	2400	Only one bivouac measured. (*Net area exclusive of turning spaces.)
Tank Bn.			92	120	10000	11040	

Major-General Sir Herbert Mullaly KCMG CB CSI

MEMOIRS.

MAJOR-GENERAL SIR HERBERT MULLALY, K.C.M.G., C.B., C.S.I.

DESCENDED from an ancient race of Irish chieftains, the O'Lallys, otherwise Mullallys, of Tullindally, in Co. Galway, Herbert Mullaly came of soldier stock. Another distinguished member of this stock was the brilliant, though unfortunate, Irish Jacobite refugee soldier Sir Thomas Arthur Lally, Comte de Lally and Baron Tollendal (usually known as Lally of Tollendal), who raised and commanded the famous Regiment de Lally which played such a great part in the French service at the Battle of Fontenoy, and who afterwards commanded the French forces in India.

Born at Bombay on the 4th June, 1860, the subject of this memoir was the fifth son of John Mullaly, of the Honourable East India Company's Service. Educated privately, he entered the Royal Military Academy and received his commission in the Royal Engineers on the 18th December, 1878.

After a brief period of service in England and Ireland he went to India, with which country the fortunes of his family were now closely bound—four of his brothers were in the Indian Civil Service, the Indian Police, the Indian Public Works Department, and the Indian Army—and served in the Military Works Department in Madras, the United Provinces and the Punjab. It fell to him to build the road to Cherat, the semi-hill-station for Peshawar and, with the true Irishman's love for trees, he was always particularly proud of the now fine avenue which shades the greater part of this road, for the planting of which, as a young officer, he was responsible.

He early saw active service, being employed as Field Engineer in the Chin Lushai expedition of 1889–90, which opened up hitherto virgin country and was carried out under great difficulties of climate and terrain. For his work here he was mentioned in dispatches and received the Indian Frontier Medal and clasp.

In 1883 he married Mabel, daughter of Hastings Read, of the Indian Civil Service, who predeceased him in 1924.

There were four sons of the marriage, all of whom entered the Indian Army and were in Gurkha regiments. Three of them gave their lives in the Great War, two being killed in action in France and Mesopotamia and one dying whilst on active service on the North-West Frontier of India.

Always an enthusiastic student of history, he made a close study of the problems of the defence of India, as the result of which he

published, in 1894, *Russia's March Towards India*, by "An Indian Officer."

The book, which was a vivid and convincing survey of Russian designs on India, created something of a sensation and opened the way to a Staff appointment. In 1895 he was appointed an officiating Secretary in the Military Department of the Government of India, and thereafter, except for a break during the South African War, he served on the Staff of the Army Headquarters in India until 1910.

On the outbreak of the South African War he was appointed to the Staff of Sir George White, and took part in the early operations in Natal, and was in Ladysmith throughout the siege, during which he was severely wounded.

He afterwards served on the Staff of Sir Redvers Buller as Intelligence Officer, and whilst employed in this capacity his impetuosity and native love of adventure led him into an exploit which exemplified his personal courage and resourcefulness.

Whilst on reconnaissance he rode, alone except for an interpreter, into the town of Wakkerstroom in the Transvaal, which was then in the occupation of a Boer commando. He had no orders of any kind, and had acted on the impulse of the moment, but, representing himself as an emissary of Sir Redvers Buller, he demanded, and by sheer bluff and force of character finally received, the formal surrender of the district and commando of Wakkerstroom "to the Queen of Great Britain and Ireland."

The nearest British troops were not less than thirty miles distant, and for the whole period of nearly twenty-four hours which he spent alone in the town his life literally depended upon his ready wit and the force of his masterful personality.

His demand, on leaving the town, that the Landrost's son must accompany him as a hostage, nearly precipitated a crisis, but his will prevailed, and he returned triumphantly with his hostage and the surrender of Wakkerstroom. He was rewarded for this exploit by a laconic message, "Well done—Buller," and was later made a Brevet Lieut.-Colonel.

He received the Queen's South African Medal with clasps—Natal, Lombard's Kop, Defence of Ladysmith, Laing's Nek and Transvaal, 1899–1900—and was three times mentioned in dispatches.

Recalled to India in June, 1900, he returned to duty at Army Headquarters as D.A.Q.M.G. in charge of mobilization.

With the arrival in India of Lord Kitchener he entered upon the most important period of his career.

It was in his capacity as Deputy Secretary in the Military Department that he first came to the notice of the new Commander-in-Chief, who was quick to recognize his unrivalled grasp of the problems of the defence of India with which the new Chief was faced, and there grew up a firm association between the two which

developed into probably the closest friendship which the austere K. of K. ever accorded to anyone except his faithful FitzGerald.

Mullaly's great talent for organization was now given full play, and he was closely associated with the great scheme for the reorganization of the Army in India on modern lines, calculated to render it capable of discharging its heavy responsibilities to the Empire.

He regarded this as his life work, and his private papers reveal that he was, to a remarkable degree, personally responsible for much of this great scheme. A devoted and loyal admirer of his great chief, he never by word or deed attempted to take any credit for his part in the vast process of reorganization, which made of the Army in India an efficient fighting machine and gave it a General Staff and Services adequate to its needs, but those few still surviving who participated in the shaping of it know how great a part he played.

During the controversy between Lord Kitchener and Lord Curzon on the matter of the pernicious system, under which the Army in India was subjected to the dual control of the Commander-in-Chief and the Military Member of the Viceroy's Council, to put an end to which Lord Kitchener was determined, Mullaly was employed as the latter's confidential emissary to lay the Commander-in-Chief's case before the Home Government.

He accordingly proceeded to England, and his complete grasp of the situation in all its aspects, and the manner in which he was able to place his chief's views before the Cabinet had much to do with the ultimate issue.

He steadily rose on the Staff, becoming successively Deputy Quartermaster-General and Director of Military Operations. He officiated for a time as Quartermaster-General and acted as Chief of Staff in 1908–1909. He had his third experience of active service in 1908, when he was Chief Staff Officer in the Bazar Valley Expedition against the Zakkha Khel.

For his services in this expedition he was awarded the C.S.I. and mentioned in dispatches. He had been made C.B. in 1905.

With the departure from India of Lord Kitchener and the sweeping readjustments which followed, his long period of service at Army Headquarters came to an end, and he was promoted Major-General in 1910 and appointed to command the 1st (Peshawar) Infantry Brigade.

As a Brigade Commander he enjoyed to a remarkable degree the confidence and affection of his troops, both British and Indian, and his departure from Peshawar in 1913 was made the occasion for an unusual ovation.

On the outbreak of the Great War he was in England on half-pay. He was urged by his old friend and chief, Lord Kitchener, whose belief in the danger of invasion is a matter of common knowledge,

to accept the post of Commander of the East Coast Defences. He was bitterly disappointed at not being given an active command in the field, but his high sense of duty stifled any protests which he may have been inclined to voice, and he loyally accepted the task which had been allotted to him.

He threw himself with his characteristic energy into the task of organizing the East Coast Defences and training the large number of troops in his area.

The prospect of more active employment once the immediate danger of invasion was over had been held out to him, but the tragedy of the *Hampshire* sounded the death-knell of his hopes of further advancement, and he served throughout the war in the post to which destiny had called him.

Imbued with the highest ideals of public service, he had a deep loathing for what he contemptuously called " log-rolling," and his reluctance, throughout his career, to avail himself of opportunities for self-advancement, and his uncompromising loyalty to Lord Kitchener, were probably responsible for his failure to reach the very highest positions in his profession to which his brilliant intellect and the bright promise of his years in India had been expected to lead him.

He retired in 1920, having been created K.C.M.G. in 1917.

He travelled extensively over Europe for some years before settling in Switzerland, and it had been his intention to devote his retirement to writing on matters concerning the welfare of the Empire, but the affliction of approaching blindness frustrated his hopes, and although he eventually secured comparative relief, he was never able to put on record all that his active brain wished to give to posterity.

Perhaps the strongest passion of his life was his ardent devotion to the cause of what he reverently spoke of as " Our God-given Empire " and, after his simple trust in his Maker, the great achievements of the British people in the last few months of his life and his serene confidence in the ultimate great destiny of the British Empire were his greatest consolations in the dark hours of his last painful illness.

He died on the 9th June, 1932, five days after his 72nd birthday, at La Tour de Peilz, Switzerland, where he was buried with such honours as it was possible to accord him.

A memorial plate of his armorial bearings is being placed in the chapel of the Most Distinguished Order of St. Michael and St. George, which faces, across the nave of St. Paul's Cathedral, the chapel dedicated to the memory of his old friend and chief, and which contains the Roll of Honour of his comrades of the Corps of Royal Engineers who gave their lives in the Great War,—R.I.P.

B.R.M.

Brigadier General C GW Hunter CMG DSO

BRIGADIER-GENERAL C. G. W. HUNTER, C.M.G., D.S.O.

CHARLES GEORGE WOODBURN HUNTER was the son of Major-General W. Hunter and was born at Lee, near Blackheath, on the 22nd December, 1871. He was educated first of all at Miss McLean's School in Restoration House, Rochester, which was a noted seminary for the youth of the period. Thence he passed on to Dulwich College, and passed into the R.M. Academy 25th of his term, in September, 1888. He passed out of the "Shop" 6th of his batch, and was gazetted to the Corps of Royal Engineers on 25th September, 1890. He went to India in 1892. His first station was Fyzabad, where he worked under E. D. Swinton, who was Executive Engineer of the Lucknow Division. Swinton refers to him as "one of the best subalterns I ever had under me. If he said he would do a thing it was as good as done."

From Fyzabad Hunter went to Rawal Pindi, where he worked with and under H. F. Thuillier on the Pindi defence works, which were in the charge of S. L. Craster. While at this work Hunter was stricken with typhoid, but recovered after a long fight. He was next employed on the Nizam's Railways in Hyderabad, Deccan, where he worked on the construction of the Hyderabad-Godavery Valley line under J. F. H. Carmichael. In 1897 he went through the Tirah Campaign. In 1897 Hunter served under S. L. Craster on the Khyber Railway Survey, and while this was in progress the scheme for the Yangtze Railway reconnaissance cropped up. On Craster being asked to nominate a man he at once named Hunter. This was the beginning of Hunter's work on the Yangtze with Sir Courtney Manifold. At first he was employed with Lieut. Watts-Jones, R.E. (who was murdered by a mandarin), but on the outbreak of the Boxer Rebellion returned to India. He came back to China with the Indian Expeditionary Force, and served under the Director of British Railway Administration, being Railway Transport Officer and Port Officer, Tongku. Hunter seems to have made a great impression in this job, for he is described by Major Dunsterville, R.S.O., Tongku, as "True as steel." "His working of the port was excellent—he was scrupulously polite, but woe betide the skipper who disobeyed him," so writes another eye-witness.

When the Indian Expeditionary Force was broken up in 1901, Hunter was deputed to accompany Sir Courtney Manifold on a reconnaissance expedition in Central and Western China. They left Pekin immediately after the issue of the Allies' Protocol to the

Dowager Empress. Their route at first lay very much on the line of that which the Empress was taking on her return from Lian Fu, the ancient Chinese capital, to which she had fled from Pekin. The method employed was plane-tabling the whole country with no concealment, as Sir Courtney considered that this was the wisest plan from his previous experience in China. The work took eight and a half months, and in this time over 3,000 miles were traversed through the provinces of Chili, North Huken, Shansi, South Shansi and Szechuan. Sir Courtney writes, "Hunter lost 2½ stone during this time. His example to his men in being first in every arduous task, or in surmounting any difficulty arising out of Chinese opposition or obstinacy, had the result of making them always look to him as one who would never leave them in the lurch."

In April, 1903, he joined Major S. L. Craster to assist in a reconnaissance for a 2' 6"-gauge railway from Berbera in Somaliland to Harrar. The expedition assembled at Aden on 5th April, 1903, and landed at Berbera three weeks later. It seems to have been a real *terra incognita* at that time, as Craster writes "the map given them by the Royal Geographical Society bore the ominous note 'This map has been compiled from sketches and reports of sportsmen shooting in Somaliland and Eastern Abyssinia.'"

This work was stopped by the party being ordered to join the force commanded by General Manning operating against the Somalis under the Mad Mullah. The work to be done for the army turned out to be the reconnaissance of a route for a 2' 6" railway, or alternatively a motor road between Berbera and Bohooli, two points in British Somaliland some 200 miles apart. This work took 30 days, in which time the party marched 400 miles.

The original project of the railway survey was now proceeded with, and when the field work was practically completed, Hunter was ordered to join General Manning's army. This he did with all speed, and was employed in leading the final night march of the attacking columns to Todbali, where General Manning had cornered the Mad Mullah, and where he smashed him for good.

After the Somali War was over Hunter returned home and completed the computations and the maps.

Hunter was now a captain, and, on return home, 1904, did two years in the War Office in the M.O. branch. Sir Charles Close writes of him, "He was universally recognized as a most efficient officer, a man of strong character and great determination. Whatever he put his hand to he did thoroughly."

In 1906 he was sent to South Africa on special duty, and spent two years there "evolving cosmos out of chaos in the Colonial Survey of South Africa."

The year 1909 saw Hunter at regimental duty at Longmoor, first as Commander of the 53rd Railway Company, and then as O.C.

Railway Companies. He was promoted Major in 1910, and remained at Longmoor until 1913. A young officer under his command in those days writes of him, "one of my clearest recollections of him was his almost boyish enthusiasm for work and the atmosphere of cheerful friendliness which he carried with him." Another subaltern says, "We all loved and respected him as much as his friends of his own time."

In 1913 Hunter returned to India, being stationed at Quetta, and then, in 1914, he went to France as a Field Engineer in the Meerut Division at the outbreak of the Great War.

Of his work one of the junior R.E. officers who served under him in this Division writes, "We were helped so much by his cheery encouragement and intrepidity." The late Sir P. G. Twining, who was the C.R.E., testified to the wonderful work Hunter did and the high esteem in which his personal and technical qualities were held by the authorities of both the Division and the Corps to which the Division belonged. General Twining went on to say how much he personally was indebted to Hunter for his efficiency, loyalty and devotion to duty. In writing again about the immediate reward to Hunter of the D.S.O. in April, 1915, he said, "There is no one in the Force who deserves it better." It was given for four days' strenuous and dangerous work with two Sapper companies near Neuve Chapelle in March, 1915. The wording of the *Gazette* is as follows:—"For conspicuous ability and gallantry on many occasions, especially from March 10th to 14th, 1915, at Neuve Chapelle. He was in command of two companies, and succeeded in establishing a strong breastwork line under very difficult circumstances whilst exposed to heavy shell and rifle fire."

In September, 1915, Hunter was appointed to be C.R.E., 26th Division, which in November went from France to Salonika as part of the 12th Corps. As a C.R.E., Hunter was indefatigable. He was a great believer in seeing things for himself. In spite of the bad climate of Macedonia he was inspecting trenches practically every day from 9 a.m. to 5 p.m., and did his office work at night. He was a strenuous walker, and could tire out people who were half his age. He was most methodical and kept notebooks containing brief details and sketches of all his work.

He was always cheerful and accessible no matter how busy he might be. His officers were devoted to him. One of them writes, "He was a wonderful example of a true English gentleman who inspired and brought out the very best in all those who came in contact with him." I doubt if any man can have higher praise. It was just the same with the Staff with which he served. The A.Q.M.G. of the 26th Division writes: "He was just the finest C.R.E. I ever came across, and I know there were others who also shared this opinion." Our personal relationship was most happy,

and my admiration for his efficiency, loyalty, determination, uprightness, and unwavering cheerfulness in very adverse circumstances was very great.

I think I may mention two personal incidents that occurred. Hunter came to me once to get my opinion as to sending Sapper detachments out with small infantry raids. My answer was, if the Sappers are necessary from a military point of view send them every time, but don't send them otherwise. He pleaded, "but they just love it and hate to be left behind." His own feelings, I know, for the farther in front he was the happier he was. The other story is different. Hunter had made a nice little hutment in the hills for the reserve troops of one of the Brigades of his Division. In course of time his Division exchanged areas with another, which took over the huts. Later on, a re-exchange of areas was ordered, and the other Division demanded an inordinate number of lorries for the move. "Q" of the Corps consulted me as to why, and I could not tell or imagine the reason. While the move was in progress a rushing wind blew into my office. This was Hunter to say that he had caught the moving Division removing his pet hutment on the borrowed lorries, and his fury (absolutely righteous, too) knew no bounds. I am afraid I had to laugh, but I think I was able to save most of the stuff for him, and, incidentally, get the culprits' tail well twisted, to make up for the balance.

Yes, he was an ideal C.R.E., and that expression covers many qualities. In December, 1917, Hunter took my place as C.E., 12th Corps, when I was invalided home, and remained in that appointment until January, 1919, taking part in the final attack upon and dispersal of the Armies of the Central Powers.

Of his work as C.E., 12th Corps, one of his Staff officers writes: "His personality radiated energy and fitness, and he looked every inch a soldier. His great aim was to make it clear to everyone that they must be soldiers first and Sappers afterwards. His stamina and energy were amazing; in my Mess he was known as 'The Hard Man': hard in the sense of physical fitness. Riding all day was not sufficient exercise for him, and he usually sent his horses back and walked the last two or three miles back to camp. He was for ever thinking of his officers and men. *Character* was his outstanding possession, and this quality commanded the confidence and respect of all officers and men under him, and also of the other branches of the Service with which he came in contact."

During the war, Hunter was mentioned five times in dispatches, and received two brevets, the C.M.G., D.S.O., the Legion of Honour, and a Servian Order.

In 1919 Hunter returned to India, and became in 1921 Colonel Commandant R.E. on the Staff of the G.O.C. Northern Command. His great achievement in this appointment was the institution of

the Engineer Technical Training Camp at Akora, on the Kabul River near Nowshera, near the site of the R.A. practice camp. Here the Sappers and Pioneers were, by reason of their concentration, enabled to do much more useful technical training than heretofore, and also benefited greatly by the facilities available for co-operation with the Royal Artillery.

As Chief Engineer, designate, of the Northern (Khyber) Line, Hunter had much work in connection with the new plan of operations then under preparation. One of his colleagues writes: "Those who worked with him will always remember his cheerful helpfulness, his commonsense and his sound practical proposals."

Major-General S. H. Sheppard, who was Inspector-General, R.E. in India, at this time, writes of him: "Hunter was a lifelong friend of mine. He was about the most dependable man I ever met, and one always felt that he was a man one would like to have with one in a tight place."

Sir Claud Jacob, G.O.C.-in-C. Northern Command, says: "Hunter showed himself far above the average and I looked forward to seeing him go very far in his profession. The Royal Engineers have produced many men of distinction in the various branches of the Corps, and Hunter is deserving of a high place in that Roll." Again, Sir William Birdwood, who was also G.O.C.-in-C. Northern Command for a time, writes, "I had a great admiration and affection for Hunter. I always felt he was a man who had no enemies, and I am sure his death will be mourned by a host of friends."

Hunter's health first broke down in 1921, when he began to feel his heart. It was about then that he was offered the appointment of A.A.G. R.E. at the War Office. He felt, however, that at that time, when Army reorganization was a burning question, only a man with unimpaired health could do justice to the work to be done for the Corps, and he consequently, as was typical of his sense of duty, declined it, and retired on 1st July, 1923, a dire loss to his country, the Army and his Corps. Hunter settled down at Hythe and in his retirement interested himself most actively in local work in the parish and in connection with the Working Men's Club, his principal amusement being gardening. In civil as in military life the old character, human sympathy and saving grace of humour earned him hosts of friends. He showed no sense of disappointment at the curtailment of his career by ill-health, but cheerfully and bravely faced up to the facts of life and made the best of things.

One of his friends writes, "the mainspring of all his high sense of duty and his healthy and inspiring outlook on life was a very living Christian faith."

Hunter died with extreme suddenness of heart failure on 27th February, 1932, and his passing has left an irreparable rift in the

hearts of many friends. His funeral in Saltwood Cemetery was largely attended.

