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THE PROBLEM OF THE ENCOUNTER BATTLE AS AFFECTED BY MODERN BRITISH WAR ESTABLISHMENTS.

By BRIGADIER B. L. MONTGOMERY, D.S.O.

INTRODUCTION.

1. The encounter battle is the term applied to operations between two forces on the move which are not yet in contact. Any analysis of such operations to be complete must deal with the tactical approach, the contact battle, and sufficient concerning subsequent operations to show the probable repercussions of success or failure in the earlier phases already discussed. This type of operation has always taken a prominent place in training in the British Army, both in schemes and on the training area. There are some who argue that undue prominence is given to it in training—that it was not met with in the Great War after the opening clashes—and that success or failure in the initial operations on any front in that war had no decisive effect on the ultimate issue of the campaign. This may be true as regards past wars generally. But as regards the Great War the Germans might have obtained far-reaching results if their stage management of the battle on the western front had been above approach, and if they had taken proper advantage of the initial successes gained.

In training exercises the encounter battle gives great scope for developing the qualities of command and resourcefulness in commanders of all grades, and in the troops themselves. For this reason alone it is worthy of study, provided the study is kept up to date—ahead of the times and not merely *with* the times.

2. When discussing future war the main difficulty is to determine the form that it is likely to take. We can get some guide on this point from post-war developments in the organization of the armies of first-class powers—infantry still remains the basis of the divisional organization, and even when moved by M.T. it is carried "in bulk" by lorry or bus transport—there has been considerable advance in the realm of mechanization of the old tools—but the general conception of how war should be waged on land does not seem to have changed greatly since 1918.

There are therefore certain grounds for assuming that the opening stages on land of any first-class war in the future will follow similar lines to the opening stages of past wars—armies will advance in columns on the roads with a view to crossing the enemy frontier and seizing territory—such movements will be resisted—and so we arrive at the encounter battle.

3. It is not proposed to discuss here whether this conception of how the war is likely to begin is right or wrong. If it is agreed that it is what will probably happen, then we must consider carefully how to stage manage the encounter battle under the new conditions brought about by the latest war establishments.

We have adopted a material solution in the hopes that it will solve for us the problems of the battlefield; but it will not do so unaided. We must also overhaul our tactics—the tactical and material solutions must go hand in hand—we must in fact develop a new technique.

MILITARY TECHNIQUE.

4. When operations are not successful, either in battle or on the training area, the blame is frequently placed on the troops taking part. This may sometimes be the case. But more generally the fault will be found to lie:—

(*a*) in a bad initial plan on the part of the commander,

or

(*b*) in the lack of knowledge on the part of commanders, down to battalion commanders, as to the technique of staging that particular operation so as to ensure a good "start" for the troops involved.

This later aspect, the technique of staging an operation, is of the greatest importance to-day. Thirty or forty years ago it was not difficult for troops badly launched into battle to recover, and for success to follow. But to-day, 1937, owing to the immense power of modern weapons and to the mobility of armoured units, recovery from a bad initial start is very difficult. It may be possible to recover, but against a good enemy it will be only with very heavy losses. It is for this reason that a good enemy is so difficult to fight—he makes you pay very dearly for mistakes.

5. It may be said that the commander who starts well has every chance of gaining the tactical advantage very early in the battle, and he is then well placed for the next round. But if the start is a bad one—either through a bad plan, or faulty dispositions, or loss of time when time is very precious, or for any cause whatsoever—then the battle can be pulled out of the fire only by the gallantry of the troops, and they are bound to suffer heavy casualties in the process.

It is clear, therefore, that all officers must have a good knowledge of the technique of staging the many and varied operations that their unit may be called on to undertake in war, whether offensive or defensive—they must understand the stage management of the battle.

The Problem of Ground.

6. The present tendency in modern armies is to reduce the numerical strengths of units and formations and to offset this reduction by increased fire power. The advantage of extra mobility given by mechanization also tends towards a reduction in actual numbers of men. In addition, armoured fighting vehicles are on the increase.

7. In the British Army the underlying reasons for the changes that are now taking place are to give greater power to the attack and to increase mobility.

There are many who consider that the progress in mechanization has given increased power to the defence, and has not greatly strengthened the attack. Certainly the power of the defence is now very great—the use of obstacles, natural and artificial, to frustrate mechanized vehicles will be normal—the fire power available is such that great depth will be possible in the defences—owing to increased mobility reserves can be moved rapidly about the battle-field to counter hostile penetrations. In fact it would seem on the face of it that the odds against successful offensive action on land in first-class war are very great. They certainly will be unless we develop a new technique; this problem is discussed further in paragraphs 23 to 26 below.

8. The progress in mechanization has resulted in the study of ground, always important in war, becoming more than ever important. From now on obstacles will play a greater part in operations than previously, and their skilful use will enable great delay to be imposed on mechanized forces. It is true that a mechanized force has a wide radius of action and can move long distances; but it is sensitive to ground, and the skilful use of obstacles and demolitions in combination may well bring it to a standstill.

So important is ground, and so great can be the dislocation caused by obstacles and demolitions, that the initial encounters between two forces are likely to develop into endeavours to secure

such ground as will enable the subsequent battle to be staged successfully. Failure to secure this ground may have far-reaching results, both tactically and administratively. Obviously, then, success in these initial encounters will be the aim of every commander and he will have to consider most carefully the best dispositions for his force in order to ensure this initial success. In thinking out the problem it must be remembered that a wholly mechanized unit or sub-unit is easily held up by obstacles covered by A. T. weapons, and that in order to defeat these tactics it will be necessary to have immediately available sub-units that can operate on foot across country, using covered approaches and outflanking the resistance. Bridges, defiles, M.T. turning-points, road communication centres —all these have now assumed an importance they never possessed before, and a commander will aim at securing such places as his forward move progresses.

The problem as outlined above indicates that we shall have to reconstruct our ideas about advanced guards, particularly when operating with a modern British Division against a first-class enemy in the encounter battle.

THE ENCOUNTER BATTLE—GENERAL DOCTRINE.

9. Let us first consider certain general principles which will serve as a guide to a more detailed analysis of concrete examples later on.

It is obvious that in the encounter battle a commander requires information; but he cannot wait for it indefinitely. Although information may be lacking, or be incomplete, he must still make a plan and begin early to force his will on the enemy. In the early stages his plan may be concerned mainly with ground. If he has no plan he will find that he is being made to conform gradually to the enemy's plan.

Therefore when information is scanty and the situation generally is vague and indefinite, he should reconnoitre widely for information using air and mobile troops in co-ordinated action under his own command. Meanwhile his force should not be unduly dispersed, and it should be directed towards some area the possession of which will give him the advantage in the operations that will follow the gaining of contact.

10. When contact becomes imminent the main pre-occupation of the commander will be to ensure that his formation or unit does not drift aimlessly into battle, or become involved in the fight piecemeal. It must be committed to the battle on a proper plan from the very beginning.

Therefore a commander must decide *before* contact is gained how he will fight the battle—only thus will he force his will on the enemy.

Further and more detailed information of the enemy will be required and there will come a stage when this information will not be obtained without fighting. But the battle at this stage is not a matter of a blind advance merely to fight for information, and with no definite object and no definite plan to achieve it.

The commander must have a definite object in view, and he will allot to his forward troops sufficient resources to enable them to reach the objectives allotted to them. In the fluid fighting that will follow immediately after the gaining of contact, the object will usually be to secure certain areas of ground (high ground, river lines, centres of communication, and so on) so that the force may be able to operate to the best advantage later on.

The initial encounters will be very important—it is on their success or failure that the gaining of the tactical advantage will largely depend. Success in the initial encounters will go to the commander who knows what he wants, has a plan to achieve it, does not allow his formation or unit to drift aimlessly into battle, but puts it into the fight on a proper plan from the very beginning.

11. An examination of the training manuals will show that the above doctrine is contained therein.

(*a*) A commander must be quite clear as to the object he seeks to attain, and he must have a plan to attain it.
F.S.R. II. 11, 3—page 23.

(*b*) To postpone a decision because the information is incomplete is likely to lead to the passing of the initiative to the enemy, with consequent failure on your part.
F.S.R. III. 12, 1—page 25.

(*c*) The general plan should have been determined before contact —the detailed tactical plan after actual contact and fighting has disclosed further information about the enemy.
F.S.R. III. 13, 1—page 27.

(*d*) Ground is a most important factor in all tactical operations— with mechanized and armoured forces it may have a decisive influence on the plan of action.
F.S.R. II. 12, 2—page 26.

(*e*) Success in the first engagements between the reconnoitring and protective troops on either side is important. Commanders of columns should be well forward so as to obtain early information, act quickly, and thus be able to influence the action of their leading troops in accordance with the intentions of the commander of the force.
F.S.R. III. 13, 2—page 27.

(*f*) Advanced guards should be strong in artillery. Tanks may be included if some special reason exists for wishing to deal rapidly with the hostile covering forces.
F.S.R. II. 41, 1—page 88.

(*g*) Time is best saved by thinking and working ahead rather than by hurrying units into battle without giving them time to make their preparations.
I.T. Vol. II. 3, 8—page 12.

(*h*) The leading infantry of advanced guards should operate on a co-ordinated plan. On no account must infantry units be allowed to drift aimlessly into the fight.
I.T. Vol. II. 9, 3—page 53.

POSITION OF THE COMMANDER.

12. The proper position of the commander is an important point in carrying out the above doctrine. He must be trained to be in the right place at the right time. In the tactical approach, *i.e.*, before contact, his H.Q. should be well forward—he will then gain the earliest possible information, see the ground, and be able to plan ahead and issue orders to subordinates before their units arrive, thus saving time for reconnaissance and preparation.
F.S.R. III. 13, 2—page 27.

Once contact is gained, the plan made, and the force committed, his H.Q. should not be so far forward that he is likely to become unduly influenced by local situations on the battle front. His H.Q. are now usually better placed at some point farther in rear, so chosen that he will be in close touch with all information derived from the air, intelligence, forward units, flank formations, and superior H.Q., and where he will be in a good position to maintain a clear perspective of the whole battle.
F.S.R. III. 16, 1—page 32.

During the battle he must be prepared to go forward at critical periods when important decisions may be required; he must take with him the necessary means to exercise command. To remain tied to his H.Q. at such times, waiting for information that may never arrive, may be fatal.
F.S.R. III. 14, 1—page 30.

His H.Q. should never be so far back that it takes an unduly long time to proceed to the forward area.

THE TACTICAL APPROACH.

13. This is more commonly known in the army as the approach march.

It will be clear from paragraphs 9 and 10 that in this phase the plan of the commander will be concerned mainly with ground, apart, of course, from the need to obtain information. He will aim at placing his force in such a position regarding ground that it will be able to operate to the maximum advantage later on; administrative

requirements of ground, such as roads, M.T. circuits, and so on, must receive very careful consideration.

Divisional fronts are likely to be wider than formerly. In the past they have been based mainly on the frontage a cavalry unit could cover when carrying out protective reconnaissance. They will now tend to be worked out on a basis of roads, so many to a Division.

14. A Div. Cavalry Regt. is now a light tank unit; such a unit is very easily held up by obstacles defended by mobile detachments provided with A.T. weapons. Thus the old conception of the mobile troops (the Div. Cav. Regt.) operating alone and carrying out protective reconnaissance on the front of the Division as it advances, and so gaining information, may no longer give results. The urgency of obtaining information on which plans can be made will force a commander to reinforce his reconnaissance units.

Under such conditions a commander would still use his mobile troops forward, but they would now be reinforced by such other arms as will give them the power to deal with minor forms of opposition and thus obtain information, and also the power to hold defensively important areas which have been secured. The less mobile troops, *i.e.*, the infantry brigades, would be kept back initially and moved forward by bounds in M.T. in rear of the forward troops as the situation demanded, being thus saved all unnecessary fatigue in this phase.

The exact composition of the forward troops will depend on the problem, but the following would be a suitable basis on which to work:—

Div. Cav. Regt.
Medium Artillery.
One Fd. Bde.
One M.G. Bn.
One Fd. Coy.
Some Motor Ambulances.

See Diagram "A."

15. In making his initial plan a commander must consult his senior R.E. officer; failure to take this officer completely into his confidence may have disastrous results in this age of mechanization. There will be bridges over river obstacles, and other potential bottlenecks, which, if demolished, would seriously retard the process of obtaining information and would also complicate the administrative situation; obviously it will be an advantage if these can be seized intact at the earliest possible moment. In any case R.E. units will be necessary for the repair of damaged communications, and their dispositions will vary with the nature of the problem involved.

16. The artillery which is allotted to the forward troops must

include medium artillery; this will carry out counter-battery protection for the Division, working with air observation. Unless the enemy field and medium artillery can be taken on rapidly and to a certain extent neutralized, a commander will be forced to de-bus his rifle units far in rear of the area where contact is first gained; furthermore the vehicles of the Div. Cav. and M.G. units will be forced off the roads and tracks so early that progress will be very slow. Hence the need for counter-battery protection for the Division while it is on the move.

17. From the above reasoning it seems that the forward troops should be composed entirely of mobile troops of various arms, under a selected commander, to operate on the Divisional front. The problem of command at once arises—a further problem is the capacity of a cavalry regimental H.Q. to exercise command over a mixed force operating on a wide front.

At first sight it appears that a separate commander and staff should be provided for the purpose; in peace-time he would command the Div. Mobile Troops, and be responsible for their training. But on closer investigation the provision of such an additional H.Q. appears to be unnecessary; it is a luxury which can well be done without.

Under the conditions envisaged in the above paragraphs the proper person to direct the action of the forward troops is the Divisional Commander himself, and for this purpose he would constitute a small operational H.Q. which would move close behind the forward troops and within their protective dispositions. In such a position he is well placed to reinforce his forward troops as necessary with other mobile troops, to move his infantry brigades, or portions of them, forward as demanded by the situation, and generally to ensure that his Division will enter the battle on a proper plan from the very beginning and will not drift aimlessly into the fight.

18. Diagram "A" gives a diagrammatic conception of how this might work out in practice. It is important to remember that it is only a diagrammatic conception, and nothing else. It may be noted that a Reserve M.T. Company consists of four sections, each of which can carry a rifle battalion.

It may often be best not to move the rear Inf. Bde. forward until after dark.

THE CONTACT BATTLE.

19. As contact between more important elements becomes imminent, encounters may be expected with hostile mobile troops; these may have either an offensive or a delaying rôle, and in any case will be so disposed with relation to natural obstacles that a wholly mechanized force would find them a serious hindrance to further progress. The dispositions in Diagram "A" may not now be suitable.

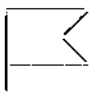
Diagram "A."

TACTICAL APPROACH—CONTACT NOT YET GAINED.

ONE RESERVE M.T. COY. AVAILABLE.

Forward troops, covering the forward move of the Division and operating in accordance with the Div. plan.

- Div. Cav. Regt.
- Medium Arty. (with air observation, providing C.B. protection during the advance)
- One Fd. Bde.
- One M.G. Bn.
- One Fd. Coy.
- Motor Ambulances.



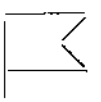
DIV. H.Q.

Moving by bounds well in rear of Div. H.Q. essential recce. elements being forward as desired.

- Div. Engineers (less one Fd. Coy.)
- Div. Arty. (less one Fd. Bde.)
- One M.G. Bn.

"A" Inf. Bde. with two sections Reserve M.T. Coy.

" B " Inf. Bde. with two sections Reserve M.T. Coy.



REAR H.Q.

" C " Inf. Bde.

It is obvious that the actual dispositions adopted in any case will depend entirely on the conditions, the nature of the problem, the ground, and so on. But generally it can be said that in the contact battle, or when following up a retreating enemy who is making full use of mobile detachments for purposes of delay, it will be advisable to have infantry units so disposed that they can operate quickly and effectively against hostile delaying forces disposed so as to make full use of obstacles. In some cases this may be done by having an Inf. Bde. H.Q. in command of the forward portion of the Division, the battalions of the Brigade being carried in M.T. and being available as and when required by the Brigadier, either in sub-units working with Cav. Sqns. or in some other way. This conception is shown in Diagram "B." It will be noted that the medium artillery still continues to be controlled by Div. H.Q.

In other cases it may be advisable to advance on a two-Bde. front, the Div. Cav. Regt. being decentralized to the command of leading Inf. Bdes.

This conception is shown in Diagram "C." Again the medium artillery is controlled by Div. H.Q. Also the Div. Comdr. has allotted to his forward Inf. Bdes. the minimum support from the other arms that he considers will be necessary; until he sees how the battle is likely to develop he retains under his own command the balance of the Div. Cav. Regt., M.G. Bns. and so on.

When advancing on a two-Bde. front, as in Diagram "C," the dispositions within each column are worthy of study. Suggested dispositions are shown in Diagram "D."

The spearhead of the advance is a small mechanized group, commanded by the O.C. Cav. Sqn. Directing its action, and moving close to Sqn. H.Q., comes Inf. Bde. H.Q. with one Rifle Coy. in M.T., and one section R.E., "at heel," *i.e.*, ready for immediate use. The Bn. Comdr., Fd. Coy. Comdr., and Fd. Bde. Comdr. are at Inf. Bde. H.Q.

The dispositions of artillery in the column must be such that the whole of the Fd. Bde. can be brought into action in support of the foremost troops without delay. There will be W/T and R/T communication throughout the column, and additional infantry and R.E. sub-units can be brought forward as required. The whole column is mechanized except for the rear infantry battalion.

20. The dispositions of the Divisional Engineers will require the most careful consideration. A modern enemy may be expected to make full use of demolitions, and unless prevision is exercised the administrative situation may become so compromised that the Division will be unable to receive supplies of food, ammunition, petrol, etc., and its further advance may be rendered impossible.

There must be at the outset, before contact is gained, an R.E. plan for dealing as rapidly as possible with those demolitions which can reasonably be anticipated.

Diagram "B."

CONTACT BATTLE.

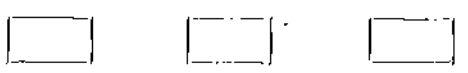
ONE RESERVE M.T. COY. AVAILABLE.

Forward troops, under an Inf. Bde. H.Q., the Inf. Bns. being mobile in M.T. and available for use as the situation develops.

- Div. Cav. Regt.
- One M.G. Bn.
- One Fd. Bde.
- One Fd. Coy.
- One Fd. Amb

"A" INF. BDE. H.Q.

Bn. Bn. Bn.



DIV. H.Q.

Medium Arty. (with air observation, providing C.B. protection).

Moving by bounds, essential recce. elements being forward as required.

- Div. Engineers (less one Fd. Coy.)
- Div. Arty. (less one Fd. Bde.)
- One M.G. Bn.