And so passed a very gallant Sapper and a great gentleman. It is impossible to quote from all the letters received, but the following extract sums up Charlie Hunter's character aptly: "Keen as a boy throughout his service; a cheery companion, who would never let one down, however much he disagreed with one's decisions; fearless, yet humble-minded; he took time to form an opinion (for his mind was essentially mathematical and logical), but once sure of his ground he would battle for his opinion against all and sundry, however highly placed. He hated anything underhand or mean, and could not, had he tried, be guilty of any 'dirty work.'" The junior officers who served under him found his life and ideals an inspiration; and I have written this short story of Hunter's life in the hope that the rising generation in our Corps may in some measure draw that same inspiration from it. For myself, I have lost a real friend, and a friend whose value arose from the fact that he was the "whitest of white men," a real English gentleman, one who did justice, loved mercy and walked humbly: *sans peur et sans reproche*.

Hunter married in 1911 Gladys Edith, the daughter of I. C. H. Hutton, Esq., of Middelburg, Cape Province, who survives him.

GEORGE WALKER.

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

THE OFFICIAL HISTORY OF THE WAR—GALLIPOLI.

VOLUME II.

MAY, 1918, TO EVACUATION.

By BRIG.-GENERAL C. F. ASPINALL-OGLANDER, C.B., C.M.G., D.S.O., *p.s.c.*, and MAJOR A. F. BECKE, R.A. (ret.).

(W. Heinemann, Ltd. Price, with maps, etc., 19s. 6d.)

This second and final volume of the history of the Gallipoli campaign maintains the high standard of the first. The narrative is clear and presented in very readable form. The smaller maps interleaved with the text are clear and quite sufficient to illustrate the narrative, while it is a great convenience to have the larger maps and appendices in a separate volume for reference.

There is, naturally, a great deal in the book about the political influences, the influence of the Western Front and the vacillations of the directing authorities in England, which added so greatly to Sir Ian Hamilton's difficulties and to the last imperilled the whole force.

The military student is more concerned in the questions connected with the actual conduct of the operations. Was it possible with the forces placed at his disposal and in spite of many and various handicaps for Sir Ian Hamilton to achieve success? If so, was decisive success ever in sight; or such success only as might have influenced neutrals sitting on the fence, and have led to the expedition receiving more wholehearted support? If even a limited measure of success was possible, what were the causes of failure and were they avoidable? Finally, to what should we ascribe the very striking success of the operation of evacuation which appeared so fraught with danger?

General Aspinall-Oglander is evidently of opinion that success, at least sufficient to open the passage of the narrows, was within Sir Ian's grasp. He does not speculate on how far the inertia of a force with very little artillery and transport in the initial stages would have slowed down and limited the advance. It does seem probable, even had the primary attacks achieved much more, that it would not have been possible to exploit success sufficiently to prevent the Turkish reserves again stabilizing the situation. It is, of course, impossible to come to a definite conclusion as so much would have turned on the factor of morale. The difficulty which a force, based on a open beach, will have in exploiting success must, however, not be lost sight of. That a considerable success was possible, which would have encouraged and facilitated further operations to an extent which would have led to an ultimate decision, we may well agree.

General Aspinall (for short) traces the causes of failure and is frank in his criticisms. Not unnaturally he is more outspoken about and lays more emphasis on the mistakes made by subordinate commanders than in his criticism of the plans and actions of G.H.Q. While admitting the possibility of error in the latter, he always presents a defence, sometimes not wholly convincing. He makes it clear, though he does not lay stress on the point, that Sir Ian was too ready to meet the views of his subordinates instead of adhering to his own better judgment, and that he was unwilling to add to Lord Kitchener's difficulties by firm demands or recommendations.

For example, one reads that, after the second battle of Krithia, Sir Ian at first held that his troops at Helles had reached the limit of their offensive capacity and that Achi Baba could not be captured without strong reinforcements. Moreover, that he was already coming round to the view that Anzac would prove a more favourable base than Helles for a real attempt to open the narrows. To his subordinate commanders at Helles, however, Achi Baba, dominating the whole area they occupied, had become "almost an obsession," and Sir Ian yielded to their view that it could still be captured with the troops available. The third battle of Krithia followed and was succeeded by other actions desperately costly and with little gain of ground, with the result that not only was the original Helles force completely expended, but a fresh Division, which Sir Ian intended to reserve for the decisive operation, was also drawn into the fighting and exhausted. When the August offensive from Anzac and Suvla took place, the Helles force had shot its bolt and was powerless to hold the Turkish reserves in the southern area.

In defence of these operations, General Aspinall claims that they inflicted as heavy casualties on the enemy as on ourselves, that they shook his morale and distracted attention from the coming operations in the north. He does not, I think, allow sufficiently for the exhaustion and disorganization the operations entailed apart from casualties. Continuous fighting in a crowded area gave our troops little chance of reorganizing and of being withdrawn to quieter conditions to recover.

That an offensive from Helles synchronized with the major operation to the north would have been of immense value in retaining Turkish reserves is clear when one reads of the results of the Australian attack on Lone Pine. That attack was intended to draw reserves and succeeded in doing so, but unfortunately drew them from the south towards the decisive area where they played a great part in saving the situation for the Turks.

When one turns to the Suvla operations, one again finds Sir Ian yielding to the views of a subordinate and modifying his original carefully-worked-out plan. This is the more surprising when one considers General Stopford's lack of experience in command and the limited opportunity he had of studying the conditions. Again, with his knowledge of the task and of the strenuous local conditions, should not Sir Ian have been more insistent on having a more experienced and physically-active commander? Lord Kitchener had accepted his objections to General Mahon and he surely must have given way if objection to General Stopford had been pressed.

Granting his defence of the previous exhaustion of the Helles force, General Aspinall is fully justified in claiming that the plans for the August offensive were bold and good, and that they failed through faults in execution.

G.H.Q. must, however, share some of the responsibility for those faults.

The suggestion, it does not appear to have been an order, that the advance on the Chocolate and "W" hills should be by the north side of the Salt Lake emanated from G.H.Q. It is difficult to accept the suggestion as sound and it possibly was influenced by Sir Ian's success in manœuvring his enemy out of positions in South Africa. As part of the original plan, the objections to the proposal were not so great. The march in the dark would have been long and delays would probably have resulted in overcoming resistance at Lala Baba and Hill 10. Still such resistance could probably have been overcome by advanced guards without causing confusion in the main body. The operation would have been very similar to that successfully carried out by the covering parties at Anzac. When, however, the suggestion led to the change of the original plan, to the rejection of the Navy's objections to the use of "A" beach and to an initial dispersal of the force, it introduced new and fatal complications. The confusion which resulted was the primary cause of subsequent hesitation, delays and exhaustion of the troops all inter-acting.

General Aspinall's criticisms of the conduct of the Suvla operations are, of course, justified and his comments on the orders issued are instructive. It is interesting to compare those orders with the orders issued for the break-out from Anzac.

The Anzac operation was an extraordinarily bold conception, entailing as it did a long turning movement in close contact with the enemy by a large force over the roughest of ground in the dark. It was unavoidably a highly-complicated operation, but so far as was possible it was simplified by giving each constituent part of the force a very clearly defined role, which each could carry out independently. Orders were amplified by instructions which left no doubt as to the task of each commander. The operation was, up to a point, surprisingly successful, and General Aspinall ascribes failure to the hesitation of the commander of the most important column. That commander, unfortunately, when meeting little or no opposition, hesitated and delayed, first owing to doubts as to progress of other parts of the force and, later, owing to the failure of a detached portion of his own column to rejoin him. In this, he certainly departed from the principles contained in the orders he had received. In one detail the Anzac plan had a complication which might have been avoided.. The attempt to synchronize an attack from within the old Anzac position, with the development of a turning movement in exploitation of the hoped-for capture of Chunak Bair, was an example of the dangers of an over-prolonged time programme. It is true that provision had been made for changing the hour of attack, if necessary, but information was not good enough to enable effect to be given to this provision. The complication arose owing to the justification of the later attack depending absolutely on the success of a prior operation by another part of the force. By itself the attack was doomed to failure and would not assist other parts of the operations. An operation is comparatively simple when each part of a force has its well-defined role and where even unsuccessful action has its influence. It is complicated when the failure of one part of an operation does not automatically cancel subsequent operations whose value depends entirely on its success. The point is worth consideration in testing the soundness of plans.

To turn back for a moment to earlier events at Gallipoli before considering the final evacuation. In writing of the Turkish attack at Anzac on the 19th May, General Aspinall criticizes the absence from orders of any plan for a counter-attack should the attack, which was expected, fail; and evidently considers that an opportunity for counter-attack occurred when the Turks were thrown back with disastrous losses on their own trenches. Did an opportunity really exist? When a counter-attack is delivered to recover lost ground, the attacker is in some disorder and trenches he has captured face the wrong way. When, on the other hand, the attack has simply been driven back to his own trenches, the situation is very different. I can recall no case in France, at least, after a trench system had been established, when a counter-attack under the circumstances was attempted. The difficulties in connection with such a counter-attack are worth thinking out and the nature of the ground at Anzac would have added to them.

One can hardly doubt that the evacuation of the peninsula was inevitable after the failure of the Suvla operation. Sufficient ground had not been gained to permit the deployment of forces necessary to break through the Turkish position. We might have continued to hold what we had gained, but the wastage in the winter months must have been very heavy. It would have been necessary to hold the position strongly and no adequate shelter could be provided. Although General Aspinall points out that no large consignments of ammunition could have reached the Turks from the Central Powers, yet there was ample evidence that the superior quality of the ammunition which did come through would have great effect on our crowded lines and unrevetted trenches. The evacuation itself was made possible by good discipline, good staff work and the firm exercise of command. The methods adopted were a new departure and the conception was based on common sense applied to the actual problem with a full appreciation of the enemy's difficulties. That there was a division of opinion as to the methods which should be adopted General Aspinall records. Success was due to G.H.Q. overruling divergent opinion and adhering firmly to its own conception. The real danger was the discovery of the earlier

stages of the withdrawal which would have given the Turks an opportunity to deliver an organized attack against the depleted garrison. The danger in the final stages was more apparent than real, though it imposed a considerable strain on the nerves and discipline of the last troops to withdraw. If one analyses the difficulty the Turk would have in discovering that the actual front lines were not fully manned and then in communicating that discovery and deciding on action, one can see this. There was much comfort to be obtained from such an analysis during the last day of the evacuation, though heavy artillery fire on the beaches at the end was an unpleasant possibility which fortunately did not mature.

If General Birdwood had yielded to those who visualized a stereotyped rearguard action to cover the withdrawal the tale would have been very different.

So far as our own actions are concerned, the book is of value as a record rather than for the additions it makes to our knowledge. On the other side, one welcomes the light which it throws on the exercise of command and dispositions made by the enemy. There is much to be learnt from the actions and decisions of Liman von Sanders and Kemal.

C.W.G.

TRANSPORTING THE A.E.F. IN WESTERN EUROPE, 1917–1918.

By WILGUS.

(New York: Columbia University Press, 1931. London: Milford. 47 maps, plans, diagrams, etc. 612 pp. £4 18s.)

The author of this large book is an officer of the American Reserve Corps who, as a member of the Military Railway Commission, was one of the first to go to France in 1917, and subsequently served as Deputy Director-General of Transportation, A.E.F., until after the Armistice. In the absence of an official history of the Transportation Department—written at the close of the war but not published—he aims at providing the American public with such a full knowledge of what actually occurred as to prevent a repetition of the mistakes that were made.

His account is a full one and his criticisms numerous and frank. The American transportation service was confronted with an enormous task under difficult conditions. The combined capacity of all the French ports that could be made available was inadequate to meet American needs; entirely new ports had to be constructed. The lines of communication leading inland from them were from 500 to 600 miles or more in length, and ran, often by indifferent cross-country connections, athwart the main lines of four different railway systems. From the outset the Americans contemplated constructing their own depots and installations of all kinds and eventually running their own trains over the French lines between their own terminals. But the American cars and trains were longer than European ones and their locomotives required more coal and water than European engines; the French lines over which they were to run needed not only doublings and new connections to link them into through routes, but the lengthening of sidings and improved coaling and watering facilities throughout. Every branch of the work required personnel, plant and materials. The British could talk on the telephone from G.H.Q. to the W.O. and frequent exchanges of visits kept each side of the Channel acquainted with the situation on the other side. The American forces were 3,000 to 4,000 miles from home; their transportation service could only cable to America and hope that in several months' time it would get what it asked for. The European Governments and the High Command were insistent on the need above all of fighting men; in America the raising of transportation personnel and the provision of the plant and materials needed to land, carry inland, and maintain the combatants took second place. Ocean shipping was insufficient to carry even the combatants, transportation personnel and material arrived in insufficient quantities and only after great delays.

The author's principal criticisms are directed at the organization of the expeditionary force, the duties assigned to the transportation service, and the

attitude of the services of the pre-war regular army towards it. The original departments looked down on a new service staffed by lately-commissioned civilian experts and made great efforts to retain in their own hands all their original functions. The discharge of ships was assigned to the Transportation Department in July, 1917, but it was not until December that the new service was authorized to take over control of the work. Throughout the war all works of construction, including port and railway construction, remained the province of the Engineer Department. The D.G.T. might plan out ports, depots, railway improvements and other transportation facilities, but had no control over the execution of his projects. The Engineer Department did not hesitate to put forward its own plans, to make modifications in the D.G.T.s, or to divert materials needed for their execution to works for some other department. The staff had neither the training nor experience needed to cope with the problems that arose in the expansion of a peace-time army of 95,000 into one of over 2,000,000 in a distant theatre of war. It was, in fact, only in 1916 that Congress had authorized the formation of a General Staff and that body had to learn its own business and gain experience by trial and error as the building up of the Expeditionary Force proceeded. Within a month of the arrival in France of the American advanced guard the pre-war *Field Service Regulations* were abandoned and a transportation organization, somewhat similar to the then British organization, was adopted, under a D.G.T. directly responsible to the C.-in-C. for the movement of men and material from ship to railhead. But there were fundamental differences in that to the end of the war the American D.G.T. had responsibility without power; another branch of the service was responsible for constructing the facilities he considered essential, the local military commanders had jurisdiction over railway movements within the limits of their commands and in the Advance Section, corresponding to army areas, the transportation services were under the direct orders of representatives of the General Staff.

From the time of the first organization in 1917, the general organization of services on the lines of communication underwent frequent changes with continual alterations in the status and functions of the Transportation Department, with the result of destroying its initiative and putting narrow limits on its usefulness. It was allowed no say in schemes for the use of the railways on an advance or for what might be necessary in the event of a withdrawal. A memorandum by the D.G.T. on the railway situation arising from the German offensive in June, 1918, and on preparations for an eventual advance was returned by the General Staff unread as being no business of his department. A brief quotation will show the position reached at the close of hostilities :—

"The shortage of railroad cars at the ports, the non-completion of many con-
" struction projects essential to efficient operation, and the evil fruits of the faulty
" organization, were gradually slowing down the transportation machine to an
" alarming extent, when the signing of the Armistice brought matters to a head.
" The Chief of Staff, A.E.F., telephoned to the author that thenceforth the Director-
" General of Transportation would be considered responsible for all phases of rail
" and water transportation, including construction and light railways, from the sea
" to the front, thereby, in this informal manner, finally restoring to that office the
" duties originally bestowed on it in July, 1917."

The book contains much suggestive of thought by officers concerned with movement; to others the incidental references to the general organization of the American Army and to the system by which it was maintained may prove its chief interest. The criticisms are from the point of view of the transportation service; to the staff transportation was only one of several services, and one would have liked to have heard something of the staff view of the arrangements criticized.

The price of the book will put it beyond the reach of most officers. There is a copy in the War Office Library.

A.M.H.

DER EHRENBUCH DER DEUTSCHEN PIONIERE.

Edited by MAJOR PAUL HEINRICI.

(Berlin: Wilhelm Kolk. Bound in cloth, 45 Reichmarks; in leather, 55 Reichmarks.)

The members of the Engineer and Pioneer Corps of the old German Army must be congratulated on their magnificent and imposing memorial volume.* Bound in black and silver, octavo, beautifully printed in leaded type on 630 pages of art paper, with countless portraits and illustrations, it must be a work financed from national rather than regimental sources.

As an introduction it contains letters in praise of the Corps, signed in reproduced autographs by most of the prominent surviving German commanders in the war: the Kaiser, Crown Prince Rupprecht, Field-Marshals Hindenburg and Mackensen, and many others, including General von Mudra, the only army commander who was an Engineer officer. There follows a 60-page history of the Corps, with portraits and notices of the Inspector-Generals, who were the heads of it; they include Gneisenau (1808–9) and Scharnhorst (1810–12). There is then some account of the expansion during the war: one item which might be overlooked is that, in 1915, each Pioneer battalion was increased from four to five companies. The special units included 236 Searchlight sections, 3 Flame-Projector battalions, 23 Trench Mortar battalions, 7 Gas battalions (originally called, as camouflage, "Disinfection Squads") and 46 Mining companies, besides Ferry, Water Supply, Liquid Air (as an explosive), Trench Dredger, and Landing (for overseas expeditions) companies, schools, Ersatz troops and depots. As an example of expansion, the 63 units raised by a single Pioneer battalion are given.

The bulk of the book is devoted to the relation of the deeds of the Pioneer troops during the war, and in every theatre. There are about 188 different articles by different authoritative hands, beginning with the attack on Liége and ending with the throwing of the floating bridges over the Rhine in November, 1918, to expedite the march home of the defeated armies.

A matter of special interest is an article at the end on the subject of the higher direction of engineer work in the field, by Colonel Eggeling. At the outbreak of war, General von Claer, Head of the Engineer and Pioneer Corps, and Inspector-General of Fortresses, was appointed "General of the Engineer and Pioneer Corps at G.H.Q." immediately under the Kaiser, not under the Chief of the General Staff, with a Major-General as Chief of the Staff and two adjutants. He had no powers of command, and there was nothing for him to do, as all mobile Pioneer units were allotted to armies. He therefore asked for military employment and was given command of the VII. Reserve Corps and soon after of the VII. Corps. His Chief of the Staff was given an infantry brigade, and later the 38th Division. The two adjutants remained at G.H.Q., one of them dealing with personal services, the other accompanying the Kaiser on his tours in the "Half-Staff" provided for this purpose.

In the summer of 1915 it appeared to the Supreme Command (O.H.L.) desirable to collect and collate experience as regards field fortification and co-ordinate design in construction. General von Claer was, therefore, recalled to G.H.Q. for the purpose, and he formed a staff, consisting of the author of the article, Colonel Eggeling, two other Engineer officers, a General Staff officer and a Field Artillery officer. General von Claer spent a year on the work, and then being refused a command in the field requested to be allowed to retire. This was granted, and Colonel Eggeling was appointed as officiating General of Engineers and Pioniere at G.H.Q. He was on very good terms with the General Staff, and collaborated with it in organizing the expansion of the Corps, the creation of new units, the manufacture of Engineer stores and the examination of new inventions, "without the slightest friction." Except in the periods during which Hindenburg–Ludendorff were on the Russian front, when

* *Pioniere* represent our engineer field units.

he remained in France, Colonel Eggeling had a weekly conference with General Ludendorff; his staff was gradually increased to nine officers; but, in the winter of 1916, the adjutant for personal services was transferred to the Military Cabinet, or, as we should say, the Military Secretary's office. In the summer of 1918, the General of the Engineer and Pioneer Corps, like the General of the Foot Artillery, was placed definitely under the General Staff. J.E.E.

AVIATION AND THE AERODROME.

By H. A. Lewis-Dale.

(Charles Griffin & Co., Ltd. London. Price, 15s.)