"B" Inf. Bde.

"C" Inf. Bde.

Diagram "C."

CONTACT BATTLE.

ONE RESERVE M.T. COY. AVAILABLE.

"B" Inf. Bde. (two Bns. in M.T.)
One Sqn. Div. Cav.
One M.G. Coy.
Two A.T. Platoons.
One Fd. Bde.
One Fd. Coy.
One Coy. Fd. Amb.

"A" Inf. Bde. (two Bns. in M.T.)
One Sqn. Div. Cav.
One M.G. Coy.
Two A.T. Platoons.
One Fd. Bde.
One Fd. Coy.
One Coy. Fd. Amb.

DIV. H.Q.

Medium Arty. (with air observation, providing C.B. Protection.)

Moving by bounds, essential recce. elements being forward as required.

- Div. Arty. (less two Fd. Bdes.)
- Div. Engineers (less two Fd. Coys.)
- Div. Cav. Regt. (less two Sqns.)
- Two M.G. Bns. (less sub-units with forward Inf. Bdes.)

"C" Inf. Bde.

and

remainder of Division.

Diagram "D."

DISPOSITIONS WITHIN A COLUMN.

Vide DIAGRAM "C."

Forward recce. and A. F. V. protection.	Cav. Sqn. M.G. Coy. Two A.T. Platoons.
Near Sqn. H.Q.	Inf. Bde. H.Q.
"At heel," near Bde. H.Q.	One Rifle Coy. One Sec. R.E.
O.C. forward at Bde. H.Q.	Fd. Bde. (less two Btys.)
O's.C. forward at Bde. H.Q.	Fd. Coy. (less one sec.) Inf. Bn. (less one Rifle Coy.)
	Two Btys. Fd. Bde.
	Inf. Bn.
	Coy. Fd. Amb.
	Inf. Bn. (no M.T. for this Bn.)

NOTE.—In all cases essential reconnaissance elements are forward as required.

Within the Corps it will usually be necessary to make an initial allotment of Corps bridging equipment to forward Divisions; this allotment should cater for probable immediate requirements, and it can be adjusted later if necessary.

A Division carries the following bridging equipment only :—

Two Inf. sets folding boat equipment each of which will make 112 feet of bridge.
Two small box-girder bridges.

It has no kapok and no pontoon equipment—these are carried in the Corps Pontoon Bridge Park. The Chief Engineer of the Corps, after he has made a careful study of the problem, should make his recommendations to the Corps Commander as to the allotment of the Corps bridging equipment. To allow of the free movement of medium artillery and tanks, pontoon bridges, if built at all, should be made "heavy" from the outset.

21. An R.E. reconnaissance party must work as far forward on each route as the tactical situation will allow. In Diagram "D" it would move with the Cav. Sqn., and the officer and other ranks composing it must not be taken from the R.E. Section waiting "at heel" near Bde. H.Q., or from the section next to be sent forward. Sections in turn should be available for putting straight on to a job of work, complete; meanwhile the reconnaissance party is again working ahead. It is vitally important that information concerning damaged communications should be sent back by the reconnaissance party to Bde. H.Q. without delay, giving particulars as to the damage, time required to repair, and the necessity or otherwise for using another route. This information may vitally affect the whole movement of the column; and should it be necessary to use fresh routes, or cease the forward movement temporarily, the Brigadier will be able to adjust his dispositions with a minimum of dislocation.

22. The following diagrams should be studied carefully and it is again emphasized that they must be regarded as diagrammatic conceptions only.

It is obvious that when contact is actually gained a force will be moving on a wide front; this will lessen the dangers of air attack and will also enable gaps and weak spots in the defence to be exploited without delay.

OPERATIONS SUBSEQUENT TO THE CONTACT BATTLE.

23. It will rarely be desirable, or in fact possible, to fight a Divisional battle on the same day as contact is gained.

The actual gaining of contact will be followed by local "dog-fights" on the front to secure valuable ground, bridges, defiles, road communication centres, and so on. While these are going on the bulk of the Division (including surplus infantry) is best held back

out of reach of long-range artillery fire; it will not be wanted in the forward area, save for recce. parties, and congestion on the roads will result if it is moved up too soon. Concealment and surprise will be assisted by keeping it well back.

24. The force which has been unsuccessful in the initial encounters, and has failed to gain the ground it requires *vide* paragraph 8, will not be content to remain in unfavourable positions in close contact with the enemy. It is far more likely to withdraw to more favourable positions in rear, keeping contact with the enemy by means of patrols. If the enemy can be induced to follow up the withdrawal it may create a favourable opportunity for an offensive movement. There are many advantages in a calculated withdrawal for the side which is at a disadvantage as regards ground; the offensive can be resumed when the enemy has been lured into an unfavourable position. If both sides adopt these tactics, and they may well do so having in view the present strength of the defence, then once the opposing forces have come to a standstill the tendency will be for them to keep their fronts well apart. This will aid secrecy and surprise.

25. The attack proper will be able to recover some of its lost power by the skilful use of obscurity, and in particular by means of operations in the dark. But it must be remembered that infantry cannot be launched in the dark against uncut or unbroken wire obstacles; furthermore, tank units dislike operating in the dark except over very favourable country, and so may not be available to crush wire by night.

Under such conditions it may be best to launch the initial attack an hour or two before dark; further operations can then be staged later in the night, depending on the state of the moon, or after dawn the next morning. The dawn attack is to be avoided, if for no other reason than that every civilized army "stands to" at dawn expecting attack. A French comment during the Great War was:—

> "The British Army consists of generals and lorries and always attacks at dawn."

Whether this comment was justified or not there is no doubt that in 1937 we should study the technique of attacking at times other than at dawn.

26. The advantages of operating under the obscurity of darkness are immense, particularly for infantry.

The scope of any operation by night will vary with the darkness, or otherwise, of the night.

On a very dark night objectives have to be limited, re-organization is difficult, and the whole operation must be carefully controlled.

On a very bright moonlit night it is possible to conduct operations almost as by day; such conditions are quite common in eastern and middle east countries.

Between these two extremes there will be many variations and all officers must understand exactly what can and cannot be done under varying conditions of lightness, darkness, etc.

CONCLUSION.

27. This article deals with a subject on which little has as yet been written.

It is realized that there may be considerable controversy over the dispositions suggested in some of the diagrams, and in particular with regard to Diagram "A" and the position of Div. H.Q.

There are many advantages in having Div. H.Q. well forward in the tactical approach and before contact is gained; the main ones are that it will enable the Div. Comdr. to obtain early information, see the ground, and develop his plan of battle in the best way.

An obvious disadvantage is that he may become unduly influenced by local events and lose his perspective of the battle as a whole.

It may also be argued that Div. H.Q. will have to deal direct with a number of small units; against this it must be remembered that the C.R.A. and C.R.E. will be at Div. H.Q., and will issue orders to their own units.

The dispositions which are most likely to register agreement are those contained in Diagrams "B" and "C," since they conform more nearly to accepted doctrines which have been in force for many years.

It is felt that the position of Bde. H.Q. in Diagram "D" is likely to be viewed with suspicion.

28. About one thing there can be no doubt—we have got to develop new methods, and learn a new technique. And in thinking out the problem we shall do no good if we are going to be influenced too much by the past when conditions were different.

There is no need to continue doing a thing merely because it has been done in the Army for the last 30 to 40 years—if this is the only reason for doing it, then it is high time we changed and did something else. For many years the composition of an advanced guard has been based on an infantry unit—or formation, *i.e.*, a battalion or a brigade. We are a very conservative army and probably the only way to get rid of this conception would be to abolish the term "advanced guard." This would be excellent, and it may here be mentioned that the term "advanced guard" has not been used in this article except in paragraph 11, quotations from *F.S.R.* II and *I.T.* It is felt that if we could get rid of the terminology which has been in use in our Army for generations, the Army as a whole would find less difficulty in adapting itself to the new conditions that now confront it.

29. If this article does nothing else it is hoped that it will at least provide data for constructive thought and discussion.

CHANGI CANTONMENT 1933–1937.

By J. F. F.

THIS article attempts to tell in very general terms the story, from the R.E. point of view, of the growth of Changi Cantonment from its re-commencement in 1933 up to the present time. The writer was concerned only with the construction of the Cantonment, and no mention is therefore made of the large works of defence which were in progress there at the same time. It is not possible in the space available to elaborate details of all aspects of the work, and special mention is only made of those points peculiar to local conditions, which it is hoped may interest those who have not been to Singapore or had to deal with barrack construction in the tropics.

The conception of Changi as a military station dates from the visit to Malaya of the Gillman Commission. At that time the name Changi belonged to a *mukim* or district of three or four square miles at the extreme eastern end of Singapore Island. The area consisted chiefly of jungle, scrub, and rubber plantations intersected by marshy valleys, developed in their upper reaches by Chinese squatters as vegetable gardens and pig-farms and merging into mangrove swamp on reaching the tidal belt at the coast. To the average inhabitant of Singapore Town the name Changi connoted a small native village, a police station, a large week-end bungalow belonging to the Public Works Department, and a palm-fringed strip of sandy beach dotted with rather dilapidated bungalows, and referred to by the local Press as one of Singapore's "playgrounds."

The Commission recognized the strategical position of Changi, standing at the easterly entrance to the Johore Straits and guarding the approach to the Naval Base. In 1927 land was taken over by the War Department from the Colonial Government, a 1/2,500 survey was carried out, a lay-out prepared and approved, and clearing and reclamation started as a prelude to actual building construction. This brave start however was to be short-lived, for in 1929, with the advent of a new Government, all work was stopped short. A considerable amount had already been done nevertheless, and most of the northern part of Changi, as it now is, had been cleared and swamps reclaimed; about 2 miles of roads, a pier, and about 1½ miles of broad-gauge railway had been constructed; seven married officers' quarters, four blocks of married soldiers' quarters, two barrack blocks and the power station were completed, together with a few subsidiary

buildings (including a squash court). These buildings were destined to lie idle for nearly four years, during which time Changi existed on a maintenance basis, and justified its existence only by acting as a "Change of Air Station" and week-end resort for troops and families stationed in Singapore.

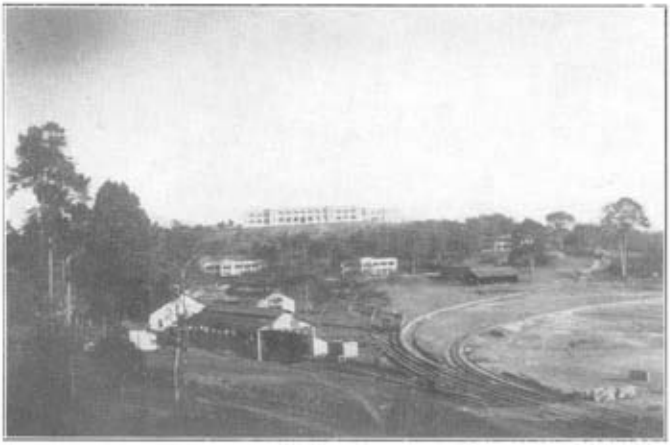
It was not until autumn of 1932 that the decision was taken to continue the work. The C.R.E. and the nucleus of the works staff were sent out during the earlier part of 1933 and were soon busy on questions of survey and lay-out. The actual siting of buildings was undertaken by boards of officers who were as a rule presented with proposals and alternatives, prepared in the C.R.E.'s office, for their consideration. The Changi area is fairly hilly, being well provided with high points varying from 100 to 150 feet above sea-level, and in siting buildings every advantage was taken of such of these as were not required for defence works. Many fine forest trees, relics of the days when Changi was covered by jungle, still remain. As many of these as did not actually interfere with building sites were left standing, and in some cases sites were even adjusted to spare the trees.

The works staff was completed in October 1933, and then consisted of a C.R.E. and assistant, E. and M.O., Surveyor of Works, a D.C.R.E. for defence works with one Garrison Engineer, and a D.C.R.E. for Cantonment construction with two. The order for the first large building contract—four barrack blocks at a total cost of about £23,000—was signed on 1st December 1933, and the battle was on.

From then on large contracts followed one another closely, as shown by the accompanying chart, which also reveals a surprising regularity in the incidence of contracts, due largely to a steady output of work by those responsible for their preparation. The amount of preparatory work involved is perhaps not always fully appreciated, at any rate by the lay mind. Outside observers and critics are apt to judge only by visible results and to take no account of the necessity for initial survey, considerations of lay-out and siting, design, drawing, and contract preparation. The larger contracts comprising type designs were prepared in the Chief Engineer's office and the remainder by the C.R.E. When it is considered that the former had also to deal with a large amount of construction work under a second C.R.E. elsewhere in Singapore, and the latter with the activities of a second and equally busy D.C.R.E. (Defences), it will be realized that the volume of preparatory work was very large.

It was the lot of the D.C.R.E. and his staff to supervise and administer these contracts, a task which was made no easier by the combined opposition of a tropical climate and the oriental mentality. In Singapore the daytime shade temperature varies between 80° and

R.E. Mess.



R.A. Officers' Mess on Temple Hill. Group V officers' quarters at hill-foot. Running-shed in foreground. The whole of the level area is reclaimed swamp.

Changi cantonment 1& 2

Group V officers' quarters, flat roof, sloping site type.

Barrack block with pitched roof; windows of offices, etc., on ground floor provided with protective overhanging canopies.

Changi cantonment 3 & 4

90° F. all the year round, rain falls on an average of 180 days throughout the year, and the resultant humid hot-house atmosphere makes itself felt both mentally and physically. The frequent heavy showers of tropical rain often interfere with progress of work particularly in the initial stages, excavation, concreting, etc., and afford contractors with a favourite excuse for procrastinations and delays due to other causes. The majority of the contractors are Chinese firms who employ almost exclusively Chinese skilled and unskilled labour and supervision, though they occasionally use Indian labour for unskilled work such as excavation or road-making. The European firms normally employ Eurasian or English-speaking Chinese supervision and Chinese labour, controlled by fairly frequent visits by their European representatives, though in the case of a few large contracts a European was continuously on the job. The average quality of work obtained from European and Asiatic firms, generally speaking, does not vary noticeably. The standard of individual tradesmanship is very level and tolerably good, and variations in the efficiency of various firms depends very largely on the competency or otherwise of the overseers and foremen directly in charge. These individuals were found to be at their best quite able and at their worst impossible. It was sometimes necessary to repeat instructions many times, in tones varying from a degree of calm intensity to one of (not always assumed) vehemence, and then advisable to go back in half an hour to see if they had been carried out.

A glance at the list of contracts will show the nomenclature of the buildings erected. A few words on the general type of construction and design may be of interest. Larger living buildings, barrack blocks, quarters, etc., are constructed of a framework of reinforced-concrete columns, beams, and slab floors, the walls being formed in brick panels, the whole rendered and colour-washed cream internally and externally.

Pitched roofs with Marseilles or Indian tiles were adopted at the outset, but in March 1934 the flat concrete slab roof, with roofing-felt and flat tiles superimposed, was introduced in a number of buildings, notably in barrack blocks and quarters. Opinions were (and are) divided as to the relative merits of these two types of roof. The chief advantage claimed for the flat roof is the avoidance of the use of roof-timbers and consequent immunity from the attentions of white ant, while the supporters of the pitched roof claim lower internal ceiling temperature, preferable appearance (admittedly a matter of taste) and failure of flat roofs by cracking due to rapid expansion and contraction of the concrete slabs. This last difficulty was encountered, but future designs may be able to obviate it. The pitched roof has been re-introduced in a number of buildings now under construction at the new Selarang Barracks near Changi. The battle of pitched *versus* flat roofs is one which still engages the

civilian architectural world and which is outside the scope of this article.

It is perhaps as well, therefore, to pass on to a feature which is common to both types of roof, the omission of eaves-gutters. Rain falls with proverbial impartiality, in the case of pitched roofs from the eaves and in the case of flat roofs from the canopies, direct to a channel at ground-level in the p.c.c. apron surrounding the building. Apart from the fact that eaves-gutters and down-pipes would have to be disproportionately large to cope with sudden heavy down-pours, their omission has other advantages. Firstly the channel in the apron surrounding the building, frequently flushed by rain-water and also by sullage-water which runs into it, forms a moated protection against possible invasion by white ants, and secondly there are no eaves-gutters to become blocked by leaves or other obstructions and so form breeding places for mosquitoes. Glazed windows are practically non-existent. They are replaced by wooden casement shutters fitted with solid panels, movable louvres of the jalousie type, or fixed louvres. These latter have been found to be very unsatisfactory for use on exterior walls, since although the louvres are closely spaced and steeply pitched, the rain forms drops on their lower edges and in high wind blows back between them as though in a funnel, falling sometimes 16 to 18 feet inside the room. Internal half-doors of the double swing type (similar to those familiar in films depicting pre-war American saloon bars) are provided in most cases. These prove satisfactory and permit air to circulate, though it is sometimes complained that this permission is also extended to refractory children and dogs. Floors of officers' quarters, and latterly of married soldiers' quarters, are tiled, and the way in which the aforementioned children and dogs rejoice to lie on them testifies to their coolness. Elsewhere where hard wear is expected, as in barrack blocks, etc., floors are given a granolithic finish. There is practically no paint-work in Changi; all exterior and interior woodwork is treated with solignum, though it is now the intention to try out the use of raw linseed oil for this purpose.

The timbers most usually employed are :—

Teak: used almost exclusively for the best grade furniture, fixtures, etc.

Chenghai: for first-grade carpentry, windows and doors of officers' quarters, etc.

Kapoh: for second-grade carpentry.

Seriah: seldom incorporated in buildings but extensively used for shuttering for concrete, temporary buildings, etc.

There is also a local timber, growing in the mangrove swamps, named Bakau. This is a very heavy close-grained wood almost twice the weight of Seriah, with a modulus of rupture of 22,000 lb./sq.

D.C.R.E. (CANTONMENT.) CHANGI.

CONTRACTS FOR PART I SERVICES 1-11-1933 TO 15-2-1937.