The author, Mr. H. A. Lewis-Dale, is an Assistant Director of Works and Buildings at the Air Ministry, and is known to many R.E. officers through having given a lecture, in 1930, at the School of Military Engineering, Chatham, on the subject of "The Maintenance of Landing Grounds" (Dec., 1930, *R.E. Journal*). There is probably no one, in this country at any rate, more qualified to write on the subject, and his book fills a well-defined gap in engineering literature. In fact, as the author justly remarks in his preface, the problems considered herein are not dealt with except by passing reference, in any existing aviation literature in this country.

The subject of engineering work in connection with aerodromes is of special interest to military engineers. Many of us must have pondered on the following somewhat cryptic sentences in *F.S.R.*, Vol. I, Sec. 87, paras. 6 and 7:—

> "The preparation of the surface of aerodromes and the provision of aeroplane hangars is the duty of the Air Force, but the necessary labour and material will be provided from Army sources.
>
> "All works services for the Air Force will be carried out by the Army."

and asked ourselves what was their exact significance and what would actually be required from us in war.

The exact answer is not to be found in Mr. Lewis-Dale's book—far from it. His book deals with permanent peace-time practice, whereas the military engineer is, as always, concerned with war-time improvisations.

In aviation, however, perhaps more than in any other form of activity, the two tend to merge together, and a thorough study of Mr. Lewis-Dale's book is incumbent on us, if only as dealing with a subject with which most of us are entirely unfamiliar, but which is one of our war responsibilities in overseas theatres of war.

This unfamiliarity is the justification for this somewhat lengthy and detailed review.

The book is divided into twenty-one chapters, dealing in logical sequence with aerodromes generally, and the principles governing their siting, layout and construction; followed by chapters on drainage, planning and design of hangars, seaplane stations, petrol supply systems, etc.

Certain chapters dealing with airship stations, examples of alterations effected to existing sheds, costs of construction of aerodromes, examples of aerodrome planning, etc., while not of particular value to the military engineer, indicate the comprehensive character of the book.

Chapter I contains a review of the present position of aviation in Great Britain, and may be characterized as being a special plea for the provision of increased aviation facilities in this country.

Chapter II discusses the selection of aerodrome sites, and the greater part of the chapter is directly applicable to the selection of military aerodromes in war. At the same time, it would have been of assistance, had the scope of the book permitted of it, if military requirements and considerations had been dealt with in a special section.

Little is said about the modifications required in aerodromes at some altitude, as occur in many places on our Imperial air routes.

Chapter III deals with the layout of aerodromes, but the special problems affecting the layout of military aerodromes, *e.g.*, security and concealment and protection from the air, are not touched on.

Chapters IV to VII deal in a very thorough manner with the construction of aerodromes; and describe the grading and various methods of treatment of the landing-ground surface, both for grass and other types of surface. Although much of the work described here is obviously far beyond the scope of possible war requirements, these chapters are well worth careful study. In fact, without knowledge of the ideal, it is difficult to form an instructed opinion as to what is practicable and necessary in any particular case.

It is perhaps worth noting that, in the Great War, work almost of the magnitude contemplated here was found necessary in the case of one or two service aerodromes in France.

Methods of levelling-out plough land, and oil treatment of the surface are fully described, and the system of run-ways, by which the treatment of the whole of a landing-ground surface may be avoided, is adequately dealt with.

Chapter VIII deals with the drainage of an aerodrome, and is illustrated with examples of work actually carried out in specific cases.

If exception can be taken to this chapter, it is on the grounds of a certain lack of definiteness.

The reviewer, when studying the question of the drainage of recreation grounds a few years ago, came to the conclusion that it was possible to lay down definitely the most suitable system of drainage for various types of soil.

In his opinion it should be possible not only to fix the sizes, distances apart and depths of the main collecting drains, but those of the feeders as well.

Information of this nature would have added to the value of this chapter.

Chapters IX and X deal with the construction of hangars, and call for little comment. They are the result of a wide experience and work on a scale which few individuals are likely to equal.

Exception might be taken to the close packing of machines in the hangar illustrated in Fig. 11, which looks most ingenious on paper, but would be an exasperation to individual owners of the small machines unhappily tucked away in the corners.

Chapter XI deals with seaplane and flying-boat stations, a most important subject when the extent of the Empire's sea communications is considered. Here, perhaps, more than in any other respect, is the best method of handling flying-boats—always an expensive and difficult undertaking—still undetermined. The author describes all the present methods of handling by slipway, floating dock, or pier and crane, and finishes with an interesting description of a protected dock for large flying-boats.

Various types and methods of construction of slipways are described, but the special case of slipways in restricted waters where danger to navigation precludes the slipway projecting beyond the bank of a river has been omitted. The reviewer actually had to construct a slipway of this kind, on the banks of the Shatt-el-Arab at Basrah, which had to be excavated out of the solid and which presented considerable engineering difficulties.

Chapter XII deals with petrol-supply systems in a very general manner, and is illustrated with one small diagrammatic sketch of a typical installation. An illustration showing the details of fixing buried tanks would have been of assistance here.

Chapter XIII touches briefly on the progress in aircraft design as affecting the aerodrome, but has little if any bearing on military aviation, while Chapters XIV and XV deal with the financial aspect of the construction and maintenance of aerodromes.

Chapter XVI gives examples of alterations to existing sheds, and Chapter XVII examples of hangar design. Both these Chapters might with advantage have been grouped with Chapters IX and X.

Chapter XVIII deals with airship stations in so brief and general a manner that comment is hardly possible. It is interesting to note the author's stress on the necessity for good ventilation. The reviewer's experience with the only shed he came across—viz., at Karachi—was that at the top of the shed, some 180 feet above ground, the natural uprush of air was such that it was difficult to keep one's hat on.

Chapter XIX deals very briefly with miscellaneous ancillary equipment, and calls for no comment.

Chapter XX deals with examples of aerodrome planning, and is illustrated by diagrams of an imaginary layout for a military aerodrome and of a civil air port.

One might be tempted to criticize the former on the grounds of insufficient dispersion of vital buildings as a protection from air attack. As regards the latter, the author disarms criticism by admitting that his proposals are tentative and to some extent visionary. Interesting as they are, their cost, put at between £300,000 and £400,000, excluding land purchase, must put them beyond the range of practical politics in these hard times.

Chapter XXI gives particulars of aerodromes in this country and abroad and is interesting as illustrating what great advances have been made in aerodrome layouts abroad.

One illustration in particular, that of the station building at Fuhlsbuttel aerodrome, Hamburg, is planned in the shape of an aeroplane and is typical of the modernist attempt—carried perhaps to extremes in Germany—to express the function of a building by its appearance.

Mr. Lewis-Dale is to be congratulated on having produced an eminently readable and interesting publication, and one which, having regard to the scope of his book and the public to which it is addressed, contains a fund of comprehensive information, valuable alike to engineer and layman.

If exception can be taken to any of it, it is, perhaps, to a few isolated instances of overstatement which are quite unnecessary to his subject.

Such absolute statements as that aviation has revolutionized warfare, or that it has rendered possible the mapping of country unsurveyable by ordinary methods, obviously require qualification; while few are the engineers who would venture to claim that concrete is everlasting.

G.B.O.T.

FLÉAU AÉRIEN.

La Guerre Aéro-chimique et la défense antiaérienne.

By S. de Stackelberg.

(Lausanne. Imprimeries Réunies, S.A. Francs 6.50.)

Warfare in the past held few terrors to equal those of the aerial scourge which constitutes M. de Stackelberg's conception of the air raids of the future.

Such raids will open with a preliminary attack in mass by heavy bombers, overcoming the resistance of the defence by sheer weight of numbers, and discharging high-explosive bombs destined to throw all buildings, civil and military alike, open to the effects of the incendiary, asphyxiating and vesicant substances which will then be rained upon them from low altitudes by following squadrons of specially fitted tank-aircraft (*avions-citernes*).

That part of the garrison and civil population which has not been destroyed by the preparative bombardment will now be faced either with escaping under the protection of its "anti-gas" clothing, or of awaiting death, incapable of retaliation, in hermetically sealed compartments underground.

Meanwhile a fleet of low-flying tank-aircraft, unhindered by the attentions of the defence, completes the devastation by distributing over the whole area dense concentrations of corrosive and toxic liquors of high persistence.

Such is the lurid picture which the author paints of the future tactics of aerial bombardment, and one has not to read far to be convinced of the futility of international conferences discussing the limitation of heavy artillery and land armaments while commercial aircraft requires no conversion but the loading of a bomb or a cistern of poisonous liquid to make it, in effect, a weapon in mobility, range, calibre, and radius of action unparalleled by any cannon yet conceived.

The author is at pains, nevertheless, to explain that the numbers of aircraft necessary for a bombardment of the type referred to above are not, at present, forthcoming, and that the conversion of commercial chemical plant to the production of adequate quantities of war gases is not the simple process it is sometimes represented to be.

The menace nevertheless remains, and, as neither the total abolition of aircraft throughout the world, nor the internationalization of the chemical, clock-making, and other industries indispensable to the provision of this type of armament can be regarded as practical propositions, we are led to the conclusion that, whatever else can be spared, an adequate air defence system is an imperative need of any nation which intends to retain the mastery in its own house.

M. de Stackelberg defines two schools of air defence which he names respectively the "static" and the "dynamic." The former, satisfied with assuring home security, depends upon extensive ground defences assisted by defending fighter aircraft: the latter envisages the "independent air force" carrying the war into the enemy's land by a system of reprisal and approximating to the nineteenth-century British policy of regarding the first line of defence as the enemy's coast. There can be no combination of the two schools, for no nation can afford the cost of equipping both systems adequately. "Rather," says the author, "not trouble with defence at all, than "convert your national defensive organization into a sort of museum in which all "the appropriate weapons would figure in but homœopathic quantities."

The "dynamic" school lays itself open to an implication of aggression which can never be applied to an exponent of the "static" system, the equipment of which lays fair claim to be classified as weapons of peace. England and America are quoted as having adopted "static" principles of strong defences, a circumstance which the author attributes largely to the facts that the frontiers of these countries are stabilized and that there can be no question of territorial loss or gain. France, on the other hand, figures as the leading exponent of the "dynamic" school of air defence, involving powerful air fleets.

In the new defensive organization which the aerial menace calls into existence, there can be no division of coast and air defences into watertight compartments, and the whole system of fortification must undergo yet another change in the course of its evolution. Concentrated and fixed armaments must give place to dispersed and highly mobile equipment, which must, at the same time, lose none of its power.

Defences will no longer surround cities and populous areas, but each whole country will develop into a single fortress. The industrial areas will gradually recede from the frontiers, though, as these are generally sited from geological rather than strategic considerations, it is difficult for the reader to comprehend how this is to be accomplished. M. de Stackelberg also argues that by thus separating the defences from the bulk of the civil population the chances of suffering and casualties among the latter will be greatly reduced. Here again, it is difficult to agree that civilians will thus be rendered immune from aerial bombardment, when it is considered that in a war of any magnitude the bulk of this population will be engaged on munition or other work in establishments now definitely recognized as legitimate military objectives.

More obvious are the points to be taken into consideration in the future planning of towns and buildings. Many of these, as the author points out, are happily to be found embodied, on hygienic grounds, in the modern "garden cities" now springing up all over the world.

Factories and workshops must lie on the outskirts of the city and be untenanted

save during actual working hours. The houses must be high to afford refuge from poisonous gases and to provide fresh air inlets at a reasonable height above contaminated layers. All buildings will require to be provided with means of hermetically sealing the lower stories; blocks must be separated by wide spaces to isolate the effects of the preliminary explosive and incendiary bombardments, and these spaces are to be planted with trees to act as "gas breaks," while avenues must in future be laid out with reference to the local prevailing winds in order to function as ventilating corridors.

A complete review of modern methods and principles of air defence is included, the account of the British system being fairly accurate, though the "Savage" searchlight is described as the equipment of the British Army, and we are credited with having in the anti-aircraft service Beard projectors throwing invisible beams of infra-red rays! Throughout the book the author appears to incline in favour of the American service, the Sperry sound-locator and electro-mechanically controlled searchlight being described as fulfilling all present-day requirements.

The work of French sound-locators receives high praise, but readers with experience in this class of work will learn with surprise that tracks plotted by these means are said to coincide identically with those recorded optically, while sound prediction, not only for artillery barrages but for searchlights also, is carried out with results hardly differing in accuracy from those obtained when laying on sight.

In considering the question of camouflage the author puts forward the apparently novel suggestion of concealing roads from the air by covering their surfaces with coal-dust; but argues, more reasonably, that roads near frontiers and leading into areas of strategic importance should be systematically planted with trees.

This book, which is well supported by reference to past history and to recent manœuvres in all countries, covers very completely the subject of air defence in its larger sense, and contains a great deal of technical matter of considerable interest, much of which is in excellent tabulated form; but it cannot be said to be an easy work to read. The alternate superiority of the attack and defence in succeeding chapters is confusing; but (in a glimpse into the not-too-distant future) we are left with the defence triumphantly projecting, from monstrous generators, short wave-length beams of powerful electric energy into the stratosphere where the raiding aircraft, propelled by rocket generators and steered radio-goniometrically, perishes from the effects of the powerful Foucault currents set up in its metal parts!

L.E.C.M.P.

ADMINISTRATIVE SCHEMES—WITH SOLUTIONS.

By Major S. W. Kirby, o.b.e., m.c., R.E., *p.s.c.*, and Captain and Brevet Major C. A. P. Murison, m.c., R.A., *p.s.c.*, *p.a.c.*

(William Clowes & Sons, Ltd. Price, 4s.)

The administrative problems arising in six phases of war are dealt with: the approach march and first contact, encounter attack, prepared attack, defence, M.T. moves and withdrawal. A number of questions arising in each phase are set, followed by very full explanatory notes. These range from the fate of a wounded trooper to a programme of dumping artillery ammunition for a prepared attack.

The object, as stated by the authors, is for assistance in preparation for promotions and Staff College Entrance Examinations, and for practice in applying administrative principles. They have deemed it advisable to take the divisional picture, though some of the problems deal with lower formations. These on the whole are dealt with sketchily, as, for instance, those dealing with the distribution of great coats and water supply. It is this type of question which is most frequently met in the examinations mentioned.

The scene of the "campaign" is the well-established battlefields of the Hog's Back–Hindhead area, which presents as good conditions for supply and transport

as can reasonably be expected in a theatre of war, and it is, therefore, the application of organization rather than principles which is illustrated. The conditions under which the British Army usually operates necessitate very considerable modifications to the normal system and it is then that a thorough knowledge of administrative principles is essential. This is recognized by examiners and some problems arising in abnormal conditions might well have been included. Under such conditions, administrative requirements must often dictate to sound strategy and tactics, although the authors state, in their foreword, that tactical requirements must take precedence over administrative convenience. Disaster has often followed a faulty appreciation of the word " convenience."

References to *F.S.R.*, Vol. I, and other books of reference would have assisted the student to digest the vast quantity of information packed in the 71 pages of the book. The student would be well advised in order to keep his mind cleared, to annotate the book accordingly. Diagrams might have been used more freely.

The problems affecting engineering matters call for some comment, but space prohibits the mention of more than two. There is a tendency to treat the Field Park Company as a transport unit. Under the present organization and equipment of Divisional Engineers, there is a possibility of a portion of this unit being required at very short notice for duty with advanced guards or rearguards. The existence of two lorries in both the Maintenance and Supply Companies for the carriage of R.E. Stores appears to have been overlooked.

It is puzzling to find, on page 63, that the Commander, 3rd Infantry Brigade, is taken from another division to command a rearguard, of which his own formation forms no part.

The problems are well set to illustrate the points brought out and the examples of staff duties are excellent. There is no doubt that there is a lot of meat to be extracted from the book, and the problems may be of assistance as guides for those who have to train officers in administrative matters.

Those who have graduated at Camberley will recognize a close relationship with the doctrine they have imbibed there.

C. de L.G.

LECTURES ON *F.S.R. III*—OPERATIONS BETWEEN MECHANIZED FORCES.

By MAJOR-GENERAL J. F. C. FULLER, C.B., C.B.E., D.S.O.

(Sifton Praed, 7s. 6d.)

Major-General Fuller has taken himself at his own word. In introducing his recent book on *Field Service Regulations II*, he deplored the lack of candour on the part of our Army doctrinaires in expressing their opinions on the development and conduct of mechanized warfare; he urged the issue of *F.S.R. III* in place of a confidential text-book, and he would, if necessary, undertake the writing of it himself. General Fuller has now anticipated official action through the normal channels and has published a series of lectures on *F.S.R. III*.

A publisher's note to this publication describes it as " a link between the old and the new; the obsolete methods of past warfare and the untried developments of the future." The author, in his Preface, explains that he has followed the system he adopted in writing his lectures on *F.S.R. II*, taking the official manual paragraph by paragraph, and, as far as possible, " motorizing " and " mechanizing " its precepts. He disclaims any intention to canvass the correctness of his views, and he allows that some of his suggestions may prove so costly as to be unpractical. His purpose is to jog the minds of unthinking soldiers and, quoting from his Preface, to remind them that " the only way to prevent ossification of mind is to accept nothing as fixed, to realize that the circumstances of war are ever-changing, and that, consequently, organization, administration, strategy and tactics must change also; and if during

peace-time we cannot change them in fact we can nevertheless change them in theory, and so be mentally prepared when circumstances require that change should be made."

General Fuller's views on the part which mechanization must play in the war of the future are already widely known, and in this, his latest publication, he seeks to consolidate the position to which he has advanced. The reader may agree or disagree in whole or in part with the author's theories and diagrams, but he will inevitably be induced to examine them carefully in relation to his own preconceived opinions—and he will find fresh impulse for the study of his profession.

There is a strong flavour of hypothetical essence in these lectures, and criticism is, therefore, disarmed. Comment may be made on our author's theories on the use of motor guerillas as aids to finding and holding an enemy, on the creation of anti-tank zones as strategical and tactical bases for the action of mechanized forces and on the role of aircraft in co-operation with ground forces. In regard to the latter, it is significant to read that " should it be found impossible to break through an anti-tank zone, then it is certain that offensive operations will be transferred to the air, every effort being made to demoralize the enemy by attacking his cities, industrial centres and civil population. Whilst mobile warfare means the attack on armed forces, static warfare can lead to but one end—attack on the civil will."

The importance of the Engineer arm in the mechanized battle is emphasized. As a combatant, the engineer will design anti-tank defences, decide on the works to be dug, the minefields to be laid, and the bridges to be constructed or demolished, and will lay down the gas policy. His duties may require such equipment as anti-tank trench diggers, mine-layers, mine-sweepers or exploders, and tanks equipped to emit clouds of gas and toxic smoke and drench areas with vesicant chemicals. There is, however, one role allotted to engineers in protracted defence, which may not generally appeal; mechanical engineers, as opposed to field engineers, will carry out repair work of all machines of the field army and the army of occupation.

General Fuller has, in addition, a further duty for our Survey Department, the modification of our present system of mapping to show areas which are suitable and unsuitable for mechanized movement. This mechanization business is undoubtedly of interest to flexible minds.

H.J.D.C.

THE MAP OF ENGLAND
or
ABOUT ENGLAND WITH THE ORDNANCE MAP.

By COLONEL SIR CHARLES CLOSE, K.B.E., C.B., C.M.G., SC.D., F.R.S.

(Peter Davies. Price 6s.)

The topography of a country is largely an expression of the underlying geological structure. The same geological formations give rise to similar topography and scenery on the surface. In a like manner a map can be made to depict much of the past history of a country. It is possible to trace on it ancient roads and tracks and other remains of a past civilization, not easily obliterated by time or weather. Certain markings on the ground reveal sites of prehistoric forts and dwellings going back to antiquity, so that the map may be made to portray not only the utilitarian requirements of the present, with all its modern innovations, but also to give us glimpses into the dim and legendary past.

Of late years air photography has been pressed into the service of archæology and ancient remains have been disclosed not visible to the surveyor on the ground. It has greatly assisted in the discovery of objects of antiquarian interest.

The maps of England are now not only guides to motorists and others, but are of immense value to all inquirers into the ancient history of our country.