SERVICE	COST. £
COOKHOUSES (2)	1,330
BARRACK BLOCKS (4)	25,390
BATHING PAGAR & DRESSING RMS	1,770
ASIATIC QTRS (7 BLOCKS)	5,885
W.O's QTRS (4) M.S. QTRS (30)	36230
R.A.S.C. COMPOUND & BUILDINGS	3,515
OFFICERS' QTRS GR V (4)	12,620
FOUL DRAINAGE & SEPTIC TANK	1,270
OFFICERS QTR GR V (1)	2,615
ASIATIC QTRS (4 BLOCKS)	3,350
ROADS	3,845
ROADS	3,000
A.A. GUN PARK SHEDS & STORES	4,220
WATER MAINS	4,250
RESERVOIRS	2,800
OFFRS QTRS GR IV (4) GR V (5)	21,860
SERJEANTS' MESS (R.E.)	2,980
M.S. QTRS (30)	17,920
OVERHEAD LINES (E.L.)	1,300
M.S. QTRS (24)	14,950
FOUL DRAINAGE & SEPTIC TKS	1,400
R.E. WORKSHOPS	7,300
ROADS	2,690
ARTIFICERS' SHOP & STORES	1,350
BARRACK BLKS (5) COOKHOUSES (2)	33,900
WATER SUPPLY	1,550
RECEPTION STN & DENTAL CTRE	5,200
OFFICERS MESS (R.A.)	15,455
OFFICERS MESS (R.E.)	13,545
BATH HS (2) GUARD HS (2) OIL STORE & FAMILY MESS RM	6,130
POWER LINES	3,550
SERJEANTS' MESS (R.A.)	2,805
REGIMENTAL INSTITUTES (2)	14,200
RECREATION GROUND	1,400
S. OFFRS & SERVANTS QTRS	6,305
BARRACKS FOR INDIAN ARTILLERY	13,540
SERVANTS QTRS (5 BLOCKS)	1,725
OFFICERS' QTRS GR V (3)	7,000
OFFICERS' QTRS GR V (1)	2,810
N.A.A.F.I. GROCERY SHOP	1,480
BARRACK BLOCK (1)	7,320
A.A. S/L SHEDS (2) & GARAGE	7,105
M.S. QUARTERS (18)	12,140
BARRACK BLOCKS (2)	12,480
ROADS	1,905
OFFICERS' QTR GR V (1)	2,295
W.O.'s QTRS (4)	3,510
ASIATIC QTRS (4 BLOCKS)	2,445
RECTL SHOPS (2 BLKS) & GAS CHAMBER	1,460
ROADS	1,360
SELARANG BARRACKS	
ROADS	2,000
SPORTS PAVILIONS (3)	1,320
A.A. S/L LIGHT SHEDS (2)	(1st) 7,215
OFFICERS' QTRS GR V (2)	(1st) 4,500
ROADS	(1st) 3,125
TOTAL (PT I. UNDER £1000)	384,715

ADD PT I. (UNDER £1000)	37,995
ADD ANTI-MALARIAL	15,050
TOTAL PART I	437,760
ADD PART II	50
ADD PART III	22,250
TOTAL EXPENDITURE AT CHANGI	460,060
ADD EXPENDITURE AT SELARANG	170,000
TOTAL EXPENDITURE IN DIVISION NOW 1933 TO MARCH 1937	630,060

1-11-33 · 1-1-34 · 31-3-34 · 30-6-34 · 30-9-34 · 1-1-35 · 31-3-35 · 30-6-35 · 30-9-35 · 1-1-36 · 31-3-36 · 30-6-36 · 30-9-36 · 1-1-37 · 15-2-37

COMPLETION DUE
31-3-37
6-5-37
6-5-37
12-5-37

inch, and a safe fibre stress of 3,600. It serves very well as piling to foundations erected on reclaimed swamp, and given ideal conditions is said to last almost indefinitely. A large number of Singapore buildings still depend on Bakau pile foundations though reinforced-concrete piling is taking its place. Bakau has not hitherto been much used in Changi since, as previously mentioned, it has been possible to find hilltop or hillside sites for most buildings. It has been very useful however for foundations in such places as road and railway culverts in swampy ground.

Malaya as a whole is fortunate in possessing liberal supplies of granite, a fact which partly accounts for the excellent roads found throughout the country. The War Department granite quarry, in the very centre of Changi, provided the stone for almost all the roads and buildings up to the end of 1935. The stone was quarried, crushed, graded, and stacked by special contract. It was then measured and accounted by the D.C.R.E., issued by him to the various building contractors, and ledgered accordingly. During the period October, 1933 to October, 1935, 103,000 cubic yards of good quality granite were quarried and incorporated. In 1935 it became necessary to close down the quarry owing to the fact that the faces were approaching uncomfortably near buildings on the hilltop above, and thereafter building contracts had to provide for supply of stone by the individual contractor, who even then had no further to go than the large quarries on the island of Pulau Ubin, about a mile away.

It was most opportune that sand also was to be found locally, and for the first two years all contractors tendered on the understanding that "sand might be obtained free from War Department land." The pits however had been carelessly worked in the past before their acquisition, and after a couple of years it was found no longer possible to obtain clean sand economically owing to the original haphazard disposal of overburden. Moreover further excavations were unpopular with the doctors from the malarial point of view, as pools were beginning to form which it was not possible to drain. Latterly, therefore, sand followed granite in becoming the individual contractors' supply.

In 1933 the few buildings existing in the Cantonment depended for water-supply on three local wells, whence the water was pumped to high-level reservoirs and distributed by gravity. The water was potable but unpalatable, and the more fastidious imported their drinking-water in bottles on the daily Singapore lorry. In March 1934 the Singapore municipal supply was brought to Changi by 9-inch main. Water flows under natural head into twin 80,000-gallon tanks constructed of reinforced concrete and sunk below ground-level. Thence it is raised by automatically controlled electric pumps to high-level reservoirs of similar design on the two highest hills in Changi, 110,000 gallons at 143 feet floor-level and 80,000

gallons at 128 feet respectively, and thence flows by gravity to 6-inch distribution mains. The systems served by the two high-level reservoirs can be interconnected in case of necessity. The question of consumption might be mentioned in passing. When the scheme was originally worked out an average consumption of 70 gallons per head was assumed. This was considered to be on the generous side and was reasonably comparable with the figures computed by the municipal experts in Singapore. At the time of writing however, in spite of all efforts towards reduction, the consumption continues to average a figure nearer 100 gallons per head.

Water-borne drainage to 3 septic tanks already existed in Changi at the recommencement in 1933. This system was extended to include all living buildings (including Asiatic quarters) and is at present served by 4 main septic tanks and 9 subsidiary ones, most of which are sited near the coast-line, whence the effluent has but a short run to the sea. The system deals solely with foul drainage, and no storm or sullage water enters it. The latter, as previously mentioned, flows into open channels surrounding the buildings and is led away, still in open drains, to the nearest outflow to the tidal area. These open drains, although subject to the disinfectant actions of the sun and frequent flushing by storm-water, still require to be swept daily. The inhabitants of Changi can be considered fortunate in possessing a water-borne foul drainage system, as there are still many European dwellers in Singapore Town who lack it.

Mention has only been made hitherto of points in connection with new construction and contract work. Apart from this the D.C.R.E. administered a directly employed labour force which at its maximum in 1934 totalled about 700, and at the time of writing has been reduced to 280. This force includes a percentage of tradesmen, but the bulk of it consists of skilled and unskilled Tamil coolies. Up till the end of 1934, when a term contract was introduced, the tradesmen carried out all maintenance work and sometimes larger jobs such as the erection of temporary buildings. The majority are Tamils, with a sprinkling of Chinese and Malays in the metal-working and electrical trades, and are capable of producing very good results. The number of tradesmen has since been much reduced, but a nucleus still remains employed in R.E. workshops and on small urgent repairs in the Cantonment. The great majority of the Tamil coolie labour was (and is) employed on anti-malarial drainage. It is not the intention to enter here into the details of this very interesting work, which might itself form the subject of another article. During the financial years 1933 to 1937, a total of about £14,000 was spent under this heading, a figure which seems amply justified by a reduction of nearly one hundred per cent. in the incidence of malaria in Changi. The expenditure consisted chiefly of labour charges; concrete slabs and inverts of various sizes were

Pitched roofs; barrack blocks in background, "B" type married soldiers' quarters in foreground.

Block of two W.O.'s quarters. Kitchen and servants' blocks in rear.

Changi cantonment 5 & 6

Flat-roofed barrack blocks: note high and low-level roofs separated by a clerestory grill protected by an overhanging slab.

Scaffolding showing normal means of access to roof during construction.

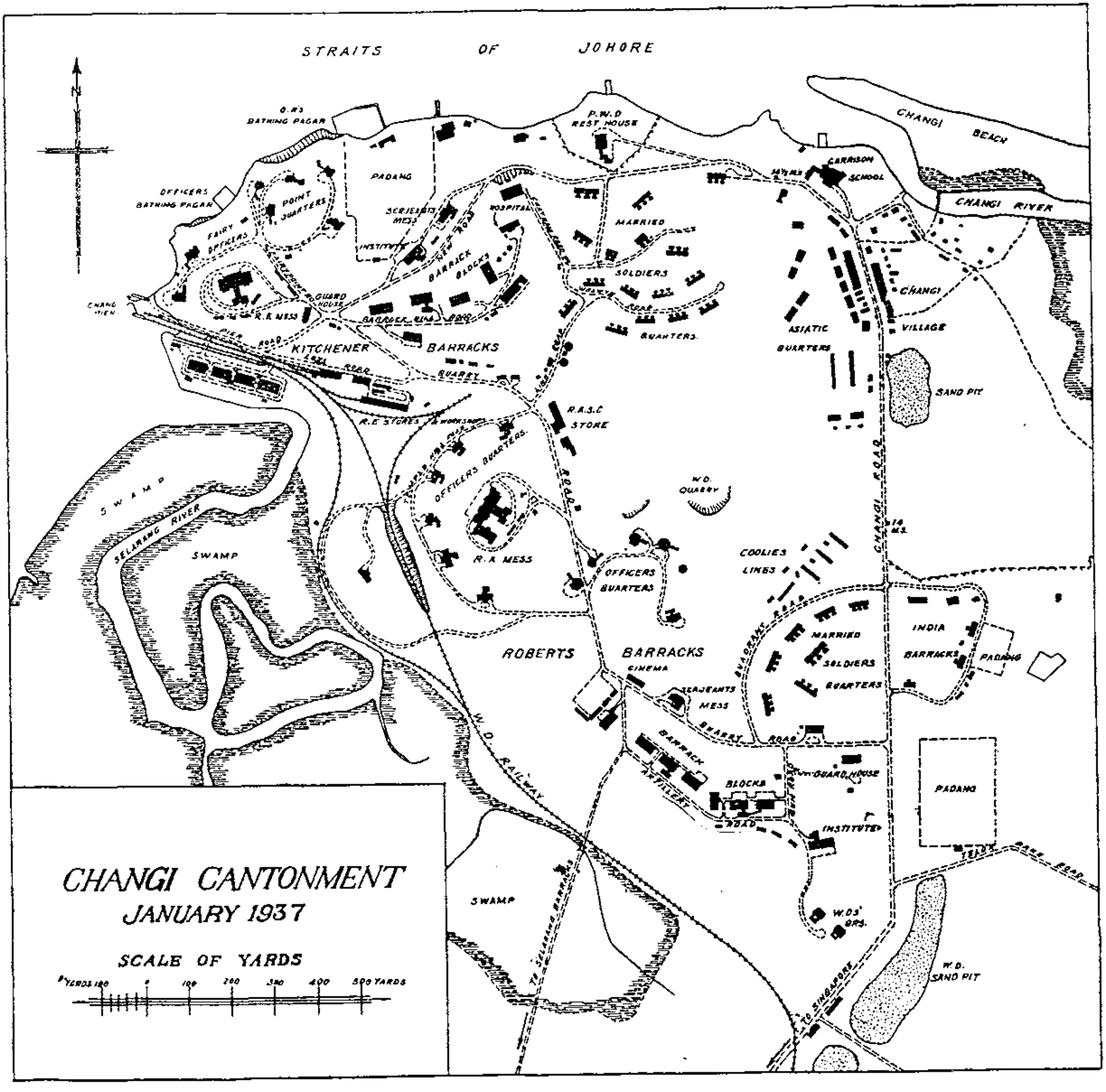
Changi cantonment 7 & 8

made in a concrete factory run by direct labour, and practically the only stores it was necessary to purchase outside were agricultural drain-pipes. Coolie labour was also extensively used for general development of the Cantonment as building progressed. The Tamil coolie takes very kindly to this type of work—making up banks, constructing paths and steps, turfing, hedge-planting and garden-work generally. Like most labour of this description, they work best when they are employed in large gangs and can enjoy visible results at the end of a day's work. The skilled and unskilled coolies are paid 65 and 55 cents respectively (about 1s. 6d. and 1s. 3d.) for an 8-hour day, with a deduction of 60 cents a month if they choose to occupy the quarters provided for them. They are not of a robust physical type and work slowly but have surprising powers of endurance. Once the ne'er-do-wells and mischief-makers have been weeded out, and with good supervision, they work well and give little trouble.

The making of gardens, tree-planting and turfing, etc., was a most interesting side of the development of the Cantonment. The tropical climate produces results promptly enough to satisfy the most impatient gardener, and the scars and blemishes left behind by building contractors can be healed surprisingly quickly Given the best conditions it is possible in three or four months to produce a garden with a grass lawn, a quick-set hibiscus hedge, and a good variety of shrubs in flower. Many of the trees found locally are remarkably quick growers, notably a variety of cherry, the flame of the forest (poinciana), and the casuarina. The last-named will grow ten feet or more a year in height for the first four or five years after planting. The soil in Changi however consists of laterite, clay, or sand, or of mixtures of these in varying proportions, and is inclined to be sterile. To remedy this it was necessary to dig in a proportion of the more fertile black soil which is to be found in the valleys where it has silted in the course of years. The grass usually planted, and which was used in constructing two large recreation grounds of about ten acres each, is known locally as serangoon grass. It is a creeping grass of a kind not seen in England and is not planted from seed but by dibbling in small roots at frequent intervals. With a top dressing of black soil it will soon establish itself and each root radiates surface-branches which in turn root themselves. A ground fit for play can in the best conditions be produced within four or five months of planting. A coarse grass known as lallang quickly covers unused open spaces. Unfortunately it is not of a creeping habit but roots in separate tufts and does not form turfs. It is therefore quite useless for artificial grassing, but if kept cut it forms a pleasantly green covering for hillsides and valleys. Like most tropical plants its growth is perennial and it needs constant cutting, an item in the D.C.R.E.'s budget which already costs nearly £1,500 a year and is naturally increasing with the growth of the Changi Area.

Towards the end of 1935 it was thought that the end of the new construction was in sight, but before Christmas the news came that complete accommodation for a battalion of infantry was required. The works staff took a deep breath and started preparatory work on the £170,000 scheme for the building of Selarang Barracks at a site about a mile and a half from the centre of Changi. The first order was signed on 9th May 1936 and at the time of writing the buildings are nearing completion. This however is another story, and should not be told until the barracks have been occupied and the occupants pacified.

In the meantime, Changi proper is still growing. The military population (all ranks, sexes, and ages) which was about one hundred in 1933 will soon pass the two thousand mark. The Changi of three years ago is already almost unrecognizable, and is now so large that a newcomer may well take some days to learn its geography. Civilization has brought Changi a 24-hour electric light service, its own bus service, an officers' club, a yacht club, and a cinema, and doubtless has other blessings in store for those who in the future join what will soon be the largest R.E. Station abroad.



CHANGI CANTONMENT
JANUARY 1937

SCALE OF YARDS

YARDS 100 — 0 — 100 — 200 — 300 — 400 — 500 YARDS

BOUNDARY COMMISSIONS.

By MAJOR E. H. M. CLIFFORD, C.B.E., M.C., R.E.

BOUNDARY commissions are not of frequent occurrence and the personnel employed on any one commission is very limited. Consequently the number of officers with experience of them is small and the lessons learnt are liable to be lost.

It is a curious fact—and yet perhaps one that is typical of our race—that, despite our very considerable experience of boundary commissions, little has been written in English on this subject. There are, of course, the papers read to the Royal Geographical Society on the conclusion of each boundary commission and a few other accounts of a similar nature. The official reports, being of a confidential nature, repose in steadily deepening oblivion among the files of Whitehall until such time as a zealous central registry weeds and destroys them. But from all this mass of experience nothing in the nature of a manual has ever been compiled to assist either Government departments in the efficient drafting of the boundary clauses of treaties, or the personnel of boundary commissions in their work in the field.

A most valuable paper was read by Colonel (now Brigadier) H. St. J. L. Winterbotham to the Empire Conference of Survey Officers in 1928. The Report of the Proceedings of this Conference, published by the Stationery Office, is now most regrettably out of print. To his neat, comprehensive résumé of the whole problem Colonel Winterbotham appended an excellent bibliography, from which three items, perhaps, deserve special mention.

Lord Curzon's *Frontiers* was the Romanes Lecture of 1907, now, alas, also out of print.

Hinks' "Notes on the Technique of Boundary Delimitation," published in the *Geographical Journal* for December, 1921, examines a number of interesting problems posed by treaty documents or arbitration awards.

Colonel Adami's *National Frontiers in relation to International Law* is an invaluable book of reference in its particular field.

An international boundary is defined in the first instance in a treaty document—be it treaty, convention, protocol, arrangement, or agreement. In the case of a colonial frontier, therefore, it is settled between the central, not the colonial, governments concerned. Consequently the personnel of boundary commissions are appointed by the central governments.

In the case of the British Colonial Empire, such frontiers are regarded as Imperial, and generally—but not invariably—the dependency concerned is not called upon to find the personnel, except the political officer, for a boundary commission, which, as a result of the same train of reasoning, is directly under the Colonial Office. There are several arguments to support this practice, of which the most important is perhaps the practical consideration that few colonial survey departments can afford to detach the necessary personnel with appropriate topographical survey qualifications for the duration of a boundary commission without seriously affecting the progress of the normal work of the department. Whether this employment of Imperial personnel evokes feelings of lack of confidence, for fear that local interests may not receive full consideration, or whatever other causes are responsible, the regrettable fact cannot be denied that, by no means infrequently, boundary commission personnel find, on arrival in the dependency on whose frontier they are to work, that they are far from being *personæ gratæ;* and this imposes on the British members an initial handicap which can only be overcome by tact and proof of competence.

The instructions issued to a boundary commission nowadays usually take the form of an exchange of notes between the two governments. These notes detail the personnel appointed and carry two appendixes. The first of these lays down the General Instructions, which may deal with the following points:—

Date and place for the first meeting of the commission.

Procedure—e.g., the first meeting—in the event of either party failing to appear at the initial rendezvous agreed upon by the two governments—in the event of the commission failing to reach agreement as to the demarcation of any portion of the boundary—on termination of the field work.

Definition of the powers of the commissioners.

Any further tasks entrusted to the commission. These would generally be of a political nature, such, for instance, as a study of transfrontier migrations of any nature.

Use of aircraft, if contemplated, for air survey or transport purposes.

The second appendix contains the Technical Instructions and may deal with the following points:—

Duties of the commission as regards demarcation.