For all this we have to thank the Ordnance Survey for providing us with a wealth of detail on so many points of interest.

In the book before us, Sir Charles Close sets himself the task of telling us, in a very pleasing manner, how we can get the most out of our National Survey from the detail shown on the map, and from the place-names on its face.

The earliest known map of Britain is that attributed to the father of geography, Ptolemy of Alexandria, who died about A.D. 150. There is then a long gap to Matthew Paris' map of about A.D. 1250. Several other maps of varying importance are mentioned, including the excellent one of Mercator, 1564, until we come to the first really important map of Christopher Saxton, who made a survey on a scale of about four miles to the inch of the counties of England, towards the end of the sixteenth century. A specimen of his map is reproduced. It shows hills, but, curiously enough, no roads. It was probably the military map in use during the Civil War. This series remained until John Cary produced his county maps in 1794, just previous to the birth of the Ordnance Survey. But before this had taken place, that patriotic and enterprising body, the Royal Society of Arts, had offered prizes of £100 for county maps on a scale of one inch to the mile. This had the effect of producing maps of several counties.

A chapter is devoted to the origin of the Ordnance Survey and one to its history. A specimen of the one-inch map of Kent, published in 1801, is given. This is a great improvement on anything that had been so far produced. The chapters on the Ordnance Survey cannot fail to interest all surveyors.

The National Survey was then definitely established. The one-inch maps were followed in 1824 by the six-inch and, in 1863, the 25-inch plans were introduced on which the maps of these Islands are now based.

Sir Charles devotes a chapter to the "Place-Names of England," from which much matter of historical interest can be extracted. Another chapter treats of "Prehistoric England on the Map," towards which Mr. O. G. S. Crawford, archæologist attached to the Ordnance Survey, has done so much good work by adding to the maps features which require expert investigation.

The author takes the reader walks through some of the sheets noting and explaining as he goes points of interest. Then we have "Roman England on the Map." This period is the subject of a special map brought out by the Ordnance Survey, in which an attempt has been made to show England as the Romans saw it.

We read of Elizabethan England, with its beacon hills marked on the map, along which the news of the Armada was signalled and by which means the authorities hoped "to muster in the course of a few hours 17,000 men at Harwich, 16,000 at "Portsmouth, 17,000 at Plymouth and 11,000 at Falmouth." Could we do better even to-day?

The book ends with an account of "Seventeenth-century England on the Map." This period is also illustrated by a special map brought out recently by the Ordnance Survey with an instructive introduction. In those days England was not intersected by hedges and "that is why the cavalry could charge freely in the battles of "the Civil War."

A perusal of this book will add much to the interest of motorist and hiker, who, tired of the broad reinforced concrete road, can spare time, in this existence of hustle, to wander off, map in hand, and study some of the interesting material that has been prepared for him.

H.L.C.

THE INDIAN POLICE.

By J. C. CURRY.

(Faber & Faber. Price, 12s. 6d.)

History, it is to be hoped, will one day recognize the achievements of the British in maintaining law and order in India. India contains one-fifth of the world's population; it cannot be said, even at the present day, that it contributes one-fifth

of the world's trouble. Much of the credit for this state of affairs must be given to the Indian Police, whose difficulties and successes are admirably set forth by Mr. Curry.

The strength of the force in British India works out at one policeman to 1,340 inhabitants or 4·5 square miles: for comparison, it may be stated that in England and Wales the proportion is one to every 690 inhabitants or 1 square mile. India cannot be said to be over-policed.

India, as the author points out, is not naturally lawless, yet there is a most astonishing variety of crime, ranging from the forgery of nickel coins worth twopence to the theft of whole herds of water-buffaloes by river, the animals swimming and the thieves being supported on inflated skins. There is a considerable element of amusement in some of Mr. Curry's stories; for instance, that of the carpenter and his tool-chest (p. 147). The chest, which was sent by goods train, actually contained a confederate who, when the train was well under way, let himself out to loot the other contents of the van. There is material for several new volumes of Sherlock Holmes in Mr. Curry's anecdotes.

Dacoity, or robbery under arms, and rioting, give the police in India their greatest trials. Inter-communal rioting, with its ghastly tale of murder, mutilation and torture, gives the policeman as difficult a task as he will find anywhere. No higher praise can be given to the police sepoy, when it can be said that he unflinchingly follows his officers in the suppression of Hindu-Moslem riots, even when firing on his co-religionists is involved.

In the political agitations of the last two years the police have been most sorely tried. Mr Curry treats this period in such a restrained manner that the gravity of the situation is not so evident as it might be. The anti-British elements made a dead set at the loyalty of the Indian ranks of the police, using every foul method they could think of: right well did they come through the trial, and their British officers may well be proud of their men. It is no reflection on the loyalty or ability of the police that the army had, on many occasions, to take charge.

Mr. Curry relates, in the plain language of the *Gazette*, a few of the brave deeds which have gained officers and men rewards and promotion: many of these deeds rival those for which soldiers have been awarded the V.C.

Mr. Curry complains of the difficulty of securing convictions on police evidence alone. This adds considerably to the difficulties of the police, while it diminishes their usefulness. Again, largely as a heritage from pre-British times, police are not looked on with the same friendly feelings as in this country, and in a court of law they find themselves in a definitely hostile atmosphere.

The Imperial service of the police, *i.e.*, the commissioned officer category, is to be Indianized to the extent of 50 per cent. by 1939. Of the Indian members of this class, the author has a very high opinion. Yet we cannot but regard the future with misgiving, when law and order will be under a minister subject to an elected legislature. The grant of a constitution is bound to mean the gaol-delivery of a number of seditionists who will find themselves in a position to harry the police, who, in pursuance of their orders, were the means of arresting them.

There is one point we would like to know—what pay does the police sepoy get? We are told that it is less than that of the sepoy in the army, but we would like to know the actual amount and his terms of pension, etc. There is a general impression that he is grossly underpaid.

In short, Mr. Curry deserves the highest praise for the compilation of this most valuable work. The style is light and easy and the book should be read by a wide circle in and out of India.

One slip may be noticed (p. 177), Hasan, the son of 'Ali, has no claim to be called a martyr.

F.C.M.

THE ROYAL ENGINEERS, WITH HISTORICAL NOTES ON THE BRITISH EMPIRE.

(60 pp. 5¼ in. x 4 in.)

(Education Office, Training Battalion, R.E., Chatham. Price 3d. post free.)

The sub-title of this pamphlet explains the object with which it has been prepared: it is a "Handbook for the use of Candidates for Second and Third Class Certificates of Education." Considering the size of the subject, the information given has been well selected and condensed within the 60 small pages of the pamphlet. Unfortunately a certain number of inaccuracies and misprints have crept in, but as this first edition will undoubtedly be followed by subsequent ones, there will soon be an opportunity of making corrections. This small handbook fills at a modest price a want which has been felt for some time, and it is good that it has been put on a satisfactory basis as regards publication.

P.H.K.

AN OFFICER'S WIFE.

By ZOË TOWNSHEND.

(Country Life, Ltd. Price 6s.)

This little autobiography, although bearing the above title, is devoted for more than half its length to Mrs. Townshend's early life before she married into the Army.

An unsympathetic home and a stern school did not make for happiness in her girlhood. It is of this period that she remarks, in one of her simple but wise observations, "All children long to be loved, and if love is denied them they are thrown back on themselves and are often ill in body and mind."

After leaving school, a great deal of her time was taken up in refusing a variety of suitors. Eventually she found herself, through "Army pals" of her favourite sister, Noll, in Service circles in India, and met Tony, an impecunious subaltern, who possessed the priceless gift of a good heart. May we hope that it is this attribute that draws the majority of girls to embark on the uncomfortable existence of an Army officer's wife.

After a few months of the horrors of Jhansi, as a bride, the Great War followed. Zoë Townshend had her own original way of cheering her husband and his brother officers up to the very last minute until they left for the fighting line. Her trials were not over with the Armistice, for her husband was engaged in the aftermath of hostilities in North Russia and Ireland. At the same time, she makes the most of life wherever she finds herself in the constant upheavals of her home.

The book is written in the simple, natural style of an intimate letter. It is a change from the romantic, hysterical creatures of fiction. The whole atmosphere is intensely English. Perhaps the praise she gives to the British troops should be shared by wives such as she who take the rough with the smooth.

Sir Francis Dalrymple, in his foreword, tells us of the sad news of her death soon after finishing the book.

The few hours of reading will give the intending brides of Army officers an idea of the inconveniences and difficulties of Army life and of the abiding consolation of good comradeship.

G.

SHIKAR NOTES.

By the late COLONEL A. H. CUNNINGHAM.

This book, written for private circulation, was completed by the late Colonel A. H. Cunningham just before his death. It is a most useful publication for officers who may be coming to India and are interested in shooting. It is compiled with the accuracy for which the writer was noted, and is based on his own 30 years' experience in Indian jungles.

Copies can be had at Rs. 2 (or three shillings postage paid) from the Adjutant, K.G.O. Bengal Sappers and Miners, Roorkee, India.

The proceeds, at the writer's request, are to be credited to the "Elles Fund," a charitable fund of the above Corps.

HEAVY OIL ENGINES OF THE AKROYD TYPE.

By WILLIAM ROBINSON, M.E.

(Blackie & Son, Ltd. Price, 7s. 6d.)

This book is an excellent introduction to a study of the modern high-speed compression ignition engine. In it the author traces the development of the type from the first Priestman oil engine of 1888 to the modern engine used in oil-electric railway cars and road vehicles.

He is at pains to stress the part played by British inventors throughout this period, and the early chapters are a description of the work of Herbert Akroyd Stuart, whose name in conjunction with that of Messrs. Hornsby & Sons (now Ruston & Hornsby, Ltd.) is a familiar one to military engineers. A quotation from the Report of the Oil Engine Nomenclature Committee of the Institution of Mechanical Engineers, whose chairman was Captain H. Riall Sankey, C.B., R.E., is worthy of repetition: "The Committee is of the opinion that the modern oil engine, as distinct from the automatic type of liquid-fuel engine, has been evolved mainly from the principles enunciated by Mr. Herbert Akroyd Stuart in his Patent No. 7146 of 8th May, 1890, and as embodied in the engine constructed at Bletchley (Buckinghamshire) and tested by ——, a member of the committee, in February, 1891. This Akroyd engine is the prototype of those in which the liquid fuel is introduced into a compressed or partially compressed charge of air, and which does not need an extraneous source of ignition. In this respect the Akroyd engine anticipated the engine, subsequently evolved in Augsberg, Germany, by the Maschinenfabrik, Augsberg, Nuremburg, from the original proposals of Rudolf Diesel in 1893. It may thus be said that the pioneer work of Herbert Akroyd Stuart has been adversely cloaked by nomenclature."

Later on the author shows that the Bosch fuel pump used so largely on modern engines is a development of the Flash Valve Fuel Pump invented by Mr. Alan E. L. Chorlton, and first used on the Beardmore engines installed in the airships R 100 and R 101.

The descriptions of early work are fully and well illustrated with photographs and diagrams. A chapter on the Hornsby-Akroyd engine, many of which are still in use in Defence Electric Light installations, is of particular interest to R.E. officers. The following chapter describes the evolution of the Diesel engine, and the differences between the Akroyd and the true Diesel types are clearly emphasized.

A section on marine engines follows, and an interesting account is given of the Scott-Still engine. This engine utilizes the heat from the jackets and exhaust gases of the internal combustion cylinders to generate steam, which is used either on the bottom side of the pistons or in separate steam cylinders.

The book concludes with a chapter on modern high-speed compression ignition engines as used in the airships R 100 and R 101, for railway traction purposes and for road vehicles. The results of many tests are given, and a strong case made for the further development or utilization of this type of prime mover. This final section might well be amplified, but the reader whose interest has been aroused can follow up the subject in the pages of most of the technical papers of to-day.

The book is not unduly technical, and the author resorts to symbols and mathematical theory in one place only. It is eminently a book for the general technical reader, and is thoroughly to be recommended to the R.E. officer.

S.W.J.

GRAPHICAL GEOMETRY.

By E. N. DIGWEED.

(Longmans, Green & Co. 1932. Price, 4s. 6d.)

This little text-book deals in a complete and methodical manner with the geometrical constructions required for the solution of the simpler problems encountered in the drawing office. The problems are stated and solved in a theoretical and rather academic manner, and for this reason the book is perhaps of greater value for examination than for practical purposes. The diagrams are very numerous and quite clear, and probably form the most useful part of the book. The method adopted in the arrangement of the work leads to much repetition, and for the purpose of R.E. officers it would, perhaps, have been better to have collected the various *methods* of solving problems, rather than to have attempted to make a complete list of the problems themselves, with their solutions. It is a pity that, having reached a certain standard, the author did not add the very few pages required to deal with the ordinary cases of the intersection of simple curved surfaces.

E.F.T.

GRADUATED EXERCISES IN ELEMENTARY MATHEMATICS.

By Lt.-Col. E. N. MOZLEY, D.S.O., R.E. (retired).

(G. Bell & Sons, Ltd. 1932. Teachers' Edition 2s.; Pupils' Edition, 1s. 3d.)

Col. Mozley has been the headmaster of Red House School for many years, and is therefore well qualified to speak upon the subject of teaching elementary mathematics. He has produced a small volume, intended for the use of other teachers, and very useful it should be. The book is packed full of dodges for making tricky points seem simple, and for explaining the more tricky points which are sometimes either intentionally "overlooked," or perhaps entirely neglected through the teacher's omission to see that they even exist. The "Notes on Teaching" at the end contain many tips, which might be adopted in teaching more advanced mathematics and its applications.

E.F.T.

LIST OF BOOKS RECOMMENDED.

Recommended by Brig.-General Sir James Edmonds, C.B., C.M.G.

INHERITANCE (Gollancz). By Phyllis Bentley.

Tells in the form of a novel the life in a Yorkshire manufacturing town from the Luddite riots to the General Strike.

A PRIVATE UNIVERSE (Cassell). By André Maurois.

Essays on England, U.S.A. and various matters, present and future, including the Geneva myth. There is advice to a young Frenchman about to visit England and America.

THE ROMANCE OF LONDON'S UNDERGROUND (Sampson Low). By W. J. Passingham.

The story of the origin, development and running of the underground railways and tubes in London and their accessories, the omnibuses and coaches. Numerous illustrations and photographs.

MAGAZINES.

REVUE MILITAIRE SUISSE.

(*January*, 1932.) 1. Under the heading of *A la veille de la Conférence du Désarmement* the editor discusses the question of universal disarmament that is about to be considered at Geneva.

The problem of disarmament is one of extreme complexity. Idealists will be profoundly disillusioned if they persist in believing that the majority of nations will lay down their arms for the sake of peace, whilst others are doing exactly the opposite and are increasing their material strength. Soviet Russia is taken as an example. Recently, at the opening of one of the largest military factories comprised in the five-year plan, the delegates of the workers who had built it wired to the War Commissar: "We know that war is inevitable and are preparing for it. . . ." It is stated that 15 million schoolboys are being intensively trained for military work. Workmen are compelled to work in factories, without pay, on Saturdays and holidays, to increase the out-turn of motor-cars, aeroplanes and tanks for the Red Army.

The Disarmament Conference meets with a view to finding means to avoid all danger of war. The Swiss Army, in its existing form, cannot be a danger to the peace of the world, and is therefore not interested in the reduction of armaments.

The writer quotes Article VIII of the Pact of the League of Nations, regarding the obligations of each member of the League, to prepare plans for a reduction of armaments—its armaments not being allowed to exceed the scale fixed by the Council of the League—and each member agrees to report any changes made in the scale of armaments and in its military, naval and air-force programmes. The idea was to find a solution of the peace problem after the Great War, that had failed to materialize in the first and second Hague Conferences.

The preparatory committee has endeavoured to work out a plan based on Article VIII of the Pact of the League of Nations. It has grouped its findings under six heads.

The first head, concerning the personnel, deals with the effective strength of armies, and length of service. The principle adopted will cause a much heavier reduction in the case of a permanent standing army than in a militia army called out for a few days in the year only. It will be difficult for all the countries concerned to come to an agreement as to the permissible length of service for their respective armies.

The second head deals with the reduction of material for land, sea and air forces. It is on these points that the greatest obstacle to a general agreement is to be expected. By 16 votes to 3, and 6 abstentions, the committee agreed to the principle of limitation by expense. The method, however, presents numerous difficulties in its application.

Switzerland is not interested in naval limitations, but, as regards the Air Force, it is very difficult to separate completely all developments in civil aviation from being converted to use in military aviation on the outbreak of war.

The writer concludes that no definite agreement can possibly be hoped for at first, but that results can only be obtained after a very long time.

2. *Caractères des Armées Modernes.* General Debeney concludes his article in this number, and subdivides his subject into (*a*) armies in peace-time, (*b*) armies in times of war, (*c*) the moral question.

Mechanization has brought about a great change in the composition of a modern army. In 1914, a battalion of infantry consisted, roughly, of 1,000 men. In the

course of the war it was reduced to about 700: the introduction of machine-guns and automatic rifles allowed of a decrease of 300 men, while actually increasing the fighting capacity of a battalion. What became of the 500,000 men thus withdrawn from the front line during the operations? We find them, not engaged in peaceful pursuits, but working in the back line on engines of destruction. Each automatic arm requires for its maintenance, repair and ammunition supply the constant services of eight men.

A tank or an aeroplane go into battle with a crew of two men apiece. The tank requires 46 men to work and repair it, whilst the plane, that carries a pilot and a machine-gunner, requires the united efforts of 60 men to keep it working and in repair.

(*February*, 1932.) 1. *La Guerre en Action. Rossignol–St. Vincent.* This is an account, taken from Colonel Grasset's book, of the battle of Rossignol–St. Vincent, fought on the 22nd August, 1914, in which the 3rd French Colonial Division was surprised and annihilated.

Two sketches explain the position of the French and German troops at 8.30 a.m. and noon respectively.

The 3rd French Colonial Division, who believed the enemy to be 50 km. away to the north, had orders to billet at Neufchâteau. On the morning of the 22nd, the 11th and 12th German Divisions, having already passed Neufchâteau, were marching south through the Neufchâteau forest on parallel roads.

The advanced guards of the 3rd French Division and the 12th German Division came into contact in the forest. In the meantime, General von Webern, commanding the 11th Division, was able to make an accurate appreciation of the situation, and realized that the French had fallen into a trap. They had crossed the Semoy river at Breuvanne, leaving the bridge at Tintigny, some two miles upstream of it, weakly held. He concentrated the whole of his artillery fire on Breuvanne bridge, thus cutting off the retreat of the French force while it was engaged with the 12th Division, crossed the Semoy river at Tintigny and attacked the Colonial Division in rear.

An unpleasant incident is recorded at Tintigny. Some shots were fired after the Germans had occupied it, and, in reprisal, they bombarded the village and set it on fire. Eighty-three of the inhabitants, men, women and children of tender age were shot or massacred, and 184 houses were destroyed.

Colonel Seydel, commanding the 22nd (German) Brigade, ordered an attack on St. Vincent by the 11th Regiment and the 11th Grenadiers.

2. *Salaires et Service Militaire.* Colonel Rilliet has written an article drawing attention to the grievance of the Swiss rank and file in the loss of salary to which they are subjected when called up for their annual training. A law was passed by the Grand Council making it compulsory for employers to pay a full salary to soldiers when called out for their *Cours de répétition*. This law was, however, repealed last autumn on account of a clause dealing with the hours of closing of shops. The writer made two separate enquiries into the question of salaries, in 1929 and 1931, and found that in 1929, 63 per cent. of the men called up received no salary at all during their period of training, whilst only 6 per cent. received from 90 per cent. to 100 per cent. of their salary. A slight improvement was found to have taken place in 1931.

Colonel Rilliet urges that the question of improving this unfortunate state of affairs should be taken up very seriously.