Definition of the type of demarcation to be effected.

Technical definitions.

Maps and other technical documents to be prepared by the commission.

The duties of the commission are defined in the following manner:—

Demarcation of the boundary as laid down in the treaty document, the relevant portion of which is quoted.

Allocation of responsibility for the maintenance of the boundary to the respective governments.

The technical definitions probably include these points :—

No restrictions imposed on the commission as regards technical methods adopted; though, wherever reasonably practicable, triangulation should be employed.

Unit of measurement to be used—generally the metre nowadays.

Limiting permissible errors (triangular closure, base measurement, latitude, longitude, and azimuth).

Figure of the earth to be used.

Projection to be used.

Two courses are open in the event of the Commissioners failing to reach agreement. The problem can either be dealt with through the normal diplomatic channels by the two governments, or it can be referred for arbitration by a third party. But the decision as to which it is to be needs to be taken in advance and not left till the disagreement has occurred. In either case, the subsequent negotiations must be based on a joint report submitted by the commission.

Definition of the powers of the commissioners is necessary primarily in order to enable them to effect modifications to the boundary " for considerations which can only be appreciated on the spot " without reference to higher authority. It is also needed so that they shall not act *ultra vires* in settling questions of a juridical nature raised by the demarcation.

The type of demarcation that is now becoming usual is that of clearing a lane of a specified width astride the actual boundary line, the width being generally four or five metres. The standard of clearing has progressively risen, from ability to carry out an instrumental traverse and to move along the lane on foot, to ability to use motor transport along it, provided of course that the terrain is not too broken. In addition, boundary pillars are erected, not only at points where the boundary changes direction, but at such intervals as to ensure that they are intervisible. The majority of them may be dry stone cairns; but it is advisable to have at least the more important ones built of cement masonry or concrete, with smooth top surface on which a theodolite can be used over a truly centred mark. In any case a buried station mark should be provided, except in relatively unimportant intermediate pillars.

An agreed specification covering these points should be drawn up by a boundary commission before demarcation is started, in order to ensure uniformity of standard throughout the work.

Strictly speaking, of course, it is the boundary pillars that constitute the demarcation. But the boundary lane is an obvious corollary, since otherwise the pillars would at the best only be visible from close to and there would be very considerable risk of their being lost. In practice, probably, to the layman the lane marks the boundary, the pillars being rather in the nature of milestones.

The limiting permissible errors laid down for normal colonial boundary work have been hitherto :—

triangular closure	20 ″
base measurement	1/50,000
latitude	2 ″
longitude	3 ″
azimuth	10 ″.

It is suggested that most of these require tightening. Experience has shown that higher standards are not difficult to attain ; and it is axiomatic in all survey activities that the standard of work should be higher than is necessary for the immediate ends in view, in order to reduce the chances of the work proving, in subsequent years, to be of insufficient accuracy and having therefore to be done again.

Thus, the ruling triangulation of the British Section of the British Somaliland–Ethiopia Boundary Commission had a maximum triangular closing error of 6·5″. A Tavistock theodolite was used, and it is thought that 10″ should be ample allowance, provided that these or corresponding modern instruments are used.

If a base measurement is made, as it should for any base that is intended to be of more than reconnaissance standard, with an invar wire in catenary, the permissible error should surely be reduced to 1/250,000.

The limiting errors appear to be about right for astronomical determinations of latitude and longitude. At all events, to quote recent experience, again that of the British Somaliland–Ethiopia Boundary Commission, on which the British Section used an 8-inch transit theodolite while the Ethiopian Section used a prismatic astrolabe, the greatest differences between the British and Ethiopian values were 1·30″ in latitude and 3·45″ in longitude.

If the limit of 10″ in azimuth is intended to apply to the difference between astronomical determinations, it is certainly much too high and ought to be reduced to probably not more than 3,″ in view of the fact that Tavistock or corresponding modern theodolites, possibly in their geodetic models, will normally be used in the future. If, however, it is meant that this limiting difference must not be exceeded at any point in the boundary triangulation, then allowance must be made for the trigonometrical observations ; but even so, 10″ would seem unnecessarily generous and 5″ would probably suffice.

Each section of a boundary commission has its own escort, the strength of which requires careful thought. Transport considerations, if no others, demand that it should be a minimum. In some circumstances, camp police are all that are needed, and in general it may be said that for detached duties the native policeman is more satisfactory than the native soldier. If the escort is found by the local military forces, one of their own officers should accompany it, for the boundary commission officers are too fully occupied with their own work to be able to attend to the administration of the escort. If it is found by the local police, the political officer can take charge. In the writer's experience, the local military authorities have strictly defined the activities of the escort, fearing apparently that the troops would be used as labour.

Since the work of a boundary commission is essentially technical, it is British practice to place a survey officer in charge. In most cases his staff will include a political officer from the local administration; but in some cases, when there are no political issues involved, this may not be done. Clearly, such an appointment is of very material assistance to the commission, not only in the maintenance of liaison with the local authorities and in dealings with the natives, but generally in the sometimes complex field of knowledge of local history and conditions.

Before demarcation can be started, the commission has to identify on the ground the basic points defined in the ruling treaty documents and agree on the course of the boundary between these points. In the nature of things, so far as colonial boundaries are concerned, that definition is more often than not based on very imperfect topographical knowledge and the result falls into one or other of certain categories.

The first, which we may call the "correct," occurs as a rule only when the definition is left in the simplest terms without qualifications of any sort; such for instance as when a point is described in terms of latitude and longitude or as a known identifiable topographical position that has already been mapped or reconnoitred, or when a length of boundary is required to run in a straight line between two such points or to follow a specific topographical feature.

An example of this category is afforded by the Anglo-Italian Protocol of 5th May, 1894, which defined the boundary between British and Italian spheres of influence "in the regions of the Gulf of Aden" as a line which ". . . on reaching the 8th parallel of north "latitude . . . follows that parallel as far as its intersection with the "48th degree of longitude east of Greenwich. It then runs to the "intersection of the 9th degree of north latitude with the 49th "degree of longitude east of Greenwich, and follows that meridian "of longitude to the sea."

Another specimen of the "correct" description is to be found in

elements of the Treaty of 12th May, 1894, between Great Britain and the Independent State of the Congo (as it then was), laying down the boundary between Northern Rhodesia and the Belgian Congo. " The frontier . . . shall then follow the ' thalweg ' of the Luapula up to . . . . . Thence it shall run southwards along the meridian of longitude of the point where . . . . . to the watershed between the Congo and the Zambesi, which it shall follow until it reaches the Portuguese frontier."

The next category may be dubbed the " vague." Two instances of this may be quoted from the British Somaliland-Ethiopia boundary, defined by the Anglo-Ethiopian Treaty of 14th May, 1897. In the first of these, the treaty definition of one corner point of the boundary was " Arran Arrhe." The Boundary Commission succeeded in identifying this, but it proved to be an area of about 50 square miles of thorn-bush country devoid of any topographical feature, known as Aranare on account of the prevalence of a variety of small thistle called " aranar " in Somali ; though this plant is by no means restricted to that neighbourhood. The other instance is provided by the following passage from the Treaty :—" . . . to the hill of Somadou, and thence by the Saw Mountains and the hill of Egu to Moga Medir ; . . ." The distance between " the hill of Somadou " and " the Saw Mountains " is about 60 miles, but no ruling considerations are given as to the course of the boundary. As this stretch of country was unknown at the date of the Treaty, this silence was prudent.

Vagueness of this nature is as a rule not a fault, as it gives the boundary commissioners full scope to find the best alignment, provided of course that they are armed with adequate powers.

The third variety is the " inaccurate " and is generally due to the use of place-names that prove to be unknown locally or to the assumption of a non-existent topographical feature.

Thus, the Treaty of 12th May, 1894, between Great Britain and the Independent State of the Congo laid down that " the frontier between the Independent Congo State and the British sphere to the north of the Zambesi shall follow a line running direct from the extremity of Cape Akalunga, on Lake Tanganyika, situated at the northernmost point of Cameron Bay at about 8° 15' south latitude. . . ." An Anglo-Belgian Boundary Commission was at work on this frontier when the Great War broke out in 1914, but neither it nor its successor of 1927-1933 was able to identify Cape Akalunga, though " Camp Akalunga " is marked on a map that was extant about the time of the Treaty. Cameron Bay is shown on maps to this day, but its northern extremity is debatable as there are two headlands. The approximate latitude quoted does not solve the problem.

A later passage of the same Treaty reads :—". . . shall then follow the ' thalweg ' of the Luapula up to its issue from Lake Bangweolo.

Thence it shall run southwards along the meridian of longitude of the point where the river leaves the lake . . ." The objection to this lies in the fact that the Luapula has proved to be the continuation of the Chambezi, which rises in the north-east of Northern Rhodesia and does not flow through Lake Bangweolo. An extensive area of swamp stretching southwards from the lake to the river was no doubt responsible for this mistake.

Boundary definitions that fall in this category may be very troublesome, but a satisfactory solution can generally be found if the boundary commissioners have adequate powers.

The fourth type is the "contradictory," the contradiction being caused by excessive definition. This is generally by far the most difficult to cope with.

A very good example of this class is afforded by the Convention of 16th May, 1908, between Italy and Ethiopia, Article IV of which reads as follows:—"From the Uebi Scebeli the frontier proceeds in a north-easterly direction, following the line accepted by the Italian Government in 1897; all the territory belonging to the tribes towards the coast shall remain dependent on Italy; all the territory of Ogaden, and all that of the tribes towards the Ogaden, shall remain dependent on Abyssinia." "The line accepted by the Italian Government in 1897," was negotiated by Maggiore Nerazzini with the Emperor Menelik and defined as running parallel to and at a distance of 180 miles from the coast, but without specifying what sort of miles was intended. In any case, the chances of being able to reconcile such a line with the tribal areas mentioned in the 1908 Convention must obviously be small, particularly when it is realized that there is frequently, if not generally, considerable overlap between adjacent nomadic tribal areas.

The British Guiana-Brazil boundary presents another example of the "contradictory," of a more unusual type. For the purposes of this article it will suffice to skip, despite their very considerable interest, the earlier two and a half centuries of the story and to take up the threads at the Anglo-Brazilian Treaty of 6th November, 1901, by which the High Contracting Parties agreed to submit the problem to arbitration by the King of Italy. The Treaty, however, contained the following declaration:—

"The Plenipotentiaries on signing the foregoing Treaty declare, as part and complement of it and subject to the ratification of the same, that the High Contracting Parties adopt as the frontier between the Colony of British Guiana and the United States of Brazil the watershed line between the Amazon basin and the basins of the Corentyne and the Essequibo from the source of the Corentyne to that of the Rupununi, or of the Takutu, or to a point between them, according to the decision of the Arbitrator."

The arbitration required, therefore, was on the western part of

the boundary from the line of the sources of the Rupununi and the Takutu northwards to the Venezuelan frontier on Mount Roraima.

The Award of the King of Italy was made on 6th June, 1904, in the following terms :—

" . . . . . .

" For these reasons, We decide :—

" The frontier between British Guiana and Brazil is fixed by the line leaving Mount Yakontipu; it follows eastwards the watershed as far as the source of the Ireng (Mahu) ; it follows the downward course of that river as far as its confluence with the Takutu ; it follows the upward course of the Takutu as far as its source, where it joins again the line of the frontier determined in the Declaration annexed to the Treaty of Arbitration concluded in London by the High Contracting Parties on 6th November, 1901.

" . . . . . .

" The frontier along the Ireng (Mahu) and the Takutu is fixed at the ' thalweg ' and the said rivers shall be open to the free navigation of both coterminous States.

" Wherever the watercourse may be divided into more than one branch, the frontier shall follow the ' thalweg ' of the most eastern branch."

It will be seen that the last paragraph is a complete contradiction of the earlier part of the Award, in which it is clearly stated that the Ireng (Mahu) and the Takutu are to be followed for the whole of their respective courses from source to confluence. It seems probable that the meaning intended, but unfortunately not expressed, was that where the watercourse divided on account of an island, sand-bank, or other obstruction, the most eastern channel should be adopted.

A map accompanied the Award as part of it. But instead of marking the boundary as keeping along the Takutu all the way up to its source, this map showed it branching off up an east-bank tributary, to which the name Dad Oua was assigned, to its source on " M. Vindaua." Now, Vindaua is either an alternative name for or is part of the mountain of Ayangcanna, between Roraima and the famous Kaieteur Falls, some 250 miles away to the north, where the Ireng (Mahu) rises. On the other hand, there is a mountain called Win-Tawa in the neighbourhood of the head-waters of the Takutu, and it may be that " M. Vindaua " is used as an understandable, though bad, Italianization of this name.

A boundary commission is at present demarcating this boundary, but the results of its work are not yet available in this country ; so that we do not know how these contradictions have been met.

Our last class of boundary definitions can only be called " freak " ; and probably the outstanding example of this group is that of the Gambia. It is given in the " Arrangement concerning the Delimita-

tion of the English and French Possessions on the West Coast of Africa," signed on 10th August, 1889, in which the following passages occur :—

" ' From this point, the frontier line shall follow the right bank (of the Gambia River) as far as Yarbatenda, at a distance of 10 kilometres from the river ' shall signify that . . . the frontier line shall be drawn in such a way as always to be at an equal distance of 10 kilometres from the nearest point of the bank of the river. . . . . .

" ' Including Yarbatenda ' shall be taken to mean that the frontier shall be drawn round and beyond Yarbatenda at a radius of 10 kilometres from the centre of the town ; and in the event of its being found that a circle so drawn would intersect the bend of the river east of Yarbatenda, then the frontier line, from the point where such circle should be found to cut the river, would follow the nearest bank till it meets a fresh intersection of the river (by the circle)."

Fortunately, definitions of this nature are rare. The result is geometrical and unrealistic, giving an extraordinary succession of arcs of circles.

The solution of these initial conundrums may present extreme difficulties. National or local history, current or projected development, and the personalities of the boundary commissioners all play their part.

The methods of negotiation adopted by different nationalities vary with the national character and offer an interesting and important study to the boundary commissioner. Obviously, it is not suitable matter for discussion in this article.

It cannot be sufficiently stressed that the purpose of a boundary commission, though officially defined as the demarcation of the boundary, is fundamentally the improvement of frontier relations. Not only, therefore, should the commissioners endeavour to work efficiently with their opposite numbers, but they should seize every opportunity of meeting the officers, civil and military, on the other side of the boundary and of bringing them into contact with those on their own side. Greater progress will often be achieved in breaking down barriers of ignorance, suspicion, and distrust by such informal methods during the work of a single boundary commission than would normally be realized in ten years or more.

The conduct of the work varies according to the circumstances of each boundary. A normal arrangement would be that the two sections co-operate in the measurement of the base for triangulation and jointly determine the initial latitude, longitude, and azimuth. Each would then run its own triangulation scheme, with a modicum of points common to both, the two systems being adjusted to the mean values of these points. For topography and demarcation, the boundary would be divided into sectors which would be allotted between

the two sections. But, in some cases, generally because of exceptional difficulties of movement or transport, each section is made wholly responsible for all work, control included, along the sectors allotted to it.

Under certain circumstances it may be necessary to have a single transport organization for the whole commission; but that is quite exceptional. For many obvious reasons it is far better for each section to be fully self-contained in all respects—labour, transport, commissariat, etc.

Similarly, the two camps should be separate. Indeed, all that is necessary is that the two headquarters shall be in constant easy communication and so located that meetings can be held whenever required.

There is no standard form for the final agreement of a boundary commission. The following is suggested as a satisfactory arrangement.

The agreement proper should deal in successive paragraphs with:—

(*a*) The composition of each section—commissioners, assistant commissioners, and political officers. If there have been changes of personnel, these should be recorded, with the dates.

(*b*) The duties of the commission—e.g., to demarcate (quote from the Instructions), and any further tasks (quote from the Instructions).

(*c*) The start of work—record the date and place of the first meeting.

(*d*) Delimitation—record the decision taken by the commission for each boundary point mentioned in the treaty document and the Instructions, whether identification, compromise, or modification, and any other modifications to the course of the boundary.

(*e*) Demarcation. Developments in survey instruments and methods may find weaknesses in the work of the commission. It is therefore necessary to specify that the boundary as demarcated, and as defined in the technical appendixes to the agreement, shall be final.

(*f*) Decisions of a juridical nature, such for instance as are often necessary along a river boundary to deal with fishing or navigation rights or with the eventuality of changes in the river bed.

(*g*) Maintenance of the boundary. To ensure that this shall be effective, it is not sufficient merely to allocate portions to each government. Periodical joint inspection should also be provided for, in order to facilitate the realization of an even standard. In addition, it is probably wise to define the duties involved.

(*h*) Cartography—state the essentials of the maps for which the commission is responsible: scale, contour interval, width of belt of topography.

(*i*) Appendixes—give a list of them and specify that they form part of the agreement.

(*j*) Signatory paragraph.

The appendixes, which incidentally almost afford an example of the part being greater than the whole, should be on the following lines:—

(*k*) The Description of the Boundary should open with a general statement of the course of the boundary, followed by explanatory remarks about the methods of demarcation employed. Then should follow the detailed description from pillar to pillar, and for the ordinary colonial boundary this is best tabulated in columns:—

boundary pillar number:
altitude (ground level) of the boundary pillar:
distance between consecutive boundary pillars:
bearing to the next pillar:
course of the boundary—*i.e.*, straight line, crest line, "thalweg" of a water-course, etc.:
description.

This is a very long appendix, but of the greatest importance legally. In addition, of course, it provides the data for non-technical perambulation of the boundary.

(*l*) The boundary Map "illustrates" the Description. It has to be signed by the two Senior Commissioners, but signature is nowadays sometimes delayed until the printed map is available—necessarily so when air survey methods are employed.

(*m*) The Trigonometrical Control Diagram is also usually signed by both parties.

(*n*) The List of Trigonometrical Co-ordinates—geographical and rectangular for major, rectangular only for minor, and altitudes for all points.

(*o*) The List of Co-ordinates of Boundary Pillars. It is thought this is best presented in two parts:—

(i) geographical co-ordinates for main pillars:
(ii) rectangular co-ordinates and ground-level altitudes for all pillars.

(*p*) The List of Boundary Pillars, with data as to their construction and marking, in case restoration should be necessary.

(*q*) The Report on any additional task entrusted to the commission.

(*r*) The map "illustrating" that report would also require signature by the Senior Commissioners.

(*s*) It is now customary for a boundary commission to prepare a gazetteer for its maps.

(*t*) It may be desirable to include as an appendix a copy of, for instance, the agreement with a third party on the position of a terminal of the boundary.