3. *Commentaires du Règlement d'Exercice de* 1930. In the first of a series of articles, Major Perret reviews the Swiss *Infantry Training Regulations* of 1930, and compares them with the previous regulations of 1908 and 1925. The special conditions that affect the Swiss army are that it is trained for a defensive warfare on its own soil, it is a militia army and its period of training is a very short one, 67 days of recruits' course, and 13 days of repetition course. It is essential, therefore, that the regulations should be as simple as possible.

In discussing the kind of war for which the army should be prepared, the writer

considers it is one in which the first few days will be decisive, and the training should be adjusted accordingly. He is glad to see that a clear distinction has been drawn between drill and training.

The first article is devoted to the formal instructions laid down in the regulations.

4. *Chronique de l'Air.* A description is given of two new foreign aeroplanes, *viz.*: the French military plane Potez 50 A 2, and the Fokker CV-E biplane. The latter, of Dutch design, is made in Switzerland.

5. *Chronique du Genie.* By Lieut. Schenk. The regulations lay down that in recruiting for the sappers, men should be selected from certain trades, such as masons, carpenters, wood-cutters, railway workers, etc., and, up to a proportion of 30 per cent. from agricultural labourers of good physique. These rules have gradually been lost sight of during the past 25 years. Tradesmen, such as carpenters and masons are becoming scarce; only the older men amongst agricultural labourers enlist; and these classes together only form about one third of the enlistments. The balance consists of clerks, mechanics, garage hands, watch makers, locksmiths, and others. They are largely men of sedentary occupation, and of poor physique. The writer hopes that the original instructions regarding the source of recruitment will be more carefully followed in future.

6. *Informations.* There are editorial notes on (1) the new Swiss short rifle of 1931, which is not only considered superior to the long Swiss rifle, but the most accurate portable weapon of any modern army, (2) the new German rifle, invented by Gerlich, firing a bullet of 6·5 gr., to which the most marvellous penetration is ascribed. The writer is a little sceptical about the results said to have been obtained.

(*March*, 1932.) 1. *La Conférence du Désarmement et la Réorganisation de notre Armée.* In this article Major Masson considers how the disarmament conference might affect the organization of the Swiss army, and he invites a discussion on this point by officers. He expresses his disagreement with Colonel Lecomte, the writer of an article in the *Gazette de Lausanne*, who states that it is not the business of regimental officers to discuss such matters, and that, in a regular army, such action would be treated as a breach of discipline.

Major Masson has no intention of attempting to foretell the results of the disarmament conference, but he thinks that since the principle of complete disarmament is no longer held, the Swiss militia army will not undergo any fundamental changes.

The general principles to be discussed are, (1) the abolition of aggressive weapons, *e.g.*, submarines, heavy guns, tanks, chemical warfare, etc. (2) a budgetary reduction of armaments. Since Switzerland does not possess any of the aggressive weapons mentioned, it can only be affected by a budgetary reduction. The latter can only affect the number of the personnel or the material of the army. Major Masson does not think that the principles of the organization of the army can be affected.

2. *La Constitution de nos grandes unités.* Colonel Petitpierre gives his views on the reorganization of the Swiss army, taking into account the topography of the country, and the size of the units best suited to operating in it. He subdivides the country into three parts, the region of the Jura, the plains, and the Alps.

For the Jura and the plains he proposes to adopt the brigade as the fighting unit; in the Alps the regiment would be the fighting unit. The new brigade would acquire special importance, and it might suitably be called a division. The division would become an army corps, and the army corps, as it now exists, would disappear.

The writer gives, in tabulated form, the composition of an army corps, an Alpine division, and Army troops. Three sketches are added, showing the territorial distribution of the different units. The order of battle of the infantry is also given.

3. *La Guerre en Action, Rossignol–St. Vincent.* This article, continued from the February number, describes the fighting round St. Vincent during the afternoon of the 22nd August, 1914. A sketch map shows the position of the opposing forces, and another sketch shows the disposition of the 22nd (German) Brigade in the attack, and of the 7th (French) Colonial Infantry in the defence of the Chenois farm and of

the village of St. Vincent. The attack was supported by the artillery of the 11th (German) Division.

The French put up a gallant defence, but their front was too long for the force at their disposal. Moreover the attack came as a complete surprise. By 15.30 all reserves had been swallowed up, and ten companies of the 7th Colonial Regiment were resisting the attack of five and a half battalions, supported by two companies of machine-guns.

At 16.00, the 42nd regiment of artillery was called upon to support the attack, and the whole of the five battalions advanced to the attack. The Colonial Regiment, after suffering heavy losses, finding themselves attacked in front and in flank, fell back hastily.

A stand was made by groups of men collected by Major Bernard in the cemetery of St. Vincent, which held up the enemy and prevented him from following up his success, giving time to the 2nd battalion of the Colonial Regiment to retire through St. Vincent.

4. *Commentaires du Règlement d'Exercice de* 1930. In this second article Major Perret discusses the combat of a group and of a section. The new regulations, founded on experience gained in the Great War, throws a much heavier responsibility on N.C.O.s and subaltern officers. The latter are, in fact, the true commanders in modern warfare.

The writer discusses the duties of groups of riflemen and groups of machine-gunners, and deals in detail with the supply of ammunition to machine-guns in action.

(*April*, 1932.) 1. *L'Instruction provisoire sur le Service en Campagne*, by General Rouquerol.

This is a criticism of the provisional French *Field Service Regulations* of 1929.

The questions dealt with in these regulations apply to important units, *viz.* : a division and upwards. In the Great War the mistake was made by the Supreme Command, both French and German, of juggling with divisions, which were passed from one command to another for different reasons. The same happened, at times, with army corps.

Strict rules have been drawn up to ensure the secrecy of correspondence and orders. Instances are quoted of secrets having leaked out through the neglect of simple precautions. The best way to keep orders secret is to communicate them to as few people as possible, and not to put them down in writing until the time comes for carrying them out.

In dealing with cavalry and its employment, the use of the *arme blanche* is now only possible in small units and in exceptional circumstances. The increasing use of hedges and fences over all Europe restricts the movement of large bodies of cavalry far more than was the case formerly. The question of attaching a force of infantry to cavalry divisions is discussed : there are points both in favour of and against such a change being made.

The ideas of security on the march or at a halt differ considerably from those held in 1914. The advance guard is, as before, divided into two parts, but the van and main guard are now known as information echelon and fighting echelon respectively. The distance of 4km. to 8 km., laid down as the distance between the reconnoitring cavalry and the foremost infantry elements, is considered to provide sufficient elasticity in accordance with the nature of the ground.

A special order is issued on the subject of gas in warfare. As there is some doubt as to whether all combatants will agree to abolish gas warfare, General Rouqueral thinks that all troops should be fully trained in its use.

2. *La Constitution de nos grandes unités.* Colonel Petitpierre continues his article on the reorganization of the Swiss army. He shows how his proposed scheme would affect the existing organization, numbers, and armament. The actual strength of the infantry being 37 regiments, totalling 108,000 men, his scheme would provide 30 regiments, totalling 81,000 men. The armament would be increased by 540

machine-guns, 180 mine throwers, and 180 guns (*canons d'accompagnement*). As regards cost, the budget of 1913 amounted to 41,000,000 francs, that of 1932 to 96,500,000 francs, while the new scheme is estimated to cost 80,000,000 francs.

The general characteristics of the proposal are:

(*a*) An increase in the defensive value of the army.
(*b*) A slight decrease in cost.
(*c*) The maintenance of the soldier's prestige.

3. *Le Réarmement de notre Artillerie.* By Major de Montmollin. The fundamental principles to be observed in dealing with the re-armament of the Swiss artillery are:

(*a*) A clear distinction should be made between what is desirable, what is necessary and what is possible.
(*b*) All artillery organization should be progressive.
(*c*) Not a single infantryman should be sacrificed for the benefit of the artillery.
(*d*) The Swiss military organization should be based on the requirements of the first engagements of a war.

The adversary that the Swiss army is most likely to be called upon to face is an invader making use of Swiss territory in order to attack a powerful enemy. He is not likely to have the enormous resources of warlike material that the belligerents had in 1918, but, in spite of international treaties, he is likely to make use of gas, tanks, and armoured cars. His cavalry and infantry, with the aid of mechanical transport, will be capable of very rapid movement. The most dangerous arm is, however, the aeroplane. Switzerland has practically no anti-aircraft defence.

Against low-flying planes, at heights of less than 1,000 metres, machine-guns, or similar small-bore weapons, are efficient. Between 1,000 and 3,000 metres the anti-aircraft gun is the most serviceable weapon, whereas above 6,000 metres the aeroplane has things very much its own way. Even as late as 1918 it took, on an average, 7,000 shots to bring down an aeroplane. It is probable that modern guns would reduce this average very considerably.

The conclusions that the writer arrives at are:

(1) It is, first of all, essential that the infantry should be provided with a quick-firing gun against all mechanically-propelled vehicles. The infantryman should decide what form this weapon should take.
(2) Equally urgent is the creation of an anti-aircraft system of defence.
(3) The reorganization of the field artillery is of minor importance.

The anti-aircraft artillery should consist of twelve four-gun batteries on mobile mountings, with mechanized transport. They should be located at frontier stations and at important centres of the country. They would not necessarily be attached to the field army, whose anti-aircraft defence would consist of machine-guns as a protection against low-flying planes.

A.S.H.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*April*, 1932.) 1. *Les opérations de l'armée belge pendant la campagne* 1914-18. The series of articles with the above main title are continued in this number. After the conclusion of the battles of March and April, 1918, the German Higher Command at first considered a renewal of the offensive in Flanders as promising the best chance of success, but subsequently decided to attack another portion of the front, with the object of attracting the allied reserves from the north to the portion attacked, and so clearing the way for an attack in Flanders. The choice of the German command fell on the Aisne sector (Chemin des Dames), a naturally strong position, but one that was lightly held by the 6th French Army. The Germans made a successful

advance on the 30th May, as far as the Marne, and followed this up with an attack west of the Oise on the 9th June. They made a further attack in Champagne in the middle of July, but it was completely checked by the Fourth French Army.

In the meantime, General Foch had planned a counter-stroke, which was carried out between the 18th July and the 7th August, and compelled the enemy to fall back upon the Vesle. After this came a series of operations carried out by the British and French, directed chiefly on the Hindenburg line. These came to an end on the 25th September, and were followed by a general advance of all the Allied forces—the final act of the war—which terminated on the 11th November.

The article describes the part taken in the operations by the Belgian Army. At the end of May, General Foch asked the Chief of the Staff of the Belgian Army to take over a portion of the British front as far as the neighbourhood of Ypres. This was agreed to on condition of receiving heavy artillery support. Between the 1st June and the 27th September, the Belgians carried out a series of raids, of which detailed particulars are given. These raids resulted in the capture of several hundreds of prisoners and in the gain of an appreciable amount of ground.

The offensive operations carried out by the Allies farther south prevented the Germans from ever making their projected attack in Flanders.

2. *Pages d'histoire de l'armée belge au cours de la guerre*, 1914-18. The article in this number, under the heading of *La reconnaissance offensive sur le château de la Borne* 19, describes an attack made on a strong German outpost on the night of the 28th—29th October, 1917. The attack was carried out by a company of infantry and a platoon of engineers. The writer was in command of the infantry.

All details were very carefully thought out beforehand, and the orders on every point were precise. A heavy artillery bombardment was kept up over a considerable area of the front from midnight till 2 a.m., at which time the attack was launched behind a creeping barrage. The enemy garrison were taken by surprise. Seventeen German prisoners were taken as well as a machine-gun and some stores. A "Minenwerfer" was destroyed. The raiding party returned safely with a loss of 14 wounded, having accomplished the task allotted to it.

3. *La défense des localités*, by J. L. H. The writer asks three questions:

Should localities be occupied?
Should a large quantity of material be expended in their defence?
How should a locality be organized and defended?

The general conclusion that he arrives at is that villages of moderate size offer excellent cover against rifle and machine-gun fire and field artillery. A small village should not be occupied by a large garrison, as it draws the enemy's fire and may become a gas-trap.

The danger of occupying the outer edge of a village is emphasized, as well as the importance of organizing the defence in depth. Strong flank defence should be provided, and the rear exits should be under effective rifle and artillery fire.

The works to be carried out, in order of urgency, are:

(*a*) Machine-guns to be installed for flank defence.
(*b*) Obstacles to be provided, and successive fire trenches dug.
(*c*) Cellars to be strengthened.
(*d*) Communications to be improved.
(*e*) Living accommodation to be improved.

Infantry should not depend too much on the Engineers for essential work.

(*May*, 1932.) 1. *Pages d'histoire de l'armée belge au cours de la guerre*, 1914-18. The article in this number describes a raid carried out on the 28th October, 1917, by a detachment of the 4th Chasseurs à pied commanded by 2nd Lieut. Goreux. Two large-scale sketches show full details. The objective was a farm, known as Farm No. 1, occupied by the enemy, at a distance of about 200 metres from the Belgian

front line. The main objects were the taking of prisoners, the seizure of documents and material, and the destruction of shelters and emplacements.

The attack was carried out at 7 p.m. For several days previously, various points in the enemy's line had been heavily bombarded, so as to mislead him as to the point selected for attack. The enemy was completely taken by surprise, although the raiding party was held up by having to cut their way through the wire. The Chasseurs returned with 23 prisoners, and suffered no casualties.

2. *Waterloo. Magie et Tactique.* In this article, Colonel Van Egroo gives an account of the main features of the battle of Waterloo, and compares the tactics and arms of those days with those of the present day. He describes the battlefield and the changes that have taken place during the past century.

At Waterloo all commanders had their troops under their eye, and commands were given by word of mouth or by gesture. How different from modern conditions! In modern warfare mechanical contrivances tend to become more and more perfect, but machinery depends upon the man controlling it, and in the long run it is the human element that counts as much as it ever did in the past. The British, whose tendencies in the direction of mechanization of warfare and tactics are most marked, insist on the necessity for physical and moral training of the men nowadays as much as ever before.

At Waterloo a greater use was made of artillery than had ever been done before in battle. Batteries came into action in line with the infantry, sometimes even ahead of it. One of the lessons of the Great War has been the importance of the co-operation of artillery with infantry; but it took us a long time to learn how to do this effectually.

Waterloo provided excellent instances of the correct and timely use of cavalry. The French cavalry charges were ill-timed, and were made against troops unbroken by artillery fire. The British were far more successful in the order of the employment of their arms; first artillery, then infantry, then cavalry. Ponsonby's cavalry charged to complete the success obtained by Picton's infantry, and the latter did not advance until after a powerful preliminary artillery action.

The writer points out some of the changes that have taken place in modern warfare, *e.g.*, the use of tanks in attack, and of aeroplanes in following up a routed enemy. He quotes at some length from Major-General Sir F. Maurice's *British Strategy*. In conclusion he points out that though we must adjust our ideas to mechanized and armoured infantry and to the steel horse of the future, the elementary principles of warfare will always remain the same.

3. *L'engagement.* In this article Captain Gérard discusses the official instructions on the tactical employment of the larger units. Two examples are taken: (1) the attack of an enemy installed in a prepared position that is more or less known and is well supported; (2) the atttack of an enemy on the move, or in an ill-organized or badly supported position.

He discusses, in turn, the general characteristics of the engagement, a methodical process of attack, and a quick and simplified method of attack. Finally, he works out, with the aid of two maps, a definitely prepared scheme.

A.S.H.

THE MILITARY ENGINEER.

(*July-August*, 1932.)—The immense mileage of the waterways in the United States is a measure of their importance, and *The Military Engineer* usually contains interesting articles on the subject. This number is no exception. *Research at Waterways Experiment Station* describes the work carried out at that recently completed institution, a feature of which is the use of models. The question of the distortion of scale necessary to give results that correspond to Nature has been thoroughly gone into. Examples of the kind of investigations undertaken are: determination of the

most suitable design for a dam; the effect of proposed levee extensions; determination of backwater limits; spillway design; the erosivity of various soils; and suggested works to eliminate continual dredging.

Some Aspects of the Flood-control Problem is a clear and interesting introduction to the study of river behaviour, well illustrated by historical and theoretical examples.

The Santiago Creek Earth Fill Dam is an unusually complete account of the problem facing the designer of this irrigation dam, which is 1,425 feet in length and 130 feet above the stream bed. The article deals with the geology, hydrology, materials and equipment used, the contractor's programme, unit prices and quantities, and the field and office practice.

The Fort Knox Map is an account of the production of a one-inch map of 475 square miles by air-photo methods. A mosaic was first prepared as a result of a single flight by a machine using a 5-lens camera, which covers 20 by 20 miles at 20,000 feet. From the time the aeroplane went up until the copies of the mosaic were ready was about 25 hours; and the mosaic was quite suitable for use as a flight map for the subsequent single-lens photography.

Général de Brigade Lachèvre contributes an article on *The Stokes-Brandt 81-mm. Mortar.* He touches on the urgent need for the infantry to be able, with its own weapons, to neutralize the small-arm fire of the defence. "Advancing fire" must extinguish "stopping fire." The employment of tanks and armoured cars, decisive though it may be under many conditions, does not solve the problem of accompaniment because these aids will never be sufficiently numerous to be everywhere, nor will they be available during the whole battle. With the object of helping the infantry to help itself M. Brandt has sought to improve the Stokes Mortar by increasing its range and accuracy. He has done both. The simplicity of the Stokes design has been preserved; that is to say, the piece is erected in its firing position and the shell dropped in from the muzzle. The cartridge is attached to the shell and is fired by descending upon a fixed striker at the breech end of the piece. The breech is entirely closed, so that the weapon can be fired from mud, sand, or even water without injury; all that is necessary is that the base-plate should be steady. A simple sighting device is provided. The rate of fire is 18 rounds per minute normal, and 30 possible. The range is of the order of 3,000 metres, and the weapon can come into action in a very few minutes.

The difficulty of keeping such a mortar supplied with ammunition is, of course, recognized; hence the importance attached to great accuracy. It is interesting to learn that a finned projectile fired from a smooth tube is so stable that it is held parallel to its trajectory during its entire flight. The fragmentation, in conjunction with an instantaneous fuze, is therefore very effective. A simple setting device enables the same fuze to have its action delayed, for use against overhead cover.

Many people will agree that this weapon fills a need; others will say that it is useless because it is not suitable against moving tanks. (Others again will say that because it was once called a "trench mortar" its only place is in a museum.) Those who remember the burst of a Stokes shell no doubt have the greatest respect for it still, and would be sorry for the located machine-gun that is engaged by M. Brandt's improved mortar.

In *Portable Steel Military Bridges* the author reviews the situation in the French and British Armies during the War. He considers that the types developed by the British were very satisfactory, and are without question the best types yet devised. He goes on to describe in some detail the R.S.J. spans, the 60-and 85-ft. stock spans —(these were Warren girders)—the Inglis bridges, and the Hopkins bridges. The American Army Engineers, after studying these British types, decided to adopt the I-beam (or R.S.J.) type for spans up to 33 feet, and designed a truss for use up to 90 feet. This was in February, 1918. The orders were sent to Washington in April, but the steel did not reach the fabricators until October. Consequently most of the actual American construction during operations was of timber.

Although he approves of the British efforts up to 1918, the author does not even mention their subsequent work. The only post-war design referred to at all is that of an American portable steel bridge "recently developed by the Board on Engineer Equipment," which is said to differ radically from any of the types previously described. And so it does! But it bears a strikingly strong resemblance to our now familiar box girder, as the following extract will show: "The bridge consists of four identical sectionalized lattice girders capable of assembly in any length from 23 feet to 100 feet by increments of 11 feet. Each girder consists of two end sections 11 ft. 6 in. long, and seven intermediate sections 11 ft. long. Connections are splice angles secured by machine bolts. Wooden bearing strips are bolted to the top of the girders and a 5-in. wooden deck is bolted through these strips to the girders. The bridge is designed for erection as a deck structure only." The photographs show the end sections to be what we call horn-beams. The intermediate sections are bigger than our present ones, being 2 ft. by 5 ft. 4 in. by 11 ft., and weigh 1,340 lb. They are all interchangeable and also reversible top and bottom. (There is presumably no camber.) Of several methods of erection tried out, the most suitable is thought to be that of "dragging the assembled girders across by means of an A-frame or gin-pole on the far bank." As regards transport it is claimed that the size and weight of the individual sections (quoted above) are such that they can be readily transported in any available trucks.