These documents should be written in the simplest possible language, great care being taken to avoid ambiguities or lack of clearness; for such would sooner or later inevitably disturb the smooth working of the boundary administration which should result from the work of the commission.

As in all forms of international negotiations, the language problem looms large in the picture. An interpreter, for dealings with the other section of the commission, is invariably included in the personnel, possibly in the person of the political officer. But however good the interpreter, the utmost care is necessary, since there is an almost sinister amount of truth in the Italian proverb "*traduttore traditore*"; and it is a tremendous advantage if the commissioners, and particularly the Senior Commissioners, have a language in common, for this brings in its train all the benefits of direct conversation and discussion, resulting in fewer misunderstandings and better relations generally.

As a rule, the documents of a boundary commission are prepared with the two national texts side by side in parallel columns. Treaty documents teem with instances of imperfect translations, even such elementary differences between texts as, say, "line" in English and *ligne droit* in French. But the greatest danger probably comes from translations that, through being too literal and too dependent on the dictionary, fail to convey the right spirit.

Sometimes, to counter this danger, a boundary commission decides that one of the texts shall be the *texte témoin*—in other words, if a difference is discovered between them, the *texte témoin* prevails.

For various reasons, some boundary commissions employ a third language, which is not the mother tongue of either party. In such cases, this of course provides the *texte témoin*, the national texts being prepared merely for convenience.

In this connection, it is as well to remember that boundary commission agreements have to be ratified, and that, so far as Great Britain is concerned, documents laid on the table of the Houses of Parliament must either be in English original or have an English translation appended to them.

RAILWAY OPERATION AND MAINTENANCE IN PALESTINE.

By CAPTAIN J. H. ANDERSON, R.E., AND LIEUTENANT W. H. B. WHEELER, R.E.

INTRODUCTION.

ON 30th September, 1936, the first contingent of the Detachment, 8th (Railway) Company, R.E., landed at Haifa, as part of the Palestine reinforcements No. 1., and went into camp with the 42nd (Field) Company, R.E., at Lydda.

To understand the situation as they found it, on the 1st October, it is necessary to consider (i) the railways available, (ii) the distribution of troops, and (iii) the method of supply.

(i) The railways of Palestine, all single line, consist of the standard-gauge line, which enters Palestine from Egypt at Rafa (not on map), and, running through Lydda Junction and Tulkarm, terminates at Haifa (212 kilometres), and a narrow-gauge line (105 cm.), which runs from Haifa to Afule and on to Samakh (87 kilometres) at the southern end of the Sea of Galilee, where it passes into Syria. There is a standard-gauge branch from Jaffa and Tel-Aviv through Lydda Junction to Jerusalem, and a narrow-gauge branch from Afule through Massoudieh (60 kilometres) to Nablus (87 kilometres) and a further branch from Massoudieh to Tulkarm (18 kilometres). The portion of the line from Massoudieh to Afule had not been used for four years, but the portion from Tulkarm to Nablus had been in use up to the time Ramin Bridge was damaged by *sabotage* and had to be destroyed by 42nd Company, R.E. (see *the R.E. Journal*, September, 1936). This bridge was later repaired by 17th and 42nd Companies (see *the R.E. Journal*, June, 1937). Owing to *sabotage*, naval and military crews still manned certain trains, all passenger trains were preceded by pilot trollies, and certain armoured units patrolled the line after dark. The pilot trollies had been constructed by fitting rail wheels to Ford V-8's and by mounting a Lewis gun in the rear, as shown in Photo 1 ; and, to give the minimum time to *saboteurs*, they preceded the trains through the section by some 2,000 yards. Accidents did happen to these trollies, and they were rather between the devil and the deep sea, one naval driver of a following train having been heard to remark, " I've had a couple of them across my bows before now ! " However, they did their job, as no train piloted by a motor-trolly ever came to grief, whereas prior to the use of these pilot trollies, several trains had been derailed with loss of life.

(ii) The distribution of troops in October was roughly as follows:—

Force Headquarters and Headquarters 1st Division were in Jerusalem.

Of the brigades forming the 1st Division, 1 I.B. and 3 I.B. were in Jerusalem, and 2 I.B. was in Jaffa.

Headquarters 5th Division was in Haifa. Of the brigades forming the 5th Division, 15 I.B. was in Haifa, 13 I.B. was in Nazareth, and 16 I.B. was in Nablus.

Troops were actually covering wide areas, and of the 16 I.B. in Nablus, two battalions with Cavalry, R.A., R.E., R.A.S.C., R.T.C., and R.A.F. were actually in Nablus, one battalion with certain attached troops was at Jenin, and one battalion, less detachments, was at Tulkarm.

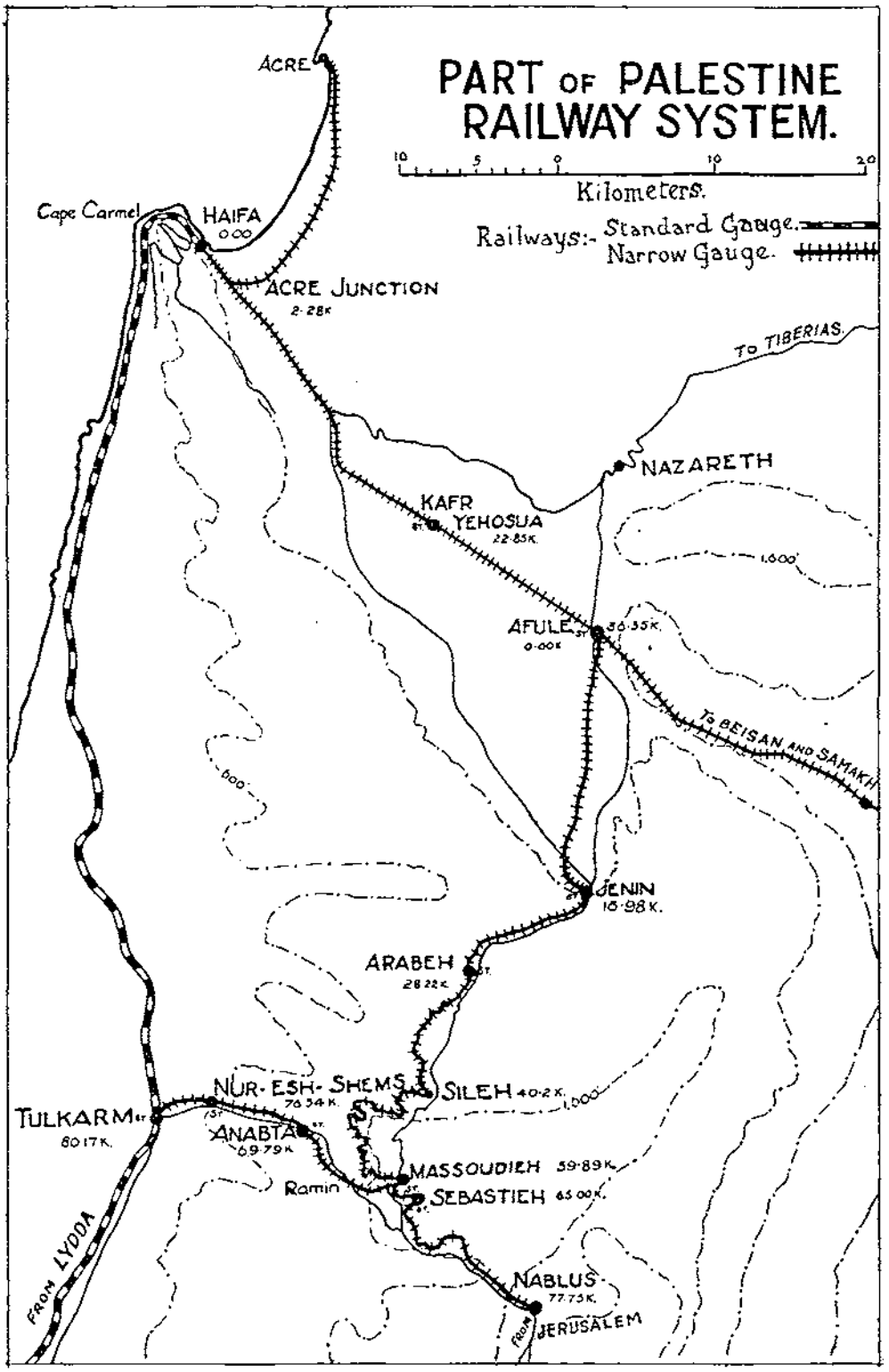
(iii) The system of supply was as follows :—the Main Supply Depot was in Haifa, and was fed from U.K. and Egypt by sea. There were Supply Depots at Sarafand, near Lydda, and at Jerusalem, which were fed by rail from Haifa, and to a certain extent from Egypt. There were D.I.D's at Tulkarm, Afule and Samakh, fed by rail. Supplies for units at out-stations were sent forward by M.T. convoy. The supplies to be carried daily to Jenin were approximately one ton, and to Nablus approximately three tons.

THE OBJECT.

The object of the inclusion of Railway Troops in the Palestine reinforcements was to ensure that a sufficient reserve of suitable personnel would be available in the country to maintain the essential railway services in the event of a railway strike. To familiarize all ranks with the loco's, stock, methods of working and layouts, the detachment was at once distributed as extra men on the trains on the main line, and in main yards, from Kantara to Haifa, and from Jaffa to Jerusalem. It was, however, soon evident that the critical days had passed, when a full dress railway strike had appeared imminent, and that the Railway Troops now in Palestine, while standing by for action on the main line, could be made available for running extra trains. Force Headquarters, therefore, conceived the idea of opening the Afule-Massoudieh-Nablus-Tulkarm line as a military railway, in order to bring supplies and civilian stores to Jenin and Nablus from Haifa and Tulkarm, thus relieving the pressure on M.T.

THE RECONNAISSANCE TRAINS.

As most of this line lay in the "Triangle of Death" (Nablus-Jenin-Tulkarm), one of the most disturbed parts of Palestine, no information was available as to the condition of the line nor the damage done by the Arabs, and, as the scheme progressed, the O.C.


PART OF PALESTINE RAILWAY SYSTEM.
10 5 0 10 20
Kilometers.
Railways:- Standard Gauge.
Narrow Gauge.
ACRE
Cape Carmel
HAIFA
0.00
ACRE JUNCTION
2.28K
TO TIBERIAS
NAZARETH
KAFR YEHOSUA
22.85K.
1,000'
AFULE
0.00K
56.55K.
TO BEISAN AND SAMAKH
600'
JENIN
16.98K.
ARABEH
28.22K.
NUR-ESH-SHEMS
76.34K.
SILEH 40.2K.
1,000'
TULKARM
80.17K.
ANABTA
69.79K.
MASSOUDIEH 59.89K.
Ramin
SEBASTIEH 65.00K.
NABLUS
77.75K.
FROM LYDDA
FROM JERUSALEM

Railway Troops, R.E., began to collect information which would enable him to run a reconnaissance train. This information was obtained mostly by road reconnaissance to stations, and on October 6th a railway reconnaissance, in which all fighting services were represented, left Haifa for Jenin.

The train (see Photo 2), preceded by a petrol trolly, consisted of a pair of armoured high-sided trucks containing machine-guns and a naval pom-pom, manned by the R.N., a few wagons of tools and stores manned by 8th (Railway) Company R.E., and a rake of wagons armed by an infantry escort. At the back of the train was a service car, manned by observers and others.

Overhead, the R.A.F. made contact with the outside world. As the Officer i/c train said bitterly, "The whole thing is so formidable that there is little hope of the Arabs making an attack."

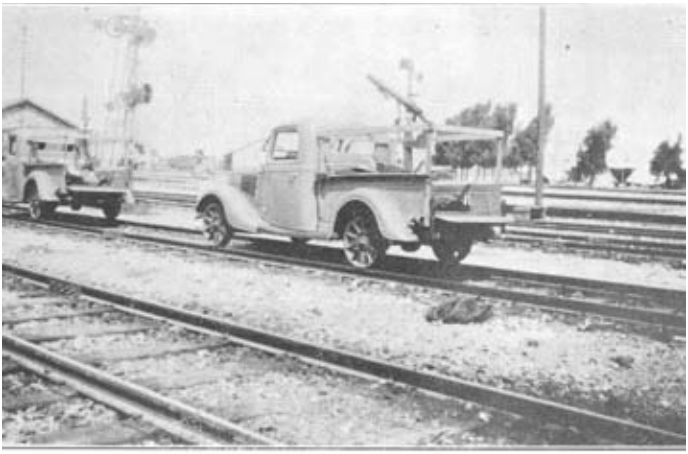
O. i/c train proved to be correct, and the train went and returned without interference. On October 13th, a further reconnaissance, only slightly less formidable, was made as far as Massoudieh, but the petrol trolly went through as far as Nablus. The only difficulties encountered were the slipping of engine wheels on the heavy grades, due to the track being overgrown by an oily weed, a derailment due to a fall of rock in a cutting, and the failure of the water-supply at Massoudieh, due to the breaking of the valve gear. These reconnaissances showed that the track was still in good condition, and that the opening of the line was a feasible proposition.

SERVICE.

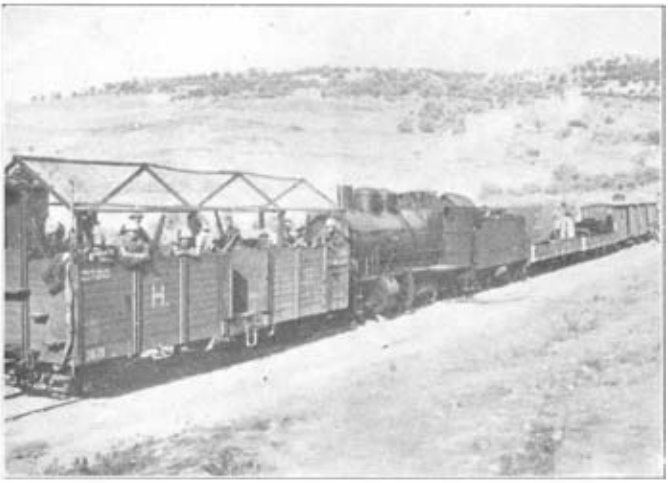
Narrow-gauge locomotives were scarce in the sheds of the Palestine Railways, so a locomotive was hired by them from the Chemin de Fer Hijaz, on behalf of the A.D.Tn. This locomotive, together with a small tank engine which had been left at Tulkarm, was handed over to the 8th (Rly.) Coy., R.E., on 5th November, with a request, that, commencing on 6th November, a train should be run daily from Haifa to Nablus and back with a connecting service from Tulkarm to Massoudieh. This service was for civil and military traffic, and to run on seven days a week, leaving Haifa at 08.30, arriving Nablus 14.30, leaving Nablus 15.30, and arriving Haifa 20.50. Stock was to be provided by the Palestine Railways as required, but the operation and maintenance of the entire line beyond Afule was to be the responsibility of the Railway Troops. Appendix "A" shows the complete timings and a table of distances.

PERSONNEL.

Detachment 8th (Rly.) Coy., R.E., had by this time been reinforced by one Officer and 45 other ranks, 35 of whom had been specially



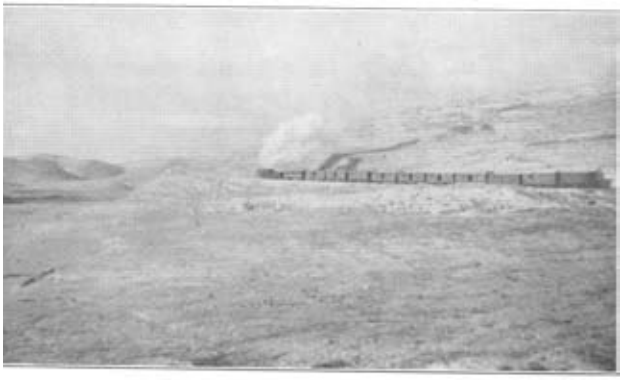
1.—Pilot trollies.



2.—Reconnaissance train.

Railway operating in Palestine 1& 2

3.—The unsupported counterfort arch.



4.—Troop train.

Railway operating in Palestine 3 & 4

enlisted from the R.E.S.R. for the emergency. All had been concentrated at Haifa, and, with the detachments from the 42nd (Field) Coy., R.E., and the Infantry, were available for the operation and maintenance of the line. Very soon after the opening of the line, O.C. Detachment 8th (Rly.) Coy., R.E., took over the duties of O.C. Railway Troops, R.E., and the 25 Sappers of the 42nd (Field) Coy., R.E., who were employed on the railway, were placed under his command. This made the total strength of the detachment 126. Out of this strength was formed an operating section of approximately 30, and a maintenance section of approximately 60, the remaining numbers being employed on camp duties, on technical work with the Palestine Railways and as Movement Control Staff. The operating section was located at Haifa, with an outstation at Nablus, and the maintenance section at Jenin, with an outstation at Massoudieh.

The Operating Problem.

As the Detachment consisted entirely of operating and workshops trades, the solution of the operating problem was easy. The factors were as follows :— the line was single throughout, and at every station one or two loops and station buildings existed.

From Haifa to Jenin grades and curves were fairly easy, but after leaving Jenin, the line entered the hills of Samaria, and in certain sections grades of 2 per cent. and curves of 19 degrees were encountered. For a Class 11 engine, the maximum loads were as follows :—Haifa-Afule, 250 tons ; Afule-Jenin, 200 tons ; Jenin-Nablus, 150 tons. 500 tons were permitted in the reverse direction from Jenin to Afule.

There was a good water-supply at Massoudieh and Tulkarm and a poor unreliable supply at Sileh and Jenin. The Executive Engineer (X.E.N.) made several attempts to improve the supply at these two stations, but the language difficulty was too great in every case. As the water-supply at Jenin had to serve the local garrison, loco.-watering there was never popular, and it became less so after one day when the sluice valve broke and emptied the carefully husbanded contents of the reservoir into the tents on the low-lying ground adjoining the line. In normal circumstances, a loco., filled at Kafr Yehosua, the last watering-point on the Palestine Railway section, could expect to reach Massoudieh.