It is interesting to note that the Box Girder Bridge was described in *The R.E. Journal* of July, 1921, and a full account of the tests was published in the following October.

I.S.O.P.

MILITAERWISSENSCHAFTLICHE MITTEILUNGEN.

(*March–April, 1932, continued.*)—*The Growth of the Tyrolese Corps of Civil Marksmen*, by Colonel Pfersmann. The story of the development of this Corps and of its value in national defence would be grist to the mill of those who, like the late Field-Marshal Lord Roberts, would have the nation trained to the use of the rifle.

Target shooting is a popular Sunday afternoon amusement in Tyrolese villages, and the Austrian Government Regulations regarding rifle galleries, issued in May, 1913, recognized the possible war value of the civilian associations for this form of sport, by providing for the enrolment and swearing-in of their members to form the basis of a people's militia. They were specifically *not* to be organized into military formations, and nothing was laid down as to their armament or equipment. All this was changed later, but the evident original intention was that the people's militia should produce the reserves for the *Landsturm* or local levies, forming the last line of defence.

In October, 1914, under the pressure of circumstances, *viz.*, very heavy losses in wars on two fronts, the Tyrolese Landsturm formations were sequestered from their original purpose of local defence by being formed into a Mountain Brigade, and transferred to the Balkans. The Tyrol became thus practically defenceless, and that at a time when it seemed more and more probable that Italy, although still nominally an ally, would throw in her lot with the other side.

By the personal influence and labours of a few public-spirited men, mostly retired officers, companies and battalions were formed out of the members of the rifle clubs. These self-appointed recruiters were everywhere up against two quite unanswerable questions: "If we are formed into battalions, what guarantee have we that, instead of being used to defend our own province against an Italian invasion, we are not taken as a body and sent to fight the Russians in the Carpathians?" and "As we have no uniforms, won't the Italians hang us as *francs-tireurs?*" In spite of these and other drawbacks recruiting proceeded. Fathers and sons having already joined the colours, the corps consisted of grandfathers and lads under military age. One dreadful period had still to be lived through, and that was when the Tyrolese peasants

learnt with horror that a portion of their country had been offered as a bribe to keep Italy out of the War. This news produced stagnation, to be followed by joyful activity when the bribe was refused. The corps reached 40,000 strong. It received uniform and rifles. It even, owing to Italy's "quite inexplicable" delay, got nearly three weeks' training; and when, on the 23rd May, 1915, Italy declared war, the Corps of Standschützen, showing that the Tyrol was "bled white, to its very last man," had taken its place in the line.

The whole story is an example of the success achievable by a movement running on goodwill, backed by unremitting labour.

Our Last Chance in the World War. The author of this article, Colonel von Schrenzel, takes as his text, "We lost the World War. We need not have done so—we might have won it. We had repeated opportunities for victory. We missed them." In his book, *The War of Lost Opportunities*, General Hoffmann deals with the same subject, but the writer of this article believes himself to have discovered one more instance. The crushing defeat of the Italians at Caporetto should have been utilized to pass the victorious Germans and Austrians across Northern Italy and so to outflank the French front. If this idea seems too fantastic for the critics, the author thinks it might still have led to a German victory, for the threat of invasion from the south-east would alone have brought to terms the peace emissaries assembled in Geneva in November, 1917. It is not difficult to find the weak points in Colonel von Schrenzel's scheme. It is more difficult not to ridicule it. Put in its simplest terms, the advancing German and Austrian armies could not have crossed Northern Italy and invaded France from there, because they were held on the Piave, a position they were unable to turn owing to the Italians' stout defence of the Monte Grappa. By December 1st they realized it was all over and gave up trying.

The Approach to the Enemy. Lieut.-Colonel Rendulic points out that the method of approach to the enemy and the measures to be adopted differ to no small extent depending upon the nature of the meeting, *i.e.*, encounter-battle or attack upon a position. In either case, he demands for the Engineers a well-considered plan for their employment; that they be attached to the advanced guard over and above those allotted for its own purposes; that motor transport be provided for bringing their working parties in and rapidly pushing them forward again. For the plans as to Engineer employment, a reconnaissance as thorough and as early as possible of the area of approach is necessary. It will be best carried out by Engineer officers in cross-country vehicles. The shorter the time available the more necessary it becomes that these reconnaissance reports be sent in by sectors immediately on completion. A composite air photograph of the area would also materially assist the officers planning the Engineer work.

Use of Tanks according to British and French Regulations. When the ban upon the possession of tanks by Germany and Austria is removed, these countries will hasten to provide themselves with what all nations regard as the necessary requisites of modern warfare. Up to that time their ideas upon the use of tanks must be culled from the literature of the more fortunate armies. Colonel Hubicki shows that this method of learning is by no means all plain sailing. From *Tank Training*, Part II, 1927, he extracts general principles for the use of tanks and armoured-cars, as understood in England; while from the two French manuals, the *Regulations for the Use of Tanks* (1929) and especially Part II of *Infantry Training Regulations*, he makes notes on marches, security, communication, co-operation with other arms, methods of fighting, etc. He is then obliged to point out that the two countries have entirely different ideas about what tanks are for. The French regulations are written with the basic idea that the tank is an infantry-accompanying weapon and works in the closest conjunction with that arm. This idea is regarded as obsolete by the British regulations, which, besides making provision for the co-operation of tanks with the other arms, legislates also for their independent use. Further, these regulations contain instructions on the use of armoured-cars, regarding both tanks

and armoured-cars as differing embodiments of the same idea, *viz.*, the combination in one arm of a high degree of mobility, fire power and protection against hostile fire. The development of these two forms leads towards a single form combining the advantages of both, as exemplified in an early stage by the cross-country armoured-car.

The diversity of fundamental ideas, Colonel Hubicki points out, is reflected in the present tank types of the two countries, thus :—

Great Britain : light tanks, Mark I and II (10½ to 12 tons) ; armoured-cars, Rolls-Royce and Crossley.

The experimental introduction of the tankettes, now classified as light tanks, has caused the reclassification of Marks I and II as medium tanks.

France : light tanks, Renault FT, about 7 tons ; medium tanks, Mark V*, 32 tons ; heavy tanks, 2C, 70 tons.

The Overthrow of Serbia. This article has been written by Major-General Kerchnawe to mark the appearance of the second double number in Vol. III of the Austrian *Official History of the War*, which consists of three parts, " The Autumn Battles on the South-West Front," " The Defence of the Tyrol " and, by a new author, Lieut.-Colonel Mühlhoper, " The Conquest of Serbia." Except for a few pages in the last number, which discussed the preliminary exchange of ideas between Austrian G.H.Q. and German G.H.Q. on the subject of a possible campaign against Serbia, the whole of the 1915 Serbian campaign is contained in this number, a boon to candidates for examinations. It is clearly defined both as to time and space : it contains all that is necessary to complete the cycle : the drawing up of the plan of operations, the regulation of the question of command when working with allies, the concentration by railway, preparations for and the forcing of a powerful river barrier, fighting in open country, fighting in mountain country with its attendant difficulties, the attempted encirclement, the arrangements for the pursuit—in fact, a boon to examiners, the perfect campaign.

General Kerchnawe likens it to the Franco-Prussian War of 1870–71 in the relative strengths of the combatants and in invasion being followed by crushing defeat within six weeks. So far, so good ; but the entry of Bulgaria into the war not only upset the relative strengths in Austria's favour but, by cutting the Serb's sole line of communication with Salonika, the Vardar railway, altered everything strategically. Also, the defeat of the Serbians though crushing was still not a surrender ; and the writer indeed gives full credit to the miserable, ragged and starving 200,000 who reached the Albanian coast and, rescued by the ships of their allies, were able eventually to furnish nearly 100,000 fit troops for the decisive battles in the end.

Germany as an Ally. Baron Werkmann, who was Director of the Press at the Austrian Court after the death of the Emperor Francis Joseph, and who accompanied the Emperor Karl into exile, has written a book with the above title, the object of which appears to be to work out the fundamental idea guiding the young Emperor, *viz.*, to obtain peace by mutual agreement, before it became too late. " His efforts to obtain a peace of this nature met with the opposition of his German allies." Baron Arz says the same thing in *Magyarorszag*, not of the Emperor, but of the Austrian General Staff, " Up to the end of 1917 we might have concluded an honourable peace. All had gone well with us—the great Tagliamento offensive, the submarine campaign. Had our diplomats been possessed of sufficient energy we would have been able to conclude a respectable peace. But the Germans did not want peace, they wanted to force England to its knees, and said they would march into Paris in a few months with bands playing. The Austrian General Staff was not of this opinion, but could not carry their view against the Germans."

Altogether one gathers the impression that the Germans were not exactly a comfortable ally : but what ally is ? Facing reality and in the hurry and bustle the big brother must often lay himself open to charges of lack of consideration of little

brother's feelings. The Austrians were sensitive enough to feel that the Germans did not think as highly of them as was their due. But, according to Colonel Pohl, quoted by the author, the trouble goes much deeper. "It was two different, two entirely opposed worlds, which fought shoulder to shoulder in the war, and which finally, each in its own way, together perished—the old realm of the Habsburgs, having its origin in hereditary agreements, and already become an empire of various nations, in which the motto from time immemorial had been *Justitia regnorum fundamentum*; and the Prusso-German Empire, which in little more than a century had grown out of the small Brandenburg-Prussia, thanks to its good sword." "One ally strove for a peace based on mutual agreement and therefore just, while the other strove for victory by the sword, and hence a peace based upon the right of the stronger."

In the Emperor Karl's eyes the only good Central Europe was one ruled by Austria, and the whole of the trouble began when, in 1640, the Great Elector started to bring Brandenburg to the front. The trouble culminated in 1918, when Austria went to pieces fighting for Prussia's principles, which differed fundamentally from her own.

Moltke, a Model. This is the title of General von Seeckt's latest book (*Verlag für Kulturpolitik*, Berlin; 187 pages; linen, 7 marks; paper cover, 5 marks), and Major-General Steinitz here investigates why Moltke, who left behind him no theory of war, should be called a model. He thinks that an attentive reader of this book will be able to deduce for himself that what was worthy of imitation in Moltke was his particular methodical thinking-out of all the factors and circumstances requiring consideration—one more instance, in fact, of genius being 10% inspiration and 90% perspiration.

A German valuation of Moltke is to hand, since Major-General Schäfer, in reviewing Captain Liddell Hart's *The Decisive Wars of History*, associates him with Alexander and Napoleon in "the three greatest commanders in history."

(*May–June*, 1932.)—*Artillery Considerations Regarding the June and October Offensives*, 1918, by Lieut. Field-Marshal Riedl. At the beginning of 1918 the Central Powers stood militarily and relatively well; Austro-Hungary, owing to Russia and Rumania having dropped out of the war, being able to oppose Italy with 52 to 54 divisions. At the same time exhaustion was becoming increasingly felt and made it clear that the war could not last much longer. Both Germans and Austrians saw the necessity of a great offensive before the strength of the Americans came into the balance against them. Hence the Germans' great attack on the British at the end of March, and the Austrian attack on the Italians in June.

The author gives the figures upon which the artillery requirements for the June offensive in Italy were based. The 14th Austro-Hungarian Army had broken through at Caporetto with 2,086 guns on a 31 km. front, *i.e.*, with one gun to every 15 metres. The recent German attack on their western front had been carried out with 3,600 guns on a 32 km. front, or 9 metres to one gun. On the basis of what the Austrians had and what they achieved, he then works out what they should have had and should have done to succeed: "If, in the 40 km. between the Brenta and Nervesa, 25 to 30 divisions with 4,000 guns and 4 million rounds (including half a million effective gas shell), 500 to 700 trench-mortars, 5,000 to 7,000 machine-guns, and the majority of the air force had been put in on *one* co-ordinated plan, this would have given a density of attack such as to make possible a break-through as far as the line Bassano–Montello before the enemy's reserves could intervene." The density mentioned works out at 1½ km. front per division, 10 metres of front per gun, 7 metres of front per machine-gun, 1 metre of front for every hundred rounds of artillery ammunition.

These figures may be compared with those with which the Allies broke through four months later. They are: 50 km. from Grave to Papadoppoli, 29 divisions, 4,000 guns, 4½ million rounds of gun ammunition, 700 trench-mortars, to one division

1·7 km. of front, to every gun (including trench-mortars) 10½ metres of front, to every metre of front 90 rounds.

Against this it must be remembered that the Austrians' morale was certainly crumbling. Field-Marshal Riedl ends with praise of the enemy nevertheless. "Tactically, this last battle of the Great War shows a skilful and surprising concentration of a powerful striking force in the decisive space of attack. On one-fifth of the front stood nearly half the divisions and rather more than half the guns."

Stone-boring Machines and Compressed Air Tools in the Austrian Army, by General Schneider. For years Austro-Hungarian troops held a mountain front, 200 miles long, from Stilfser Joch to the Adriatic, and it was only by the aid of stone-borers that they were able to carry out the rock excavations, of battle positions, support positions, roads, etc., necessary for the resistance of an opponent, far superior in numbers, especially in artillery, and for combating the worst climatic conditions.

Before the war the use of boring-hammers, whether driven by compressed air or electrically, was confined almost exclusively to civil practice, for road construction, railway tunnelling, in quarries, in mines, etc. Owing to the popular idea of the time that future wars would be short, little attention was paid militarily to stone-borers. As far as is known, Italy alone possessed a stone-boring battalion. It was formed of miners and had its headquarters at Udine.

As soon as Italy entered the war and it became necessary for Austria, with scanty forces, to defend her mountain frontier against the new enemy, everything possible was done to aid the troops and the country was combed out for stone-borers. Those which reached the front fell into three classes :—

(*a*) Pneumatic; consisting of a compressor driven by an internal combustion engine, with an air cylinder or container for equalizing the pressure, and pipes leading to the site of the work, where, by means of flexible tubing, they were connected up with the drills.

This type was the best for the front line, being stout, easy to erect, work and maintain. A drawback, however, was the rigid air pipes, which it was hard to protect owing to their not fitting in to the trenches or cover generally.

(*b*) Electro-pneumatic; in this case compressor and air cylinder were at the site of work, together with the electric motor driving the compressor; from the switchboard up to 2 km. of cable led back to a dynamo and oil-engine combination.

Since the cable was easy to lay in trenches, this type got over the difficulty of pipe protection; but as regards energy, it is wasteful owing to the double conversion and also C^2R losses with a long cable.

(*c*) Electric; from a supply system, or from an oil-engine driven dynamo, cables lead to the electric motors forming part of the stone-borers or other tools.

This type takes up little space and like (*b*) is easily protected. It is more economical than (*b*), but the borers are heavy, necessitating a tripod or some sort of support, and too complicated, having altogether too many parts for rough usage, where repairs and replacements are difficult. All-electric drive is, therefore, chiefly suitable for large works in back areas.

Besides stone-borers in the above classes there was tried out, but rejected, a petrol type, *i.e.*, one which carried a small single-cylinder petrol engine, motor-cycle pattern, driving toothed gear.

Whether single or multiple borers were driven off the same plant depended on the facilities, and in one instance an installation with six drills was in use quite close to the front.

Since the war a great advance has been made in the manufacture of pneumatic tools and, being now made of steel alloys, they are almost indestructible, the ideal of a front-line tool.

The article closes with pictures of the various pneumatic tools, including a paint pistol, which does the work of five painters, and is specially recommended for camouflage. There are also two useful lists, one of manufacturers with some information of their products, and the other, tables showing correction factors for oil-engine performance depending on height above sea-level, fall of pressure in pipes and in hose.

Amongst the manufacturers are Worthington's, London, with 15, 25 and 40 H.P. engines, and Lacy-Hulbert, of Croydon, with 10, 20 and 32 H.P. Ingersoll Rand, of New York, and Diatto, of Turin, were the makers of 500 sets of compressed air plant which were captured as part of the spoil at Caporetto. A Swiss firm, the Locomotive Works at Winterthur, has produced a turbo-presser, which, however, has two drawbacks, requiring greater energy and being particularly bad as regards oil being carried into the air passages.

The Fight for Manchuria, by General Wiesinger. The Far East is usually dealt with in *M.M.* by Major-General von Mierka, once an attaché in Tokio, who has given us "The Civil War in China," "China in 1929," and "Civil War and Communism" (*v. R.E. Journal*, Sept., 1929, Mar., 1931, Dec., 1931). To these articles General Wiesinger expressly states he has "nothing to add." He sketches for us here the historical relationship of China and Japan since 1850; shows how Manchuria, China's northern outpost and having 90% of its population Chinese, is, owing to its geographical position, wonderful fertility and its richness in industrial raw materials, essential to Japan's expansion; Japan's consequent steps to obtain economic control; China's reply by boycotting Japanese goods; Japan's attempt on Shanghai in order to break the boycott; and Japan's great stroke in making Manchuria autonomous under the former Emperor of China, Pu-Yi.

General Wiesinger thinks that Japan's object has thus been gained, since it was economic control and not possession of Manchuria that she aimed at. He reads out of the story a lesson for us all, how a nation, struggling for space and its very existence, can and must pursue its aim with all means, even military ones.

Cross-country Motor Vehicles, by Lieut.-Colonel Tippmann. The progressive motorization of civilian traffic is all for the good of military transport, because the efforts of civil undertakings run in the same direction as military demands. That is, as long as traffic is confined to the roads. When it comes to the transport of troops and material across country, the civil side has little to offer the army, and that mostly unsuitable. Armies have, therefore, to see to it that their needs in this direction are satisfied by the construction of the necessary vehicles and their incorporation as military equipment in peace time. An example of what can be done by co-operation in spite of difficulties is the production by the Austro-Daimler-Puch Works Company of a very good cross-country six-wheeler, their type ADG.

This lorry weighs 2½ tons and can carry another 2½ on the road, but across country only 1½ tons. It carries petrol for 350 km. Tracks are provided for the hind-wheels for use on very soft ground; and at the same time the reserve wheels can be used alongside the front wheels. The most important novelty appears to be the patent Hollos axle which makes every wheel entirely independent of the others and capable of being moved 18 inches out of the vertical.

Two New Infantry Guns, by Major Däniker, Swiss Army. Although products of different countries these latest of infantry guns run distinctly to type. They have both got two bores, one carrying quickly-interchangeable barrels, while the other has a second barrel for insertion. Both have splayed trails and both break up into man-pack. They are the Dutch H.I.H. Siderius NV 7·5 cm. L/13 infantry howitzer combined with 4·7 cm. L/30 infantry gun, and the Swedish Bofors 7·5 cm. infantry gun with a 4·7 cm. removable liner. Fortunately for designers some much-needed battle experience is being gained by the use of the Siderius gun in China at the present moment.

F.A.I.

WEHR UND WAFFEN

(*April*, 1932.)—*Thoughts on Artillery Fire Training*, by Lieut.-General Marx. The writer thinks that, as he has already challenged in the military Press the travelling tale of the superiority in range and equipment of the French Field Artillery over the German Field Artillery in 1914, he is entitled to offer some criticisms of the latter. He compares them this time with the German Heavy Artillery and finds certain weaknesses in their fire training. These he attributes first and foremost to an unhappy development of organization which, starting after the war of 1870–71 with the separation of mounted from dismounted artillery, was subsequently carried out to far too great an extent. Thus, the separation was carried so far as to include the inspection branch; the officers' corps was split into good horsemen and driving experts on the one side, and good gunners and good technicians on the other; Field Artillery officers were no longer admitted to the Artillery School; and a cavalry officer became Inspector of Field Artillery. Further, the allotment of Field Artillery Brigades to the Divisions in 1899, while having perhaps certain advantages for purely tactical training, was undoubtedly disadvantageous as regards artillery education.

General Marx then goes tooth and nail for the method of fire training which consists of cut-and-dried schemes necessitating masses of paper and preparation beforehand. "Tactical training with live ammunition digs its own grave when it lays down in writing beforehand the probable course of the practice and the targets."

He would consider an error of 1,000 metres in the range of the first round fired not as evidence of bad training, but as evidence of good secrecy having been kept.

Finally, he considers the subject from the psychological standpoint, and quotes, not without apology, a subaltern as having said, "We all look forward to the hunting season, but what would our feelings be if, before each day's hunting, we had to work out and hand in long lists of instructions with the probable runs, and as soon as possible afterwards multiple copies of a detailed hunting report, with all places, distances and times, nature of the going, height and breadth of all jumps, and every casualty down to a cast shoe; and then to get our reports back *x* times for revision!"

Turning from frivolity the writer quotes a respected Chief, Count Haeseler, as having said, "Gentlemen, I assure you, there is a kind of courage which is much rarer than courage in battle, and that is the courage of responsibility. The education which leads to *this* kind of courage cannot be taken too seriously."

General Marx's points are evident enough. Firing with live ammunition should be looked forward to like a day's hunting, and set schemes of artillery practice, known to all beforehand, do not educate to responsibility. He that runs may read!

The Film for Army Purposes. This article contains no exhaustive collection of all the possible uses of the cinematograph in the army, but touches shortly upon some of the uses to which it has already been put, shows how by its aid many observation methods and work processes can be simplified, and describes shortly but with a number of good photographs the different types of apparatus.

A Comparison of Artillery Strengths and the Amounts of Ammunition Used in the Great War. The figures are based upon an article by Major Giannini in the *Rivista militare italiana*, but as regards Germany they have been completed in some instances from German official sources. The writer's method is to make a comparative table, year by year, of the number of guns and the amount of ammunition used in the more important battles. From these and from frontages and durations he works out rounds fired per gun, rounds fired per day, rounds fired per metre of front, etc. Of the state of affairs in August, 1914, he gives a picture by means of the following list, the unit being thousands of guns of all sorts:—Germany, $7\frac{1}{2}$; Austria, $2\frac{1}{4}$; France, $4\frac{1}{2}$; Great Britain, $\frac{1}{2}$. Of Russia no mention is made, and the lists are in many respects far from complete. Nevertheless, one must agree with the industrious compiler that the figures he has worked out for the later battles will serve as a

standard by which to estimate probable requirements at the commencement of another war.

A comparison of the figures given for any two battles of different dates will show the trend of development, thus, comparing the 3rd Isonzo (Austrians only) with Vittoria Veneto (Italians only) :—

Rounds fired in millions, .34 : 3.1
Rounds fired per gun, 500 : 700
Rounds fired per metre of front, 4 : 51

The total consumption of artillery ammunition by Italy is given as over 47 million rounds, valued at £720,000,000—an illuminating sidelight on the world's present poverty.

The Screening of Big Bertha. Reminiscences by a Heavy Artillery officer of the mounting and concealment of the 38-cm. gun used for bombarding Paris at a range of 120 km. A certain *naïveté*, an element of boyish glee, is discernible when the writer recounts the astonishment and alarm which this quite unexpected bombardment caused among the inhabitants of Paris. That a church, filled with people at a Good Friday service, was hit is also related, and it appears that the Germans had not then, and that the writer has not even now, learnt the lesson that "frightfulness" does not pay. The writer admits that the French were not far wrong when they called the Berthas (for there were two of them) "a political gun." The workingmen's quarter of Montmartre was chosen as a target in order to stir up dissatisfaction among the population.

The first round was fired at Paris on a Friday morning, and by the following Monday a French bombardment of the battery position showed that the gun had been located. Two hits killed ten of the crew and wounded a number more.

The camouflage methods adopted were :—Rails to the gun positions well screened from the air; a smoke-screen to hide the gun at the moment of firing in order to defeat the enemy's flash-spotters, and to prevent the flash from being seen also by hostile airmen; no night- firing except in misty weather; two gun positions instead of one; simultaneous firing.

The smoke-screen was arranged for as follows :—A number of smoke-drums and a number of anthracene posts were placed surrounding the gun position and about 1 km. away from it. Each anthracene post was a pit in the ground, 1 m. × 1 m. × 30 cm. deep. It was filled with anthracene which, when set fire to, like the specially prepared smoke-drums, produced a thick smoke, rendering the gun completely invisible.

Simultaneous firing with the other guns in the battery—two 24-cm. railway guns, two 17-cm. position guns, and two 17 cm. railway guns—was invariably adopted, so as to screen the Berthas against the French sound-ranging sections, who, like the flash-spotting sections, were known to have reached a high degree of skill.

The guns were at Couvron, 12 km. N.W. of Laon. The shell took three minutes to get to Paris, and had to rise 30 km. in order to do so. It was at its culminating point nearly half-way to the heavyside layer as placed by Wegener, and where the temperature is estimated to be 67° below zero Fahrenheit.

The Italian Engineers. Extracts acknowledging as their source the *R.E. Journal*, Vol. XLV, March, 1931.

Tank Strengths in the Most Important Countries (continued). Besides the 581 tanks mentioned in the last number, Great Britain still possesses 100 heavy tanks remaining over from the war, and one modern 32-tonner as a model, which can reach the great speed of 40 km. an hour. Its armament is one 4·7-cm. Birch gun and four heavy machine-guns (one for A.A. defence), all in revolving cupolas. Its armouring is only 15 and 10 mm. There are also 25 12-tonners for close support, armed with one 8·4 cm. Birch gun and carrying smoke equipment, and 20 Engineer tanks for bridging and mine clearing. There are, of course, besides the foregoing, special tanks for wire-

less, and for supplies. According to the *Infantry Journal*, British tanks go in extensively for air-cooled engines.

Tank construction in the country lies almost entirely in the hands of Vickers, who also do an export trade, and in war-time are capable of a very large output.

The United States have a large number of tanks, and attach great importance to their future development. Their 80 heavy tanks M. VIII are 37-tonners, have only 16 and 12 mm. of armour and a maximum speed of 8 km. an hour. There are 900 light Renaults, carrying either a 3·7 cm. gun or a machine-gun, with 22 mm. of armour and a maximum speed of 7 km. an hour, and six 6–7-tonners Renault M. 17A with a speed of 15 km. an hour.

The 7½-tonner Tie 1, which has been under trial since 1927, owes its inception to the desire to make mass production easier in war-time, and has a universal pattern chassis. Its armament is one 3·7 cm. gun and one m.g. in cupola, but being unsprung it makes a bad gun platform, and does indifferent shooting on the move. It is very good across country, where it can cover the ground at rates from 22 to 32 km. per hour, but for long road journeys it must be carried on a lorry. Its introduction appears not to be intended, and several of its weak points have been improved in a later pattern, Tie 2. The adoption of the latter is in abeyance pending the result of thorough trials with the new Christie tank, M. 1940. According to Major Heigl this is a 7·8-tonner with 12·4 mm. of armour, carrying one 12·7 mm. machine-gun under cover and one 8 mm. m.g. for A.A. defence standing unprotected. The engine is a Liberty 330–400 H.P. The crew have to get out for the change from wheels to caterpillar, which takes ten minutes. According to the *Army and Navy Journal*, the reputed speeds of 110 km. per hour on the road and 64 km. per hour across country were not nearly reached at the purchase test last year.

The Christie swimming tank, which was completed late in 1930, is a 10-tonner, said to reach 110 km. an hour on concrete roads and 24 to 70 km. an hour across country. It is supposed to move in the water at 15 to 18 km. an hour. It can cross trenches two metres broad and climb at 1 in 1. Further claims are that it is bombproof and gas-proof, and that it can carry up to 12 tons of explosives. Its armament is either a 4" howitzer or a 3" gun in a revolving turret, and several m.g's. Cost reported at £80,000.

The U.S.A. have small tanks, especially one-man tanks, under trial. Of medium tanks there exist only patterns.

After France, Great Britain and the United States, the next most important country dealt with is Poland, a choice sufficiently explained by its great strength compared with that of Germany, and by the existence of the Polish corridor separating East Prussia from the rest of Germany, and thus a perpetual bone of contention. Poland is particularly rich in tanks, possessing 270 light tanks, Renaults (of three patterns) and Vickers. The weights of these vary from 6 to 19 tons, their speeds from 7 to 18 km. per hour, except the Vickers, which can get up to 35. They are all armed with one gun and one m.g.

Poland possesses also 20 armoured m.g. carriers, Carden Loyd Marks IV and V. These are 1·6-tonners with a maximum speed of 45 km. per hour. Nothing is known as to medium tanks, but of heavies, 30 to 70-tonners, there are 50, either British Mark V* or French 2C and including a few German A7V.

Poland is believed to be the only country possessing special tanks for gas or smoke producing, of which it has ten 6–7-tonners, travelling 7 km. an hour. This brings the total of tanks of all sorts to 350, not counting reserves.

No confirmation has yet been received of the repeated statements that Poland is now manufacturing its own tanks.

Italy has in service 150 tanks of good performance; 140 light and 10 heavy. The former consist of the 5-tonner Fiat M3000, dating from 1919, and two later patterns of the same, M3000 A and B. The original pattern was rated at 15 to 20 km. per hour, and in the absence of definite information about them it may be

presumed that the later patterns are faster. According to *Deutsche Wehr*, they have thicker armour without exceeding 5·6 tons, have a fan-shaped tail for the better crossing of broad ditches, and are male or female, *i.e.*, carry either a 3·7 cm. gun or one to two machine-guns.

The heavy tank is the 40-tonner of 1918, the Fiat M2000. According to Major Heigl (without drawing upon whom it would be hard to write about foreign tanks), there is undergoing trials a heavily-armed 35-ton tank with 200 H.P. Fiat engine.

About the tank position in Czecho-Slovakia and in Russia little becomes public. The former has 80 armoured-cars in the army, KH50—at its introduction, more than five years ago, called by Major Heigl the best armoured-car in the world—KH60 and KH70, which disclose in their nomenclature a rise in horsepower. Czecho-Slovakia has nine different works for the manufacture of tanks, belonging to seven different firms, the best-known of which is the Skoda works in Pilsen, employing 36,000 workmen, capable of being increased to 50,000 on mobilization.

Russia's tank strength is unknown, but it is believed by far to exceed the following which it is known to possess :—10 small tanks, *viz.*, armoured m.g. carriers, Carden Loyd Mark VI ; 170 light tanks copied from the Renault M17, made in the Russian Putiloff works ; 50 medium tanks, British Medium MA 14-tonners ; 20 heavy tanks, British 30-tonners. There are also special tanks for gas warfare.

The situation as regards home manufacture is bad, and only two firms can be seriously considered.

Colonel Blümner finishes his interesting notes by saying that the present state of affairs which forbids Germany the possession of tanks must be changed by the Disarmament Conference now sitting. It must either do away with all tanks in all nations, or permit Germany to have them again.

(*May*, 1932.)—*The Madsen Rifle-Grenade.* The object of the rifle-grenade was as regards range and effect to fill the gap existing between the hand-grenade and the light trench-mortar bomb. It made its appearance on both sides at the commencement of trench warfare, but did not come up to requirements, not failing in respect of range, but doing grossly inaccurate shooting and too little damage. The stick pattern had the further drawback of damaging the barrel of the rifle, and the Germans gave it up on that account. Two years later they revived the rifle-grenade, but with its weight increased from 1 lb. to 1¾ lb., and with a cup arrangement to hold the projectile, and thus save the wear on the barrel. As the front line trenches were then everywhere very close together the range could be reduced to 150 metres.

The well-known Danish firm of Madsen (light machine-guns—*v. R.E. Journal*, Dec., 1928—and 2 cm. anti-tank and A.A. defence gun) has now produced a pear-shaped rifle-grenade, 2″ in diameter, weighing 1¼ lb., containing 3½ oz. of explosive, and fired, by the aid of a cup-like attachment, from the ordinary rifle on a stand. Stability in flight is given by eight vanes projecting from the base and by grooves round the body. The range is normally 150 to 650 metres, but dispersion begins to be excessive after 250 metres.

The principle has also been applied to the Madsen 2 cm. machine-gun, which with a similar cup attachment can fire a 2¼ lb. bomb.

Important Extracts from Military Periodicals about Foreign Armies. In these days, when considering fresh dangers to be encountered in modern warfare owing to technical progress, there will generally be in any given company one who will soothingly reply, " It all comes back to the human element in the end." This is true enough, but only given one condition, which the speaker does not always make, *viz.*, equal, or not too unequal, technical strength. When the Fuzzi-Wuzzies with shield and spear charged at Omdurman against m.g. fire, they did not find that it all comes back to the human element in the end ; nor did the German infantry when attacked by tanks at Cambrai. With which introduction the following quotation from Major-General Huppert's " War Industry and National Defence " may be left to speak for itself :—" For the successful conduct of war, material provision in

accordance with war technics is of entirely decisive significance. Every nation which seriously endeavours, when necessary, to defend its welfare and its position by arms, must therefore be able to make completely serviceable for war the whole of its strength, economic and otherwise, and all the achievements of technics. In the present state of the development of weapon technics the morale of the best troops cannot be maintained, unless they are equipped and continuously supplied with modern weapons." These lines serve as a text to an examination into the armament production of what the article claims to be "the arsenal of the countries of South-East Europe"—Czecho-Slovakia, the country formed out of Bohemia, Moravia, part of Galicia and part of Hungary, when Austria was dismembered by the Peace Treaty.

Eighteen months ago the *Berliner Börsen-Zeitung* pointed out that Czechia, in spite of its small size, had at its disposal one of the most powerful armament industries, not only in Europe but in the whole world, acting at the same time as France's arsenal for providing all her East European vassal states with war material. Since then the increase has been continuous and systematic.

The close financial connection between the firm of Schneider-Creuzot and the wide-reaching Skoda undertakings is under the leadership of French capital. The representative of the French General Staff, General Lerond, brought it about that, in 1928 and 1929, Rumania and Jugo-Slavia were drawn into the circle by a Skoda company obtaining from the former a 40 years' monopoly in the supply of war material and by a contract on similar lines with the largely extended country formerly known to all as Serbia.

The article also gives the following figures to indicate the importance attached to "army and armament purposes":—Great Britain, 14% of national expenditure; France, 21%; Italy, 22%; Czecho-Slovakia, 25%.

New British A.A. Guns. Vickers-Armstrongs have produced two patterns of a new 75 mm. anti-aircraft gun. The comparative figures are:—L/40, shell weighs either 6·5 or 7 kilos, maximum range 13,900 metres, maximum height attainable 9,235 metres; L/46, shell weighs 6·5 kilos, maximum range 14,650 metres, maximum height, 9,800 metres. The barrel has either a shrunk-on outer tube, or an easily-changed liner. The breech mechanism is half-automatic, opening, ejection and compression of the striker-spring being actuated by the recoil and forward movement of the barrel. Rate of fire is given as 25 rounds a minute. The mounting is a pillar on cross-arms removed from the travelling carriage and laid on the ground. Horizontal traverse, 360°; vertical ditto, 0 to 90°. The gun is also intended as anti-tank. As a result of trials with other makes it has been very favourably reported on.

F.A.I.

REVUE MILITAIRE FRANÇAISE.

(*April*, 1932.)—Général Duffour begins *L'élément terrain en stratégie* in this number. Later in the article he proposes actually to compare the French Plan XVII with the Moltke-Schlieffen plan for the invasion of France; but in this instalment he deals with the strategical views of various warriors since 1800. We all know what Napoleon, Moltke and Foch thought, and to a lesser extent, perhaps, the views of Jomini and Clausewitz, but the writer also mentions Heinrich von Bülow and the Archduke Charles. The former, who began to write about 1800, based his views on geometry. He stated that if the enemy's front is penetrated the apex of the penetration must have an angle of at least 60°, and also that if one side achieves a circumference of a semi-circle around the enemy, it is in the best position for crushing him. This did not prevent the disaster of Jena, but it is worth noticing that Foch, in 1918, paid some attention to Bülow's geometry in his attacks. The article is well written, and it will be interesting to read General Duffour's view of the French Plan XVII as opposed to Moltke and Schlieffen in 1914.

Les fronts de combat, by Général Brossé, is completed in this number. The article is not of great interest except to anyone wishing to study the question of fronts and how they were affected in the Great War. We know now that by mobilizing their armies so that all were in line, the French had great difficulty in switching troops from one part of the front to another, owing to their finding themselves on the defensive. All the great commanders have fought on narrow fronts and advanced or pursued on wide ones, and the difficulty is to achieve both of these in practice.

In continuing *Comprendre*, Capitaine Carrias discusses Napoleon and Blücher at Waterloo. Although what happened is well known, it is interesting to note how Blücher was determined to help Wellington at all costs, while Napoleon was badly served by Grouchy at Wavre. In this article it is suggested that the reason for the French failure was the lack of a second bureau (or intelligence section) in the staff. One would like to know if the English or Prussians had an intelligence section. One cannot imagine Wellington allowing his staff to think very much for themselves; it seems likely that the division of the staff into various sections did not occur till some time later. The real difficulty for the French was that Napoleon was not supported by his generals in the same way as Blücher supported Wellington.

Colonel Charbonneau finishes *La grande guerre sous l'equateur* with a discussion of the lessons to be learnt from the varied actions which took place in the Cameroons. It may not be well known that at the outbreak of the Great War, the Allies seriously considered remaining on the defensive in this part of Africa if Germany would do the same; but the action of those on the spot prevented this. One could hardly expect the people in the colonies not to act, and they did so before receiving orders, thereby bringing on the operations which lasted on and off throughout the war. Colonel Charbonneau points out that, although the Germans seemed to be at every disadvantage, Von Lettow Vorbeck lasted till the Armistice. Their method was never to sit still, and the Allied troops, with no preparations before the outbreak of war, found it very difficult to actually defeat them. In conclusion, the writer points out that there must be one, not several fronts, for France and her colonies, and that the necessary preparations must be made in peace time, not left till war.

Capitaine de Dumast has an article on *La conférence du désarmement*, which is interesting as it exposes a point of view which is not the same as the British. We are apt to regard France as having really failed to cut down armaments; Captain de Dumast claims that she has done so considerably. The article leads up to the present disarmament conference which is sitting, or languishing, at Geneva, and it does give the French point of view as far as military, rather than political, considerations are concerned. The whole question is too complicated to be dealt with here; but the article is well worth reading.

(*May*, 1932.)—Général Duffour continues *L'élément terrain en stratégie* with a comparison of the Schlieffen plan and Plan XVII. Although he considers that Schlieffen looked too far ahead and did not pay sufficient attention to the ground and to defences in the country over which the Germans proposed to attack, the German plan was considerably superior to that of the French. Where Schlieffen failed was in looking too far ahead at the expense of the first main battle; but he realized that if the French attacked, it would suit the Germans better than if they withdrew at first in readiness to attack later. Plan XVII had two offensives, one in Alsace-Lorraine and one on the left, according to the amount of Belgian neutrality violated by Germany. To us, an attack in Alsace-Lorraine, however favourable the country, seems absolutely wrong in view of the German superiority, while to leave to the 5th Army only the main opposition to the German right wing is again wrong. General Duffour realizes this, but the instalment concludes before he goes into any detailed criticism.

Général Meymer's *La guerre sainte des Senoussya* appears in this number. The article starts with an indication as to how the Germans were in contact with the holy men of the Mussulman religion in the Sahara at the outbreak of the Great War,

and how the French fought with them right up to the Armistice. The writer then continues with a description of Northern Africa, particularly the Sahara, and how this territory has been peopled in the past. We are then introduced to the first of the famous Senussi, who was met by an Italian missionary about 1858. Mohammed Ben Si Ali Ben Senussi, to give him his full name, founded the Senussi order, and made a great impression on the Italian missionary, both by his holy temperament and warlike tastes. The rest of the instalment deals with occasions where the French and the Senussi came into contact before the Great War. The article is interesting, particularly as it refers to a part of the world little known to the average Englishman.