The Palestine Railway is operated by electric staff with Western Electric Control, but all instruments had been removed from the stations between Afule and Nur esh Shems. The Palestine Police occupied the station buildings at Jenin, Arabeh and Sileh, and had telephones on an omnibus circuit connecting them to Jenin main Police Station and Post Office. Afule, Jenin, Nablus and Tulkarm were on the Post Office telephone, but all services were bad, and one

was very lucky to get a call through in less than half-an-hour. Even then, it was likely that at the most important point in a conversation a voice would ask, "Are you speaking?" and without waiting for the answer would cut off the connection. There were no signals on the line between Afule and Nur esh Shems except for home signals at Nablus and Nur esh Shems, all points being worked by hand tumblers. As it was possible that the section Massoudieh-Nablus might be required by either engine in succession, it was decided to open the line in three sections, viz.:—Massoudieh to Nablus, to Tulkarm, and to Afule, using a single wooden staff of different cross-section for each of the above sections. Blockmen were posted at Massoudieh and at Afule, and A/M.C.O. Nablus and A/M.C.O. Tulkarm, who were traffic operators from Detachment 8th (Railway) Coy., undertook the duties of blockmen at those stations. Station limit boards and flag boards were installed at all stations except Nablus and Nur esh Shems.

PRELIMINARY WORK.

The two trips made by the Reconnaissance trains showed that a fair amount of clearing would have to be done before a regular service could be operated with safety. The slipping caused by weeds growing thickly on some parts of the line had been such as to bring the trains to a standstill, and on the second reconnaissance one of the wagons in the train had been derailed by accumulations of chalk which had fallen on to the track in one of the cuttings between Sileh and Massoudieh.

In order to remedy these and other defects, two construction trains were run on October 15th and October 19th, consisting of a lowsider and four vans for stores and personnel, a water tank wagon, and, as the trips were of three days' duration, the Service Car was added for the comfort and convenience of the Officer in charge. As a precautionary measure, the lowsider was propelled by the engine, but the only attempts at *sabotage* met with were of an easily visible nature, such as stones and short lengths of rail, originally 100 metre mark posts, laid on the track. These two trips enabled the weeds to be removed in the worst places and the cuttings were cleared sufficiently to ensure that further derailments would not occur.

On the second of the trips, a brake failure caused the train to crash through the wire knife rests which closed the two rail entrances to Jenin camp. It was very fortunate that no real damage was done, as there were tents pitched close to the track, and such wire as had not got itself wound round the axles of the lowsider converted this vehicle into a kind of chariot which mowed down three or four sets of guy ropes, felling the tents which they supported. This little

incident was the subject of many " leg-pulls " later on, but was taken surprisingly well, particularly by the owners of the damaged tents.

During these few days the 17th and 42nd (Field) Companies were also assisting towards the common object by rebuilding the bridge at Ramin, repairing the water column at Sebastieh, and many other jobs. The reconstructed bridge at Ramin forms a prominent memorial to their industry.

The Permanent Way.

The rails used were of flat-bottomed section, about 45 pounds per yard in weight, and 9 metres long. They were fastened to pressed steel sleepers by a clip and a chair-plate held down by a " T " headed bolt which could be withdrawn through a slot in the sleeper, so that rail changing did not necessitate the removal of the sleepers. To allow for widening the gauge on curves, the chair-plates and clips were made in five sizes, giving a maximum variation of 2½ centimetres.

The fishplates used were flanged to fit along the flat bottom of the rail, giving a very stiff joint; evidence was found that a plain fishplate had been used at some time but had been discarded in favour of this type. The absence of any oil on the fishplates for four years had led to crippling of the rails on long straights, some of which had a ghastly appearance, even after they had been most carefully lifted and slewed. On the curves, particularly where the track had a hard bed, crippling was almost entirely absent. On the sharper curves, which went up to 19 degrees, side wear was very pronounced.

The most interesting feature of the permanent way was its standard turnout. The angle of the turnout was 1 in 8, the switch blades and crossing were of cast steel, the switches being pivoted on a steel bearing plate to which were fastened bearing blocks and stock rail clips, the whole being coachscrewed to timbers. Timbers were also used under the crossing, but laced steel sleepers were used in the leads. Check rails were bolted to the stock rail with distance blocks in the usual manner. The point-operating gear consisted of a single stretcher without adjustment, and a rod connecting this to a tumbler.

These turnouts were admirable in every way, the switch blades were always snug and had no tendency to stand open, there were no adjustments to make and the arrangement of the tumbler was such that the setting of the points was indicated to the driver of an approaching train.

That the track had had a rough time was evident by the large number of sleepers marked by the wheels of derailed vehicles, but it was in a surprisingly good condition in most places, considering how long it had been neglected.

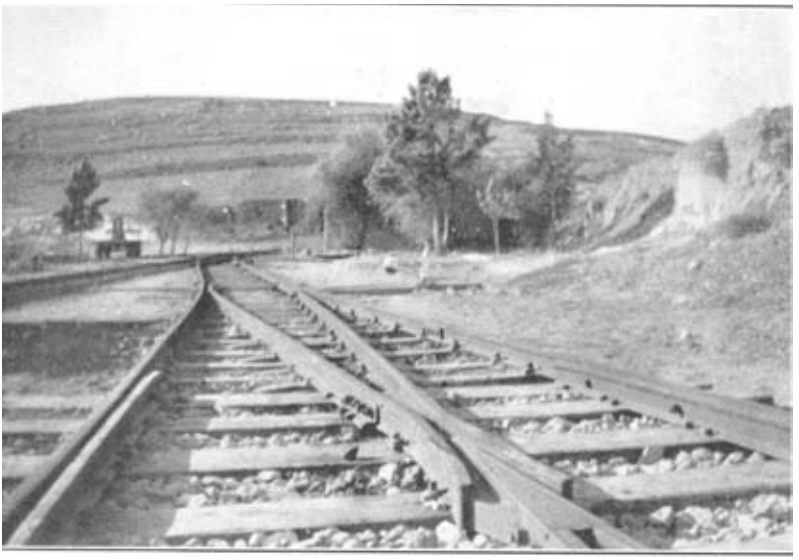
THE FORMATION.

The formation fell naturally into three classes, black cotton soil, soft sandstone and chalk, and limestone and hard rock. Of these, the third gave little trouble and not much can be said about it; a few loose rocks were removed from the walls of the cuttings and one or two embankments had to be built up where cattle crossings had knocked them about. Between the other two there was little to choose. The cotton soil was found in the plains where the line usually lay in shallow cuttings or on low banks; side drains had evidently existed at one time, but four Rains had filled them in. As there were about 25 kilometres of line on cotton soil, it was not possible to re-excavate the drains throughout, and only the worst places, where water was likely to accumulate in large quantities, were tackled. This lack of good drainage was a continual source of trouble and prevented the track from being put in really good order.

The chalk and sandstone were found mostly between Sileh and Massoudieh, where the line passed through numerous cuttings. Here again the Rains had done their work and the side drains in the cuttings were overflowing with fallen matter. During the hot weather this did not give any trouble, as the chalk set almost as hard as cement; but after the traffic had shaken it, the first rain brought it down in large and small pieces which fell in the track, having nowhere else to go. Photograph 3 shows a portion of a counterforted wall in one of the cuttings which had been built to prevent collapse of the soil. One of the arches is totally unsupported at one side and the soil is supporting the arch. The engineer thought seriously of having the whole wall down, but after watching it carefully for about a week, during which time no movement took place, it was allowed to remain. It never came down, but had it done so, it would have brought about 1,000 tons of masonry with it as well as the side of the cutting.

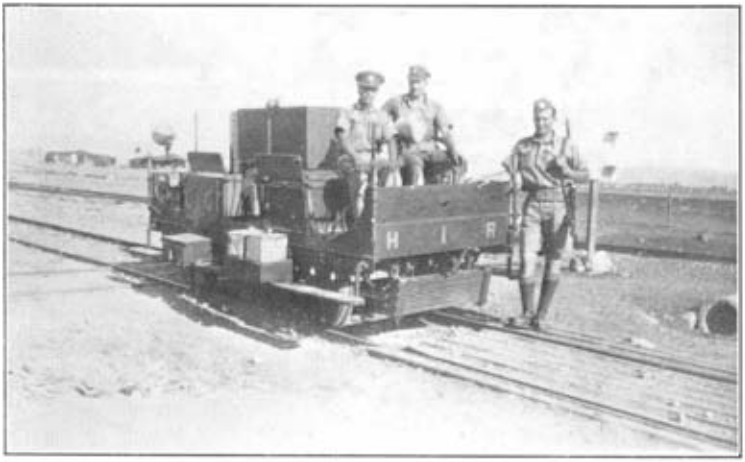
One of the most annoying things was the sinkage of the track on either side of the numerous culverts. The humps so formed caused the engine to ride very badly, and one of the worst of the culverts had a permanent speed restriction of 15 kilometres per hour on it for the whole of the time that the Railway was being operated. No amount of lifting seemed to have any permanent effect, the passage of one train was often enough to undo several hours of careful work. It is said that this same trouble was noticed during the operation of the line when first captured from the Turks in 1918.

In most parts of the track the ballast was too coarse to give a good close bed for the sleepers, and on the cotton soil particularly it had a tendency to work its way upwards and outwards. Ballast in Palestine, so it seems, is the panacea for all ills of the permanent way, and no excuse for putting more on the formation is overlooked. The



5.—The standard turnout.

Railway operating in Palestine 5 & 6



7.—The narrow-gauge trolly.

8.—Nablus station.

Railway operating in Palestine 7 & 8

Arab platelayers erroneously put most of it in the middle of the track, where, instead of draining the water off the formation, it causes a water pocket to form right under the track, with obvious results.

Weeds were plentiful and could be divided into good and bad weeds. The bad ones looked like a lavender bush, smelt like an olive, and exuded oil when crushed, causing serious slipping of the wheels of the engine. The bad weeds were removed. The good weeds did not appear until the first rain had fallen, and then mostly in the cotton soil. The virtue of these weeds, which were of a grassy nature, lay in their ability to hold the ballast in place against a stream of water flowing across it. In all good permanent way work weeds of any sort are abhorred, but in this case they prevented washouts in about four places, and so they were allowed to remain. It was noticed, after a washout in the main line, that the platelayers were mixing straw with the ballast. On being asked why, the ganger said it was to bind the ballast together. It seems that this is the normal way of dealing with a place which washed out, and the weeds mentioned above performed the same service as the straw, probably with rather more certainty.

Stations.

The station layouts on the line were, generally speaking, simple, consisting of a straight road, a loop, and a lie-bye. Junctions and termini were naturally somewhat more fully equipped, and Haifa, with its dual gauge, was in a class of its own. Little trade was done at Arabeh and Sileh and as attempts had been made to force the points to a half-cock position, there being no blockman there, they were spiked over at the ends of the stations facing the down grade. To give the driver warning at night of the position of the points, the P.W. gangs lit lamps on the station limit and flag boards and the train crew brought them in. The lamps were padlocked to the boards, but in spite of this precaution two were stolen.

Jenin station was rather a problem, a good deal of trade was done there and one of the lines was permanently blocked by a rake of derelict wagon underframes. Further, it was surrounded by a camp, and shunting, particularly at night, was rather a hazardous business as it was not unusual to find marquee pickets firmly embedded in the centre of the track.

The station buildings were well constructed in the local stone and those on the disused portion of the line would have made admirable platelayers' quarters. Unfortunately the Police had seen their opportunity some years before us and a post had been established in each one.

Stations on this line have something in common with those in the more rural districts at Home, in that they are anything up to a mile from the town or village whose name they bear.

THE MAINTENANCE PROBLEM.

The factors which affected the maintenance problem were :—

The number of men available.
Accommodation existing.
The requirements of security.
The possibility of *sabotage*.
Administrative arrangements.
The initial state of the track.
The probable effect of traffic on the track.

When the opening of the line was first projected, the strike was still continuing, and although the reconnaissances carried out by road had revealed no signs of *sabotage* of a serious nature, it was thought likely that the appearance of a train would be the signal for a concerted effort in this direction. For this reason, and because of the impossibility of protecting the line with certainty in the broken country, it was essential that the line should be closely patrolled.

A scheme was therefore prepared by O.C. Railway Troops, R.E., for the placing of small gangs of Sappers, with Infantry protective troops, at each of the stations along the line. These gangs were to divide and work outwards from the stations through their length and would then return, making adjustments and repairs to the track as required. To deal with any heavy or emergency work, it was proposed that gangs of about fifteen men should be stationed at Haifa and Nur esh Shems, where other useful work could be found for them when they were not required for permanent way work. This scheme closely followed the proposals put forward by the Palestine Railways when it was suggested that they should be responsible for the maintenance of the line.

The main difficulties which lay against this scheme were the accommodation and rationing of the large number of small parties scattered over a wide area. The optimum arrangements for the maintenance required dispersion, but the administrative and security factors required concentration.

The cessation of the strike, and the absence of any opposition to the two reconnaissance trains, caused the administrative factor to gain weight. Further, on the two trips made by the construction train, men had worked in small parties at many points along the line without interference, and Infantry protection during the hours of daylight was no longer necessary. At night, however, it was still necessary to take precautions, and had the platelayers been scattered in small parties they would have had either to sacrifice working-strength to provide their own protection at night, or Infantry picquets would have had to have been provided.

The idea of dispersing small parties over a wide area was therefore abandoned. Road traffic was normal again and it was possible to use

single M.T. vehicles to convey the gangs to the stations and other accessible points on the line, and the subsequent organisation of the Engineer's Department was built up on this basis.

The Engineer's Department.

On October 24th, the Detachment 8th (Railway) Coy., R.E., was divided into two parts, one part remaining in Haifa to form the Operating Department, and the other part going into the camp at Jenin to form the Northern Division of the Engineer's Department.

In the first instance, four gangs from Detachment 8th (Railway) Coy., R.E., took over the line from Afule, at kilometre 0·0 to the tunnel at kilometre 48·2 For this task they were supplemented by fourteen men from the 42nd (Field) Company, R.E., making a total of 34 men, these, together with a maintenance gang 14 strong, the Permanent Way Inspector (P.W.I.) and O. i/c., were accommodated in the camp at Jenin. The two lines from Massoudieh to Nablus and Tulkarm, together with the stretch between the tunnel and Massoudieh, comprised the Southern Division of the Engineer's Department. Three gangs found by the 42nd (Field) Coy., R.E., worked outward from the junction at Massoudieh, where they were accommodated in the disused buildings provided originally for the Arab platelayers, and two further gangs, also found by the company, worked from Nablus and Tulkarm.

The object aimed at was to give gangs of six or eight men a length of 12 or 16 kilometres for purely maintenance work, and the large gang at Jenin was to undertake any heavy work which might arise at any point on the system. Two of the gangs at Jenin worked outwards from that station, and the other two were taken to Sileh each day by M.T. and worked outwards from there.

The gangs were equipped with tools as shown on Appendix " B," and the tools for the gangs working outward from Sileh were stored in a locked van kept in the station. Four " Pump " and three hand trollies were obtained from the Palestine Railways and were allotted to the gangs for movements within their lengths.

A great deal of useful work was done in this way. Old drains were cleared and new ones dug at the worst points; slewing, lifting, packing and boxing were also done in many places, and the necessary signalling devices were sited and erected. The maintenance gang also did some useful work, a culvert was reconstructed, and an embankment which had been badly undercut by the flood-water was made up. More than this was impossible in the short time available.

As things were superficially politically stable and as the 42nd (Field) Company, R.E., were due to return to Moascar, four of the

gangs in the Southern Division of the Engineer's Department were withdrawn during the second week, and the maintenance of the sections from Massoudieh to Tulkarm and Nablus was again taken over by the Palestine Railways. This left the stretch from Afule to Massoudieh (60 kilometres) for which the Executive Engineer took responsibility. The distribution was then one officer (X.E.N.) and 45 other ranks at Jenin, and 14 other ranks at Massoudieh. Sixteen men of the 42nd (Field) Coy., R.E., remained with the Department to make up this number, and when all duties had been found there was one man per 1½ kilometres. This corresponds roughly with practice on the main lines at home, but it must be remembered that the track was taken over in a very poor condition and there was correspondingly more to be done.

The service opened on November 6th. The trains were, of course, running at greater speeds than on any of the preliminary runs, and the effect of the four years' lapse in the maintenance of the track began to be seen. For this reason, the normal system of maintenance had to be abandoned and the problem resolved itself into three questions; first, which were the really bad places; second, were platelayers or unskilled labour required to remedy them; and third, what was the best distribution of labour to these places. Once these questions had been answered the working strength was sorted out into whatever parties were required, but as there were only eight men with any knowledge of platelaying the task of detailing the parties was often difficult and the track suffered accordingly. Fortunately for the Engineer's Department, the timings were slack enough to allow speed restrictions to be put on at one or two places which could not be dealt with immediately by the gangs. The drivers themselves helped to a very great extent by getting to know the places which were likely to give trouble and driving over them with caution.

The most common troubles were subsidence of the formation causing slacks, and falls of chalk and soft rock in the cuttings and scarps. The Rains when they came increased these troubles and added three more, namely—sinkage of the inside rails on the curves which had been canted for higher speeds than those obtaining, washouts, and burying of the track by earth and rubbish washed on to it. During one heavy fall of rain the track was buried to a depth of two feet for a distance of about fifty metres at a point between Sileh and Massoudieh. This caused a delay to traffic of one hour, but on that particular day the main line suffered some twenty hours' delay, and the line to Syria had a delay of six hours from similar causes.

The worst of the trouble lay in the section between Sileh and Massoudieh, as falls of rock and chalk were likely to occur in the cuttings at any time, and, as most of these cuttings were on a curve, it was impossible for the driver to see any obstruction until he was

right on top of it. A motor-trolly was therefore obtained from the Palestine Railways, and this, stabled at Massoudieh, was used to patrol the section daily before the running of the first train. This trolly eventually broke down, and the patrol had to be carried out on a " pump " trolly, a very tedious business.

The system of patrolling differed from that in force on the main lines at Home and elsewhere, in that there was no daily patrol of the whole length carried out on foot. The only section which was patrolled daily by any method was the section from Sileh to Massoudieh, as mentioned above; other sections were patrolled on foot about twice a week and by trolly whenever considered necessary, as, for example, after a fall of rain. The method of finding the bad places was for either the X.E.N. or the P.W.I. to feel them by making a trip on the footplate as frequently as other work permitted—the proof of the pudding is, after all, in the eating. The chainage of a fresh bump or hollow was carefully noted and a trolly patrol was sent out to ascertain the cause.

The student of Railway Engineering practice will throw up his hands in horror at such practices, but they were as good as circumstances permitted and did not let the Engineer down. Had the Railway been in operation during the strike, it would have been rather a different matter, but as we were not troubled by attempts at *sabotage*, it was considered worth while to take a small risk in order to economize in man power.

Ballast trains were run frequently in the section Sileh-Massoudieh simply for the purpose of clearing the falls of rock and chalk and re-establishing the drainage in the cuttings. The trains consisted of the small engine from Tulkarm and four low-sided wagons manned by all available personnel. The timings of these trains were arranged so that the full rake was drawn into Massoudieh by the time that the morning train was due to leave Sileh. While this train was running in the section, the ballast train was being emptied on a very convenient embankment within station limits, this being made possible by a warning arrangement. By the time the morning train whistled up for its flag, the ballast train had been unloaded, the gang had been fed, and they were then ready to go back into the section for another spell, whilst the booked train made the journey to Nablus and back.