In this number is a short article, *Le centenaire d'un général diplomate : le lieutenant-général Belliard*, by Lieutenant-Colonel de Nerciat. General Belliard was one of Napoleon's generals and first appeared in Belgium with Dumouriez in 1792. He was made Governor of Cairo later on, but was forced to surrender, and at Waterloo he was on Napoleon's staff. The important part of his history, however, occurs when he was sent as first French Ambassador to Belgium in 1831. Owing to the Belgians wishing to absorb the Duchy of Luxembourg, the Dutch threatened to invade the country. Belliard was successful in persuading the Dutch to come to a peaceful settlement, and the Belgians were so grateful that they gave his name to one of the streets in Brussels. Belliard died suddenly in 1832, a hundred years ago, since when Belgium and France have continued the best of friends.

In continuing *Comprendre*, Capitaine Carrias describes how an intelligence section of the General Staff would have provided information during Grouchy's operations in 1815. What the writer gives is no doubt accurate, but one cannot help feeling that it is rather academic. As in Napoleon's day there was no staff, in the sense of the present day staff, it is difficult to write a really practical article showing how such a staff would have acted without doing it for both sides. As an Englishman, one feels that if Napoleon had a properly organized staff, so would the British and the Germans, and so the result would not necessarily have favoured the French alone.

(*June*, 1932.)—Général Duffour continues *L'élément terrain en stratégie*, with a description of the French 1st and 2nd Armies in Lorraine attacking the Germans in August, 1914, and being eventually repulsed. The most interesting part of the instalment lies in the writer's comments. He points out first of all how Plan XVII gave difficult work for the 1st and 2nd Armies on this part of the front and goes on to show that there was small resemblance between the French attack on Mulhouse and the German attack on Liège. As the writer says, Liège opened a decisive direction for manœuvre while Mulhouse was only a *hors d'œuvre*. He continues by explaining that in the Lorraine country the two armies were bound to meet each other with both intent on attacking and he explains the great advantage to the side who chooses its ground when they hear of the approach of the enemy. If the French had done this throughout, there is little doubt that the Germans would, at any rate, not have progressed so quickly.

Chef d'escadron Dupuy begins *La lutte pour l'Hartmannsweilerkopf* in this number. This is an example of a part of the Great War which took place away in the Vosges, where the French troops were chasseurs, commanded by Mand'huy, also a chasseur. The writer has selected an engagement, unsuccessful to the French, as he regards this type as of more value than a successful action. This instalment only deals with the troops and the country concerned, and good sketches are given of the Hartmannsweilerkopf and its surroundings.

Chef de bataillon Pots begins *Considérations tactiques sur la guerre au Maroc en* 1925, with a description of the mission given to the French troops, the means available and the enemy. It is in no way intended to give a history of the operations, but merely to deduce tactical considerations while the campaign is still fresh in memory. First of all, the mission was very different from that in France, junior commanders

were given a very wide scope of action provided that the general idea of the French campaign was observed throughout. The writer then goes on to the troops and points out how they varied considerably in 1925, and finally, he begins a description of the enemy by pointing out what a savage country Morocco is for military operations.

The fifth instalment of Lieutenant-Colonel Guigues' *Le gouvernement de la défense nationale* deals with the application of the measures taken by the Republican Government which succeeded that of Napoleon III, in 1870. The article is of more interest to a Frenchman than to an Englishman, except one who is studying this part of French history. This actual instalment deals with various operations on the Loire and the arrival of Gambetta, who left Paris by balloon during the siege. It is pretty clear that although the spirit was willing the flesh was weak among the forces hastily formed by the French, and the Germans had little difficulty in capturing various towns and fortresses, thus bringing the acceptance of an armistice a good deal nearer.

Flancourt, by Général Abadie, begins in this number. The article describes the break-through on the French front in July, 1916, but it is given in such detail that it is difficult to pick out the main facts. The Germans, quite correctly, realized that the chief blow would be made by the British, on account of the French losses at Verdun; but all the same the French attack surprised them. The first few days were a complete success, and no doubt many of us will realize how much farther the French penetrated than we did at the early stages of the Somme battle.

H.A.J.P.

REVUE DU GÉNIE MILITAIRE.

(*March*, 1932.) 1. *Le Génie dans la bataille sur les cours d'eau.* Colonel Baillis continues his series of articles under the above heading. He gives an account, with sketch plans, of the crossing of the Aisne by the 69th Infantry Division on the 18th August, 1918, and of an attempted passage of the Aisne by the 56th Reserve Division on the 12th and 13th September, 1914.

A study of these crossings shows that if, at the time a river or watercourse is reached, the infantry and artillery do not obtain a superiority of fire over the enemy's troops holding the other side, the first attempts to cross will fail. Until this superiority of fire is obtained, the sappers cannot attempt to do any bridging by day.

The second instance quoted failed mainly on account of the lack of liaison between the engineers and the infantry, a common enough occurrence prior to 1914.

The writer discusses the question of the position of the engineers in an advance. An engineer company should not be split up into small detachments, nor should sappers be placed in the van of the advanced guard. This was the position assigned to them in 1914, when means of liaison were not as good as they are now.

One company of sappers should be with the main guard, the commander of the divisional engineers accompanying the divisional commander. The second company of sappers should be at the head of the main body of the divisional infantry.

These arrangements do not preclude sending a reconnoitring party of an officer and a few picked sappers, who would reach the river at the same time as the infantry patrols.

Great stress is laid on the importance of keeping engineer units in rear informed of what is going on in front, and of units in rear giving all the assistance they can to those in front of them.

Nowadays, a lorry, filled with empty petrol tins, or material useful for extemporized light bridges, can be run up rapidly to the front when required.

If bridging material has to be brought up rapidly from the rear, a staff officer should accompany it, with authority to clear all transport away to one side and enable the material to get to the front without delay.

Corps and divisional engineers should work in with one another.

2. *Les auxiliares de la couverture.* In this number Captain Mandaroux concludes his article. He devotes one chapter to permanent fortification, the main role of which is to hold up the enemy and give time for field fortification to be developed in the intervals between the *points d'appui*.

The last chapter is a general summary of the previous ones. As regards aviation, it is more than a defensive arm, it is an arm of reprisals, to quote Lord Robert Cecil. It is impossible to foresee what the final result of aerial action will be in its protective effect. The curtain has not yet been lifted on the possibilities of "vertical strategy."

Demolitions can be rendered far more helpful if they are thought out and prepared in times of peace; they are far more effective if carried out on a huge scale. The carrying out of demolitions necessarily involves a retirement.

An instance is quoted of the German retirement in February and March, 1917, over ground covered with demolitions. It shows that a complete destruction of all railway tracks over a depth of one day's march—without any rear-guard action—reduced the speed of advance of a keen and well-equipped adversary to about five kilometres a day.

(*April*, 1932.) 1. *L'Oeuvre économique de l'arme du Génie en* 1931. This is a brief account of various works carried out by engineer companies in France and Algeria in 1931. The works consist of new roads and tracks, bridges, and foot-bridges, railway construction, telephone work, and miscellaneous jobs, such as demolitions, and the construction of officers' quarters, hangars, etc., in Algeria.

The diminution of the economic activity of the country reduced the number of opportunities offered this year to commanding officers to carry out works of general utility by the troops under their orders.

2. *Le Génie dans la bataille sur les cours d'eau.* Colonel Baillis here concludes his series of articles on the work of engineers in crossing rivers during a battle.

It is more than ever likely that light tanks will be used in future to accompany an infantry attack. Crossing a river on an extended front is likely to be a lengthy operation, as the amount of bridging material available will probably be limited.

The only methods of crossing are rafts or bridges. A tank will require a raft of three boats. In crossing the Marne in 1918, the Germans allowed two hours from the moment the first troops disembarked to the time they advanced to attack. The Austrians made a similar allowance on the Piave. If tanks are to be taken across, the operation will take longer, and the ideal method would be to provide as many rafts as there are tanks, and take them across simultaneously. This, however, would require an amount of material that would, in actual practice, never be available. Crossing by rafts can therefore only be considered as *pis aller*.

If a bridge, capable of carrying nine-ton loads, can be constructed in an hour's time—a feat that would require training and skill—it offers the best solution. A column of thirty-two tanks could be taken across the river in an hour and twenty minutes after the infantry had begun to cross, and would be in position on the farther bank within two hours of the start.

To protect the bridge from damage by shells after the troops have crossed, it might be disconnected and swung across under the lee of the further bank. The writer discusses the relative merits of constructing a bridge by means of rafts and by building out, and concludes that, in spite of certain disadvantages, the raft method is by far the best.

Having arranged for the transport across the river of the troops, guns, tanks, etc., the question arises of keeping up supplies for the battle, but the difficulties that this presents are trifling compared with those of getting the troops across in the face of an enemy who has had time to organize a stout defence.

After the experience gained during the war with bridges, both French and Germans have made it a rule that all supply of material, etc., during a battle is to be made by boats or rafts, until the bridge sites selected are out of range of the enemy's field artillery.

The appoaches offer a larger target than the bridge itself, but a line of three rafts presents a target about two-thirds of that of a bridge 100 metres long.

There seems to be no doubt that in order to keep up the necessary supplies for a battle on the farther side of a well-defended river, the construction of bridges will have to be taken in hand before they are out of range of the enemy's artillery. To ensure that this can be done with reasonable safety, the following arrangements should be made:

(1) They should be concealed behind smoke screens.
(2) Boats should be replaced as soon as possible by trestles. The latter are less vulnerable.
(3) There should be large reserves of material.
(4) There should be a superiority of fire on land as well as in the air.

In a footnote it is suggested that a trestle that can be used in water four metres deep is very desirable, and that possibly such a trestle could be made of some light metal such as duralumin.

3. *Note sur une sondeuse mobile*, by M. Joffet, engineer-in-chief of the city of Paris.

This is an article in two chapters, of which the first deals with different types of water-boring plant generally; the second chapter contains a detailed description of a portable water-boring plant.

The weight of the apparatus described is 10,000 kg., of which 5,300 kg. come on the front axle, and 4,700 kg., on the rear axle of the chassis. The wheels have solid rubber tyres, the wheel-base is 3·90 metres, and the track 1·82 metres. The plant is worked by means of a four-cylinder petrol engine of 30 h.p. On the road it is towed by a tractor of 33 h.p. (nominal). The pipes, rods, tools and accessories are carried on a lorry.

The apparatus can be worked either on the percussion system or with a rotary drill. It will drill a bore-hole 200 metres deep. The personnel required for working it consists of five men.

Two drawings show the working details, and two photographs give front and side views of the apparatus.

(*May*, 1932.) 1. *Réflections sur la technique et l'emploi de compagnies de Sapeurs de Chemin de fer*. By General Gauzence de Latour.

This the first of a series of articles on the employment of companies of railway engineers.

The campaign of 1870 gave the French army few opportunities for railway work. Work in the colonies provided useful experience, but it did not fulfil the conditions of a European war. No one had ever foreseen that the regiment of railway sappers would grow to the dimensions that it attained during the Great War, when it consisted of 450 officers, 20,000 sappers and nearly 100,000 auxiliaries, and it used up daily 20km., of complete track, and as much timber as all the other regiments of Engineers put together.

The second chapter gives a detail of the various works carried out by the regiment of railway engineers from January, 1915, when it was first constituted, up to September, 1919.

The heaviest work was carried out in 1915, when, amongst other things, the British and Belgian bases between Rouen and Dunkirk had to be established. A number of ropeways were erected towards the end of the year.

After the armistice, in 1918, a large amount of repair and restoration work devolved upon the railway engineers, and in 1919 they helped to restore the navigable canal system in the north of France.

Chapter III is devoted to a comparison of the methods adopted by contractors working with civil labour and those adopted by military railway engineers. The officer regards the object to be attained merely as a condition of national welfare.

Time is everything, and economy of means, forms and procedure, are secondary considerations. For him there is no distinction between workshops at the front and at the rear. The civil engineer and the railway contractor take up a very different point of view. As in all industry, they depend upon complete procedure. Projects have to be worked out in detail, discussed and approved, before they can be carried out. Their career depends upon their work proving a financial success.

The relation between the number of workmen employed and the time taken is discussed. A contractor will employ machinery to as great an extent as possible; the requisite plant is not always procurable in the short time available in war. The officer in charge of works will have to consider what material he can lay hands on most rapidly, and will adjust his projects according to the material at his disposal, even if he has to make a departure from customary procedure.

As compared with the British and American armies, who had all their railway plant standardized, the French were at a disadvantage, having to put up with a large variety of types.

2. *Le controle des constructions en béton armé, (to be continued)*, by M. Henry Lossier. This is an article dealing with calculations and design of reinforced concrete structures. Among those engaged in reinforced concrete construction there are various schools of thought, of which the two extremes are the "simplistic" school and the "scientific" school.

One of the mistakes made by the "simplistic" school has been to assume that, in a beam continuous over several spans, the bending moments over the supports do not exceed half the moments in the middle of the spans. The action of shrinkage has been neglected and the role of compression bars over-estimated.

In spite of the fact that many buildings have been constructed on such arbitrary rules, the author does not consider that, in themselves, the errors made have been the direct cause of serious accidents. The "scientific" school, too, does not altogether escape criticism.

The author goes on to deal at length with the checking of projects. Some of the mistakes commonly made are, (*a*) arches or beams are considered to be resting on absolutely fixed supports, when the latter are liable to deformation; (*b*) beams are calculated as perfectly fixed at the ends, when they are only partially fixed; (*c*) no allowance is made for shocks or vibrations on bridges; (*d*) long structures are built without expansion joints.

The writer deals with arches, with and without articulations, hollowed slabs, silos, hangars, and most forms of construction ordinarily met with.

With regard to fortification, the question of replacing a thick concrete wall by a thinner wall of reinforced concrete to resist the shock of projectiles is a complex one. If, for instance, a wall six metres thick is to be replaced by an equivalent wall two metres thick, the reinforcement should be calculated to give a moment of resistance at least three times the moment that would fracture or overthrow the thicker wall.

3. *Note sur une sondeuse mobile*, by M. Joffet, Engineer-in-chief, Paris. The article on well-boring is continued in this number. The writer deals with the methods of sinking a bore-hole.

The rotary drill is preferable to the percussion method for attacking clay, marl, and chalk; for hard rock the percussion method should be used. The length of drop of the chisel and the number of blows per minute depend upon the hardness of the rock, but, with a given power, a long drop with, say, forty strokes per minute will give better results than a shorter drop with fifty strokes per minute.

The method of taking geological samples is described. In certain soils the lining of the bore-hole can safely be omitted.

The question of obtaining water from a sandy stratum, the filtering of water through sand, its velocity, and the effect of the latter on the particles of sand, is gone into at some length.

In driving a bore-hole through chalk, it is necessary to strike a fissure containing

water. If the discharge is found to be insignificant, it can often be increased by pouring a quantity of hydrochloric acid, which attacks the chalk, down the bore-hole. The cost is comparatively small, acid being cheap. The writer quotes an instance where two tons of hydrochloric acid were poured down a bore-hole thirty metres deep; the result being a doubling of the supply. In using this method, precautions have to be taken.

The different kinds of deep well pumps are described briefly; vertical piston pumps, centrifugal pumps, submersible electric pumps, pulsometers. If a piston pump is used, the piston rods must work only in tension, or they will bend. For very great depths, the piston can be worked hydraulically.

A.S.H.

CORRESPONDENCE.

BRIDGING OF THE BERESINA, NOVEMBER, 1812.

Historical Section (Military Branch),
Committee of Imperial Defence,
Audit House, Victoria Embankment,
E.C.4.
2nd June, 1932.

To the Editor, *The Royal Engineers Journal.*

SIR,

With reference to Lieut.-Colonel L. Chenevix-Trench's article on the "Bridging of the Beresina, November, 1812":

I lived with one of the Chichagov family at Pavelovsk when learning Russian in 1891. He showed me Admiral Chichagov's *Memoirs*, which contained a secret order from the Tzar to the effect that, although every effort should be made to destroy the French Army, the Emperor Napoleon himself, whom the Tzar greatly admired, must not on any account be captured. The Admiral seems to have acquitted himself well of his task, and Chaplitz's sudden withdrawal when in a position to stop the French is thus fully explained.

N.B.—Pronounce Berésina, not Beresína. The word will be found in Hardy's *Dynasts* with the correct scansion. The river is a wide ditch, twenty to thirty feet below the general level of the plain.

I am, Sir,
Your obedient Servant,
J. E. EDMONDS.

CARDEN LOYD AMPHIBIAN.

Onslow Court Hotel,
Queens Gate, S.W.7.
23rd June, 1932.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

In perusing those notes on foreign military magazines, which are always such an invaluable feature of your journal, I notice that there is a reference to one of them in which it is said that the new Carden Loyd amphibian "is said to have been built according to the plans of Captain Liddell Hart." It is perhaps needless to say that this statement is evidently due to a misunderstanding, as I had no responsibility whatever for the plans of that machine.

With all good wishes,
Yours sincerely,
B. H. LIDDELL HART.

[The reference is to page 374, *R.E. Journal*, June, 1932. Review of *Militaerwissenschaftliche Mitteilungen.*]

THE BLACK HORSE.

Randle House, Corbridge,
Northumberland.
14.6.32.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

I see there is a controversy about the title "Black Horse" as regards R.E. Field Companies.

I joined the 23rd Coy., as an attached Y.O., when the unit came to Chatham in November, 1888, to relieve the 11th Coy. Major E. A. Cockburn was in command. The unit then called itself "The Black Horse," "The Terror of the Football Field" and "The Pride of Chatham"!

The first title came from the black teams, the second from the fact that we had a champion football team, headed by, who was then Lce.-Corpl. Walstow, later S.M. Walstow, D.C.M. The third, I assume, came from the ladies of Chatham! I think it must have been them to judge from the hordes of them that accompanied the unit to the Dockyard Gates when we embarked in the *Assistance* for Ireland in March, 1891. However, that is another story that is not without its lighter side.

The embarkation took place in the tidal dock and was superintended by the Admiral Superintendent and the King's Harbour-Master. The latter was arrayed in a frock coat and top hat, like a mute at a funeral. It nearly was his, as he was, by some occult means, projected into the dock but was fortunately rescued before he was drowned.

During a discussion of the affair at dinner afterwards, when we got to sea, the 1st-Lieutenant of the ship said to me that his only regret was that it had not been the " B—y Admiral " who had fallen into the water. I was a 2nd-Lieutenant and was much shocked at the 1st-Lieutenant's irreverence.

Yours faithfully,
G. WALKER, *Major-General.*

23rd Field Coy., R.E.,
Wyke Regis Camp,
Weymouth, Dorset.

To the Editor, *The R.E. Journal.*

DEAR SIR,

With reference to Captain Baker's reply to my letter, I must admit that I cannot trace the Black Horse beyond 1885, but in response to letters to three Colonels Commandant of the Corps, who at that time, or shortly afterwards, belonged to the 23rd Company, I have established that the Company had a very definite penchant for Black Horses by then.

I have not troubled the fourth Colonel Commandant from the Company, because he came slightly later, and could not establish any earlier claim.

I think this does, however, antedate any record of the 7th Company in this connection.

Though there does not seem to be any common origin to the two Company emblems, by all means let the 7th Company take the " Old Black Horse " as their badge, we shall be only too happy for ours to retain perennial youth.

Yours faithfully,
J. SPOTTISWOODE, *Major, R.E.,*
Commanding 23rd Field Company, R.E.

GENERAL SIR CHARLES PASLEY, K.C.B.

THE articles which have been appearing on the above subject in *The Royal Engineers Journal* have been reprinted in pamphlet form, and can be purchased from the office of the Secretary, Institution of Royal Engineers, Chatham, price 1s. 6d. each.

DATA, FORMULÆ, AND TABLES FOR STRUCTURAL DESIGN.

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