Altogether some 500 tons of material were removed from the cuttings in this way, and yet in spite of this they were, taken as a whole, still in a very bad state when the railway closed down. All this work was nothing better than navvying, and it was a sickening sight to see about thirty skilled tradesmen wielding nothing more than a shovel for hours on end, but all ranks appreciated the necessity of the task and " made the muck fly."

OTHER WORK.

Although nominally belonging to the Engineer's Department, the Sub-Detachment at Jenin and Massoudieh, being on the spot, were called upon to deal with any emergency which might arise. Breakdowns, engine failures, shortage of coal and water, all these things and many others formed no mean part of the work of the Department.

November 25th was undoubtedly the "black" day. The cowcatcher of the engine drawing the morning train picked up a check rail from a level crossing close to Arabeh station, and by propelling it forward broke the stretcher rod of the facing points, pulling the switch blades in together. The engine and tender all but one pair of wheels were derailed. The Engineer's department was on the scene in very good time, and working in shifts, set about the arduous task. This was almost as bad as it could have been, as the tender could not be uncoupled from the engine and both had to be lifted together.

THE LOCOMOTIVE DEPARTMENT.

The locomotive obtained from the Chemin de Fer Hijaz was No. 106, a 2-8-0 tender engine built by Hartman in 1910. It was not superheated and the boiler carried a pressure of 12 atmospheres, giving a tractive effort of 5,650 kilogrammes, which allowed a maximum load behind the tender of 150 tons over the most severe sections of the line. The tender carried 4,000 gallons of water and five tons of coal, and the total weight of the engine and tender was 85 tons with a maximum axle load of 10 tons. For night-work, the engine was fitted with a motor-car headlamp, the current being supplied by train lighting batteries which were charged three times a week.

The engine at Tulkarm was No. 16, a six-coupled tank built by Krauss in 1899. It weighed 24 tons and had a tractive effort of 4·470 kilogrammes at a boiler pressure of 12 atmospheres. It was really a shunting engine and used to pull a tender with extra coal and water when going up to Massoudieh; this reduced its load to 75 tons. It is interesting to note that this engine was one of the first engines to be captured from the Turks during the advance from Gaza in the autumn of 1917.

Both these engines were vacuum-braked and in good condition. By arrangement with the Palestine Railways, we were allowed to use their running shed at Haifa, fitting work, engine preparation and disposal being done by Detachment 8th (Railway) Coy., R.E., boiler work being done by the Palestine Railways. One day each week No. 106 was washed out and to take its turn another engine of a similar class was loaned by the Palestine Railways. The presence of this similar class of engines at Haifa enabled spares to be obtained if required.

Locomotive duties were divided among five crews on a weekly basis, one crew took the morning train to Nablus, one crew took the evening train back to Haifa and were on Company employment next day forming a reserve crew, one crew on night duty and one crew at Tulkarm. All fitting work, except on shed day, was done at night, and as coaling was done by basket, it was usually midnight before the engine came on shed. The hour allowed at Nablus was barely sufficient to complete the necessary shunting, to turn the engine and clean the smokebox. The coal used was Welsh, and owing to the heavy blast on the grades, a short brick arch, and fine coal, it was not unusual to find the smokebox filled to the blast nozzle with ash on arrival at Nablus.

The Traffic Department.

The rolling stock of the narrow gauge consisted mainly of high- and low-sided wagons and box vans, all running on bogies with oil axle boxes. The vehicle mainly used was the box van which had a tare of 10 tons and a maximum load of 15 tons; it could take up to 25 men for troop moves.

The maximum number of vehicles permitted on a train was thirty and the heaviest train actually hauled consisted of nineteen loaded wagons, seven empties and a brake, making a gross load of about 350 tons. Fifty per cent. of the stock was fitted with handbrakes and trains had to have a brake power of 40 per cent., *i.e.*, two braked vehicles in every five. For this reason extra brakesmen travelled with the train as required.

The opening of the line was well advertised in the Press and after a few days, a certain amount of civil traffic began to arrive, mostly through Tulkarm. During the period 14th November to 13th December 1,023 tons of goods were moved, and the average train-load from Haifa was one coach and six box vans, about 90 tons. The line was closed to ordinary traffic on 17th December, and on 22nd December the section Afule-Massoudieh was finally closed and the section Tulkarm-Nablus handed over to the Palestine Railways for operation. On the 21st-22nd December and the 23rd January, three parties left for the U.K., and the main body returned to Lydda, where they are now being employed in charge of trains and as extra men on the main line.

In addition to the normal daily service, nine troop trains and several construction trains were run, extra engines being supplied when necessary by the Palestine Railways. Photo No. 4 shows a troop train with the 2nd Battalion Scots Guards *en route* from Nablus to Haifa. During the period 19th-20th December, the line played its part in the main evacuation of the Palestine Force. In all, five troop trains and five empty stock trains were run, covering a

distance of 714 train-kilometres, and while on the military railway these trains ran on time, without a hitch. The running of these extra trains over sections worked by single staff led to the opening of certain sections on a temporary basis for "telephone and ticket" working, and on one occasion for "wireless and ticket." On this occasion two troop trains had to be worked from Nablus to Massoudieh in succession, one train going to Haifa and the other to Tulkarm. Short-range wireless sets were installed at Nablus and Massoudieh, and by the kindness of the Signal Officer a set was installed at Haifa and a spare set was put on the train for Haifa in case of emergency. Telephony was unreliable and all messages were transmitted by Morse telegraphy. In spite of the fact that the official range of these sets is only twelve miles, reception was good between Nablus and Massoudieh, and block working messages were picked up at Haifa.

In certain cases the long section from Afule to Massoudieh was broken into two or even three portions. After withdrawal of the long section staff one section was worked by short staff and the other by "telephone and ticket," using the Post Office telephones, special arrangements having been made to get "urgent" calls. In order to obtain flexibility of working for the petrol trolly patrols and the ballast trains, a field line was installed between Sileh and Massoudieh, and the section Afule-Massoudieh broken into two, viz., Afule-Sileh, worked by staff, and Sileh-Massoudieh, worked by "telephone and ticket." As it was not considered safe to station a blockman at Sileh by himself, the guard of the train arriving at Sileh acted as blockman and obtained permission to issue a ticket to the driver, or gave "Train out of Section." This telephone was no exception to the general rule and on more than one occasion the section had to be worked by "Pilotman and Austin 7."

CONCLUSION.

The experience of these six weeks of Railway Operation and Maintenance was of great value, not only on account of the useful work done, but also on account of the training which the Railway tradesmen received and the many opportunities for getting any and every sort of job done under adverse conditions.

The long run over difficult grades, usually with full loads, gave particularly good training to drivers and firemen, and to guards and brakesmen. There could be no slackness on the part of engine crews, who had only one hour in which to shunt and to clean fire and smoke-box between two journeys, each of six hours duration. This daily run of 224 kilometres for six days a week with one engine, required good and conscientious work also from the repair staff who, in addition, had the difficulty of working in with, and borrowing

tools and spares from a shed staff who did not speak the same language.

Some of the crews were able to test their ability to deal with an emergency and to work a train home with a partially disabled engine.

Probably the most difficult thing to contend with was the lack of reliable telephonic communication. Either something went wrong and nobody knew about it for a long time, or else one could see things about to go wrong and was powerless to do anything about it. Everything had to be left to the man on the spot. The impossibility of operating a railway with anything like efficiency without a sound telephone system was continually demonstrated.

The engineer's department suffered, as has been mentioned, from the lack of platelayers, but those who had any knowledge of the work did very well. The remainder had to be employed on entirely unskilled work although this was very necessary to the safety of the line.

As a general rule, the local inhabitants were friendlily disposed towards the railway, and, apart from a little stone throwing, the detachment met with little or no opposition. The villagers soon got accustomed to the idea of a daily train and were not slow to see its uses. Traffic increased slowly but surely throughout the whole time and quite a number of passengers were carried.

The grand finale to the whole venture, namely the running of a series of troop trains, went without a hitch, and the line closed on a high note. It seemed a pity to withdraw the service at a time when traffic had reached paying proportions and was increasing daily, but its military uses had come to an end and the Palestine Railways were not prepared to continue it.

After four years of peaceful sleep, the old Turkish line awoke to two months of considerable activity, only to fall asleep again, this time, perhaps, for ever. Who knows?

APPENDIX "A"

Working Time Table.—HAIFA-NABLUS.

Station.	Distance Kms.	Time Mins.	Conditional Mixed. No. 101		Daily Mixed No. 103	
Haifa...	—	—	--	0400	—	0830
Acre Junction	2	9	0409	—	—	0839
Kafr Yehosua	20	29	0438	0442	0908	0912
Afule	15	30	0512	0522	0942	0952
Jenin	17	40	0602	0612	1032	1042
Arabeh	12	32	0644	0647	1114	1117
Sileh	12	35	0722	0732	1152	1202
Massoudieh	20	58	0830	0857	1300	1327
Sebastieh	5	20	0917	0919	1347	1349
Nablus	13	41	1000	—	1430	—

NABLUS-HAIFA.

Station	Distance. Kms.	Time Mins.	Condl. Mixed. No. 102		Condl. Mixed. No. 104		Daily Mixed. No. 106	
Nablus	—	—	—	1006	—	1230	—	1530
Sebastieh	13	28	1034	1036	1258	1259	1558	1600
Massoudieh ...	5	16	1052	1102	1315	1325	1616	1626
Sileh	20	70	1212	1227	1435	1445	1736	1746
Arabeh	12	32	1259	1304	1517	1522	1818	1823
Jenin	12	28	1332	1342	1550	1600	1851	1901
Afule	17	30	1412	1422	1630	1800	1931	1941
Kafr Yehosua ...	15	30	1452	1455	1830	1835	2011	2015
Acre Junction ...	20	30	—	1525	—	1905	—	2045
Haifa	2	5	1530	—	1910	—	2050	—

Subject to alteration when No. 102 runs.

MASSOUDIEH-TULKARM.

Station.	Distance. Kms.	Time. Mins.	Condl. Mixed. No. 212		Condl. Mixed. No. 214		Condl. Mixed. No. 216	
Massoudieh ...	—	—	—	0655	—	1300	—	1400
Anabta	10	20	0715	0718	1320	1325	1420	1425
Nur Esh Shems ...	6	14	0732	0738	1339	1344	1439	1444
Tulkarm	4	12	0750	—	1356	—	1456	—

Continued.

	Condl. Mixed. No. 218	
Massoudieh ...	—	1700
Anabta	1720	1725
Nur Esh Shems ...	1739	1744
Tulkarm	1756	—

TULKARM-MASSOUDIEH.

Station.	Distance. Kms.	Time. Mins.	Condl. Mixed. No. 211		Condl. Mixed. No. 213		Condl. Mixed. No. 215	
Tulkarm	4	—	—	0715	—	1135	—	1505
Nur Esh Shems ...	4	15	0730	0735	1150	1155	1520	1525
Anabta	6	15	0750	0755	1210	1215	1540	1545
Massoudieh ...	10	30	0825	—	1245	—	1615	—

APPENDIX "B"

Scale of Tools held by Gangs.

Tools.	Per Length Gang. (9)	Per Maint. Gang. (1)	Total.
Beater Picks	4	14	50
Baskets	10	20	110
Shovels	4	14	50
Crowbars	4	8	44
Hammers, sledge	1	2	11
Hammers, hand	1	2	11
Spanners, adjustable	1	1	10
Spanners, fish	1	3	12
Chisels, cold	1	2	11
Track gauge	1	1	11*
Track jack	—	3	3
Detonators	6	6	60
Flags, sets	1	2	11
Jim crow	—	1	1
Ratchet, brace	—	1	1
Drills	—	3	3
Oilcans	—	1	1
Centre punches	—	1	1
100-ft. tapes	—	1	2*
Rules, 2-ft.	—	1	2*
Hacksaw	—	1	1
Blades	—	12	12
Spirit Level	1	1	11*
Straight-edge	1	1	11*

* Denotes extra for P.W.I.

NOTE.—The small number of track jacks, rules and tapes was due to the impossibility of obtaining a further supply.

QUETTA RECONSTRUCTION.

By COLONEL C. J. S. KING, O.B.E.

INTRODUCTION.

THE earthquake at Quetta occurred on 31st May, 1935. The immediate problems confronting the Corps were described in an article in *the R.E. Journal* for December, 1936. The present article proposes to give a general outline of the progress of the work of permanent reconstruction. A very large mass of technical information is accumulating and it is hoped that it will be made available in due course; the work involved in analysing results is considerable and can only be undertaken when time is available. In the meantime, a preliminary review of the position may be of interest.

PRELIMINARY MEASURES.

Shortly after the earthquake, a Committee was assembled by the Government of India to consider the policy to be adopted with regard to the re-building of Quetta. The main decisions may be very briefly summarized as follows:—

i. All Government buildings in the earthquake area would be rebuilt.

ii. The garrison in Quetta and the outlying stations of Chaman and Shelebagh would remain the same size.

iii. All buildings would be built in earthquake-proof design, strong enough to resist the maximum earthquake of ten on the Rossi-Forel scale in accordance with the report of the Government geologist.

Various other decisions were also made which affected the work; roads, railways and water mains were not damaged in the earthquake, and the new layout had to be based on these as they existed before the earthquake. The possibilities of town planning in Quetta were therefore limited.

For the benefit of those who are unfamiliar with Indian conditions, it is necessary to give a short explanation of what is included in the expression "Government buildings." Quetta consists of three areas:—

i. The cantonments, which are under the Defence Department of the Government of India.

ii. The North-Western Railway area. This railway is a State

railway which is run as a commercial department under the Railway Board.

iii. The Municipality or Indian city area; this is similar to the municipalities in England. In this area, however, there are the civil lines which are occupied by the officers and staff of the Civil Administration; in Baluchistan, their building is carried out by the Military Engineer Services, but in certain other respects, such as water and conservancy taxes, they come under the Municipality.

It was decided that the reconstruction of the civil lines as well as the cantonments should be undertaken by the M.E.S., while the railway reconstruction would be carried out by the railway authorities. In order to secure a general co-ordination of the work of the Government departments, two committees were formed :—

i. The Central Quetta Reconstruction Committee, containing representatives of all departments concerned, sitting at the headquarters of the Government of India.

ii. The Local Quetta Reconstruction Committee, containing local representatives of the various departments, sitting at Quetta.

A general policy of design was approved by a sub-committee of the Central Committee.

Work at Army Headquarters.

As soon as the decision of the Government of India was promulgated, a designs section was formed in the Engineer-in-Chief's branch at A.H.Q. and the enormous work of preparing the new designs, the preparation of the project estimate and the preparation of the contracts was undertaken. This work got started rapidly and a very large amount of the preliminary work was well in hand before the engineering staff was collected at Quetta.

It was decided that Government designs should be prepared and that contractors should also be asked to submit their own designs if they wished to do so. It was originally hoped that the Government architect would be available for any work that was required, but the rush of work involved in the preparation of designs for new provincial capitals necessitated by the coming reforms made this impossible. An architect was therefore obtained from England, but this gave rise to considerable delay at a time when every moment was important.

The many problems confronting the designs branch can only be adequately dealt with in a separate article, but they can be briefly summarized here as they have had many repercussions on the subsequent work.

Two major problems required solution :—

i. Strength. The building must be strong enough to resist the horizontal stress produced by an acceleration of four feet per second per second.

ii. Heat Insulation. The climate in Quetta is very severe, with extreme ranges of temperature.

Concrete was the obvious solution for the first problem, but introduced many difficulties in the second. A four-inch concrete wall is sufficiently strong, but its insulating properties are negligible.

The original designs consisted of a hollow concrete wall, eight inches thick with a four-inch air space in the centre. Firms produced other designs utilizing some form of insulating material with a four-inch concrete wall or designs in brick. Various objections to the use of brick existed and for the first contracts brick designs were not accepted. Subsequent investigation showed these objections were unfounded and brick is now being used.

When tenders were opened, it was found that the costs in many cases were prohibitive. The designs produced by two firms were acceptable but, for a large amount of the work, the authorities were faced with the necessity for producing more economical designs at a time when contractors should have been starting work. To this difficult problem, two solutions were possible :—

i. Postponement of the major portion of the building programme for a year to give time to produce fresh designs and call for new tenders.

ii. The adoption of a special system of tendering to meet the peculiar circumstances.

It was decided to adopt the second alternative. The system was somewhat erroneously called the "Becontree" system, after a method of mutual cost accounting and a sharing of profits which was adopted in a big housing scheme in England. The system is, however, different and a short description of its principles may be given here.

Tenders are called for a number of buildings of varying sizes and shapes. There is not time to produce details of all the buildings, so a limited number of buildings are chosen ; these are called "key" buildings, and for them full detailed drawings and specifications must be available, though it is not necessary that these shall be exactly the same as it is intended to build.

The contractor submits firm lump sums for the key buildings and also a schedule of rates. In submitting his tender, he considers which of the remaining buildings are sufficiently similar to a particular key building to be built at similar rates ; he therefore "ties" such buildings to that key building and offers to build all those buildings at similar rates.

Key buildings are then priced on his schedule and the figure thus produced is compared with the lump sum he has quoted. Suppose the quoted figure is Rs. 10,000/- and the result of pricing on the schedule is Rs. 11,000/- The pricing of all buildings tied to that " key " is then made on the schedule and reduced in the proportion of 10 to 11 to find the actual cost.

At first sight it may appear that there is no advantage in the system over the ordinary method of measurement work, priced at a percentage on or off a schedule. It must be remembered, however, that no Government schedule was in existence on which contractors could be asked to tender. A detailed comparison of two different schedules to obtain the lowest tender is not possible. Furthermore in concrete work, repetition work has an overwhelming effect on values owing to shuttering costs. The effect of repetition would appear in the L.S. figure for the key building and this would be automatically reflected in the adjustment figure. He would be a very poor contractor indeed who agreed to build one special building in reinforced concrete at the same rate as he would build a hundred of them.

The contractor was at liberty to select as many key buildings as he wished ; on this point difficulties have arisen and much avoidable work has been caused by a failure on the part of the contractors to appreciate the system.

The principle is simple; its application is more difficult, but, whatever criticisms may be made, it has enabled work to proceed and has actually saved Government a large amount of money. A delay of a year would have resulted in higher tendering owing to the general rise in world prices.

A full description of the method and its advantages and disadvantages in practice will probably be of interest, but it is at present too early, since the contracts are still running.

Work at Quetta.

A tentative layout of the new Quetta cantonment was submitted to A.H.Q. in August, 1935. Owing to the restrictions imposed by the use of existing roads and railways, no major town-planning scheme was possible. This layout was made the basis of all future changes which were found necessary as time went on owing to changes of policy.

The normal M.E.S. staff were fully occupied in dealing with the many problems arising in the way of temporary accommodation and they were not able to spare time for the problems of reconstruction. The reconstruction staff started to arrive in September.

The most urgent problem was clearance and the provision of sites for rebuilding. A.H.Q. were anxious to go out to tender for about a

million pounds' worth of work on three-year contracts and wanted to know what sites could be made available by the following first of April.

One of the chief difficulties that existed in the earlier stages was the conflicting claims of rebuilding sites and temporary accommodation. The problem was a large jigsaw puzzle which was not complete and in which few of the pieces fitted. Although one brigade had left Quetta, a considerable garrison remained. These were and still are accommodated in walled tents and lowered buildings. Economy in temporary accommodation was of obvious importance and the bulk of the work was completed before the rebuilding programme was ready for consideration. A.H.Q. decided the general order of priority of building and these had to be fitted into the layout in a reasonable manner. The existing cantonment contained many wide empty spaces and advantage was taken of the opportunity to fill these up. As a result of this, certain existing lines are never required for building sites. They therefore provide a permanent " spare-room " which has been of the greatest value in giving temporary accommodation.

A reasonably satisfactory solution was reached to this immediate problem and it remained to organize the clearance so that the sites would be ready by the following 1st April. Other urgent problems were the submission of the details of external services for inclusion in the project estimates and the necessary preparation for permanent building work, which was expected to start in the following April.

DEMOLITION AND SALVAGE.

An estimate of the total amount of debris to be moved came to 1¼ million tons, of which some 200,000 had to be cleared by the 1st April, 1936. It was clearly a job for machinery and every labour-saving device that could be found. An immediate order was placed for two dragline excavators which were available for disposal at Sukkur on the Indus and for some six miles of narrow-gauge railway with engines and trucks. One of the ever-present difficulties in Quetta is the length of time it takes for stores to arrive, and the delays in the arrival of this plant brought this difficulty very clearly to notice.

It was known that some old Government three-ton lorries were up for disposal; fifty were ordered at once and arrived quickly. They had been up for disposal for years and several attempts had been made, without success, to utilize them in various parts of the frontier. They have been, and still are, invaluable at Quetta and without them the initial clearance programme could never have been completed.

Work was started with manual labour and service M.T. The use of the latter was soon discontinued owing to excessive wear and tear on

the lorries. As the plant arrived and the work got really under weigh, the output increased until a maximum of over 3,000 tons a day was moved.

A machine called an elevating grader was obtained from America. This consists of a scraper delivering the debris on to a moving belt, which can discharge it at a height of about eight feet ; it is a most economical method under certain conditions of loading lorries.

Each particular form of plant has its own special uses and must be employed accordingly. Machinery is economical under certain well-defined conditions, but indiscriminate employment in all cases is extravagant. The original figure of about Rs. 1/8 per ton moved, is now down to about eight annas. Naturally, the lead affects the cost ; at first dumping was done on the edge of cantonments, but a general scheme was prepared to permit local dumping in the many inequalities of the ground. This will improve the amenities in due course and is much more economical.

The problem of salvage needed early attention. Immediately after the earthquake, materials were taken for temporary accommodation as required. It was obvious that some accounting would be needed and this was gradually brought into being. All salvaged material except bricks is brought into a central dump and accounted for in the ordinary way. At present, the bulk of it is required for temporary accommodation, but bricks and, in due course, steelwork will be used again in permanent work.

Estimate for External Services.

Estimates were prepared for the following :—water-supply, drains, water-borne sewage, electrical work, parade grounds, recreation grounds, arboriculture and temporary works for building ; these were based on somewhat limited information, but subsequent detailed investigation has not, up to the present, brought to light any grave errors.

A list of " odds and ends " of buildings was also compiled so that the project estimate as submitted for the approval of the Secretary of State should be as comprehensive as possible. It is curious what a lot of " odds and ends " there are in a town. The list comprised several pages of type, and the items ranged from a detention barracks and a cantonment butchery to *dhobi ghats* and *tonga* stands. Up to the present, no serious omission has been discovered, though the final policy regarding many of these items is not yet settled.

Preliminary Arrangements for Building.

These may be classified under the following heads :—

i. Labour accommodation.

This was and still is a big problem. The normal accommodation

which would have been available in the city was completely destroyed by the earthquake. The civil administration had its hands full in catering for the permanent population and naturally did not wish to be further embarrassed by a large influx of labour. It was decided that a labour camp should be made in cantonments in which all contractors' labour should be accommodated.

Accommodation for 18,000 men was prepared. Sanitary arrangements and waterpoints were provided on the site and the contractors had to provide the actual housing. The camp was divided into 18 areas, each 200 yards square, sufficient for 1,000 men; areas are allotted on demand to contractors.

Up to the present, the labour camp has not fulfilled expectations. The labourers prefer to live in the limited and congested huts in the city, in spite of the fact that it is expensive and a considerable distance from the work. Frequent investigations have been made into the reason for the unpopularity of the camp and have produced some amusing results. One reason given was that merry-making was not allowed in the camp, another that goats were not allowed in the huts. As far as possible, unnecessary restrictions are gradually being removed and the signs are not wanting that this dislike of the camp is gradually vanishing. The chief reason is probably pure conservatism added to the natural reluctance of the contractor to build huts, and it is possible that as time goes on most of the labour will move to the camp.

ii. Sanitary arrangements on working sites.

As the working sites are in the middle of the cantonments surrounded by troops, the problem of efficient sanitation received a great deal of thought. The local labour has very limited ideas of sanitation and a rigid control was obviously essential in the interests of the health of the troops. Up to the present, the result appears to be satisfactory, but it needs constant supervision and it is always a source of anxiety.

iii. Medical arrangements.

The conditions existing after the earthquake were such, that the chances of a serious epidemic were an obvious possibility. Inhabitants of Quetta, like many places on the frontier, are apt to suffer from frontier sores, an unpleasant form of open sore which takes many months to heal. The cause of this is the sandfly and its control is difficult. Regular medical inspection of all labourers is enforced and compulsory vaccination and inoculation are carried out. One unfortunate man complained that he had been inoculated and vaccinated four times in one week, a tribute to the unceasing care and vigilance of the medical staff.

iv. Transport.

It was mentioned that about one and a quarter million tons of debris had to be removed and it was therefore a fair inference that about the same weight would have to be brought in. Quetta, as a reference to the map will show, covers a large area, the farthest end of the cantonment being nearly five miles from the railway station. A long road haulage would obviously raise prices and would cause great congestion in the roads leading from the railway station. It was found possible to bring in the line into the heart of cantonments and to provide sidings specially for the contractors; these were ready for use by the 1st April, 1936. Contractors were told that they would be available and undoubtedly they have helped to keep down prices. They have certainly saved endless trouble and confusion on the roads running through cantonments.

Layouts.

The preparation of the detailed layouts caused a great amount of work. Owing to the absence of designs, it was not possible to prepare accurate layouts in the first instance. Provisional site plans were prepared based on probabilities and these were modified as designs became available. In many cases, as many as a dozen were made before any sort of finality was reached. Buildings like the British and Indian Hospitals were the most difficult cases, as much time elapsed before the designs were complete.

In order to avoid the presence of large empty spaces in the middle of cantonments, a central area was selected in which it is proposed to concentrate the important buildings; in every change of policy—and there were many—all layouts were closed up on the centre. The restrictions imposed by the necessity of retaining the roads added to the difficulties, but it is hoped that the final result will be reasonably compact.

The help of units was freely enlisted. It is so very much easier to criticize a layout than to produce a better one; units were therefore asked to produce the "ideal" layout in the area allotted them and the reconstruction staff then criticized it, a fair division of labour which saved an enormous amount of trouble.

Acceptance of Contracts.

After various delays, five contracts were accepted about May, 1936. These included the following works:—

i. Two Gurkha Battalion lines and one Indian Battalion lines (30 *lakhs*).

ii. One British Infantry lines (27 *lakhs*).

iii. The Hospital group, comprising the British and Indian Hospitals of 300 and 500 beds respectively, the quarters for the

medical personnel and the lines of the Indian Hospital Corps, with a strength of about one battalion (45 *lakhs*).

iv. Fifty bungalows and three messes (24 *lakhs*).

v. Thirty bungalows in the Staff College area (12 *lakhs*).

The first two contracts were lump sum contracts, the remaining three were the special type of contract described on page 396.

Later on two more contracts were accepted.

vi. Posts and Telegraphs (7 *lakhs*).

vii. A detachment lines at Shelabagh in 1937 (2½ *lakhs*).

The total amount of work in the main contracts is therefore about 1½ *crores*, rather more than a million pounds. External services and local contracts are not included in this figure. (Note.—One *lakh* is about £7,000 : 100 *lakhs* = 1 *crore*.)

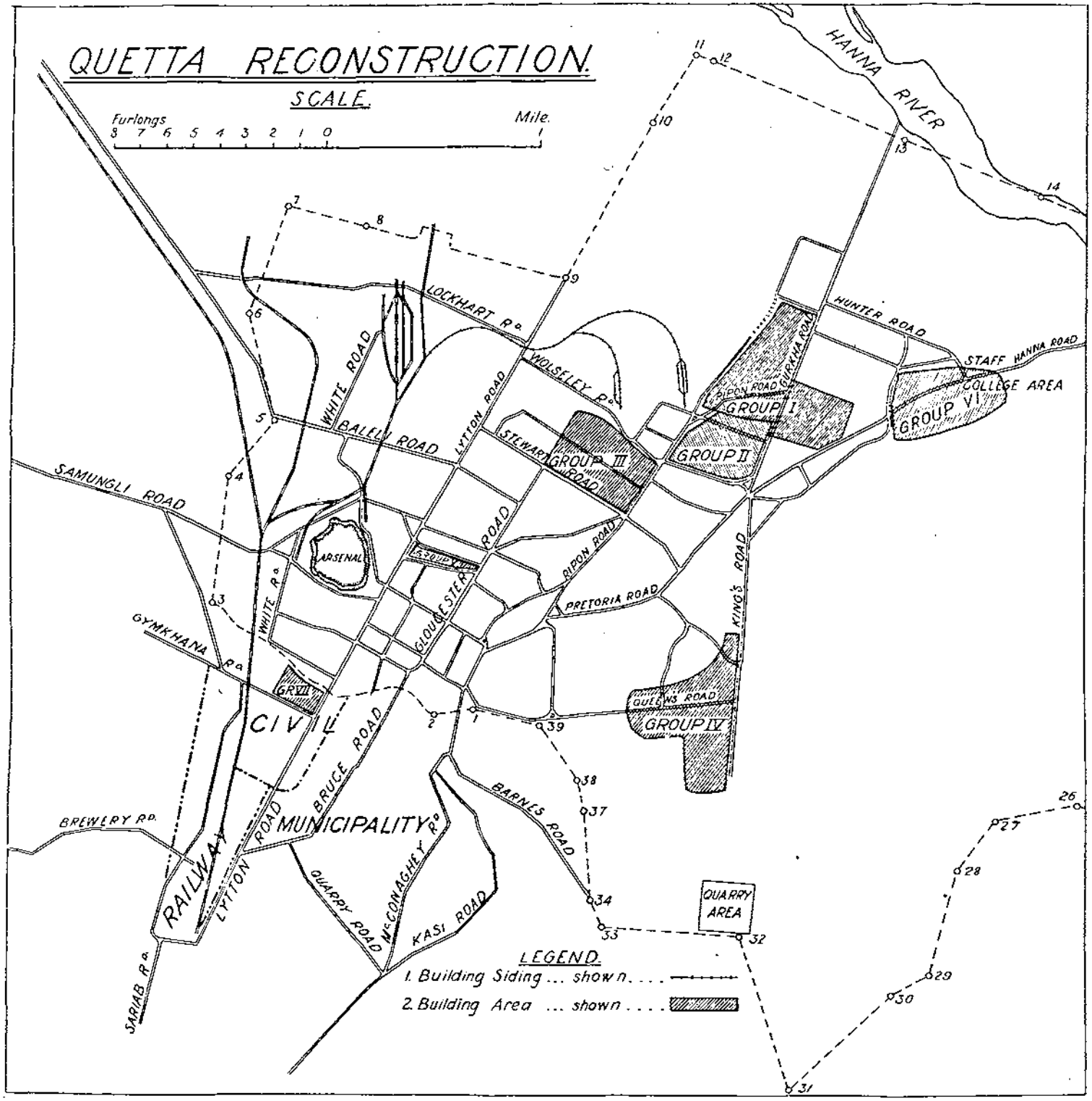
The amount of work that was done in the year 1936, was limited. Contractors took a long time to get started ; there were many difficulties, but it must be admitted that contractors did not make the most of their opportunities to find out what the difficulties were before they tendered. One firm, who fortunately did not get a contract, had the audacity to tender for a million pounds' worth of work without sending any responsible person to Quetta to investigate conditions ; it was indeed lucky for the firm that they did not receive a contract.

The first and obvious difficulty is the climate. For at least four months in the year, hard frost must be expected and concreting is not economically possible. For two months even outdoor work of any kind is very limited ; when the " Khojak " wind blows, labour closes down and small blame to them.

The transport difficulty has already been mentioned. The normal time taken to obtain stores from India is about three months and that is an optimistic estimate. Stores from England may take anything from three to six months ; one firm who hoped to have their plant erected and working by October did not in fact get it ready till January. When orders to start work were only issued in May, a delay of six months meant that the building season was over before the contractor was ready to start work.

To anyone who knows the frontier of India in general and Baluchistan in particular, it will seem strange that the supply of stone and sand for aggregate should produce any difficulty. Round Quetta, however, the local sand and shingle is covered with a thin film of clay which is almost impossible to wash off. Firms installed crushers and used almost exclusively quarried material with a small proportion of local sand. The hills consist of limestone providing an aggregate which is too good to condemn, but which has many faults. A quarry of first-class stone was found some forty miles from Quetta, but the expense of bringing it in rendered its use impracticable.

The supply of skilled labour in Baluchistan is limited to immi-


QUETTA RECONSTRUCTION.
SCALE.
Furlongs 8 7 6 5 4 3 2 1 0 Mile. 1
HANNA RIVER
LOCKHART Rd.
WOLSELEY Rd.
WHITE ROAD
BALLEY ROAD
LYTTON ROAD
STEWART ROAD
HUNTER ROAD
STAFF HANNA ROAD
COLLEGE AREA
GROUP I
GROUP II
GROUP III
GROUP IV
GROUP V
GROUP VI
RIPON ROAD
GURKHA ROAD
SAMUNGLI ROAD
ARSENAL
GLOUCESTER ROAD
PRETORIA ROAD
KING'S ROAD
QUEEN'S ROAD
WHITE Rd.
GYMKHANA Rd.
CIVIL
BRUCE ROAD
BREWERY RD.
MUNICIPALITY Rd.
RAILWAY
LYTTON ROAD
QUARRY ROAD
McCONAGHEY Rd.
KASI ROAD
BARNES ROAD
SARIAB Rd.
QUARRY AREA
LEGEND.
1. Building Siding ... shown ....
2. Building Area ... shown ....

grants from other parts of India. The local coolie is available in large quantities, but he is completely unskilled and even as a coolie leaves much to be desired. Contractors were, therefore, faced with the necessity of importing all skilled labour and dismissing them in the cold weather when outside work was not possible.

Organization of the Reconstruction Staff.

This consists of three branches :—

i. The " Q " Staff.

In the light of subsequent events, it is curious to think that no provision was originally made for any " Q " staff. In the early stages of the work, a very large part of the work was " Q " work and this was done by the Engineering staff. A second-grade staff officer was appointed as D.A.Q.M.G. and this was shortly afterwards increased by the addition of an A.Q.M.G.

ii. The Financial Staff.

A Financial Adviser was provided from the very beginning. Under him are the M.E.S. accounts sections, the Local Audit Officer and a special section of Test Audit. The advantages of this arrangement have been overwhelming. The whole financial and audit staff are housed in the same building as the engineering staff, the closest liaison is maintained and the two branches work together in the closest harmony. In consequence of this, audit troubles, that bugbear of the M.E.S. officer, are reduced to negligible proportions ; there is very little correspondence as everything is settled in discussion with merely a record of the decision. Test Audit is also concurrent and they take part in discussions and give their opinions before rather than after the event. It is, in fact, an ideal situation ; everything having a financial effect goes to the Financial Adviser before orders are issued, and Audit takes its rightful place as the guide, philosopher and friend of the M.E.S. in its progress along the straight and narrow way of financial rectitude.

In the early days some of the Audit staff could not quite realize the conditions. In one lengthy discussion between the C.R.E. and Test Audit on some abstruse financial point, Test Audit raised an objection. It was admitted that the objection was entirely correct according to the letter of the law, and the Auditor was told that anything he said would be done. This conception of his duties so flummoxed the Auditor that, after much thought, he burst out with the remark : " Sir, I deal with paper, not with facts."

iii. The Engineering Staff.

The original staff provided consisted of the usual District staff of a C.R.E., A.C.R.E. Works, A.C.R.E. E/M and three G.E's with two A.G.E's under each of them. In the financial year 1936–1937, this was found to be just possible, though some 35 *lakhs* (a quarter of a

million pounds) was spent. It was obvious that with increased rate of work, involving the expenditure of nearly a *crore*, an increase of staff was inevitable. The present organization is given in the attached chart and follows normal practice with a few exceptions.

The essential basis of the organization is the A.G.E. or the "Engineer i/c Work" of the contract documents. He is provided with a tin hut on the site of his work and his job is to supervise the work and nothing else. He has no routine and apart from his many drawings and specifications, has very little paper to deal with. He is entirely responsible for everything that goes on in his group (*i.e.* a contract) and he is the only officer who signs a work order to his own contractor. He has, therefore, a position of very great responsibility and a very interesting job. It falls to the lot of few junior sapper officers to be in charge of works of this magnitude and it is a golden opportunity of which as many as possible should take advantage.

The A.G.E. is provided with a subordinate staff of S.D.O's (foremen of works) and overseers. This subordinate staff has no powers of approval or condemnation of work. Their duty is to assist the A.G.E. in his work and bring to his notice cases which do not appear to be up to specification or in accordance with the drawings.

The A.G.E. has no accounts to keep. Payments on account are made on the monthly progress report by the C.R.E. who keeps the accounts.

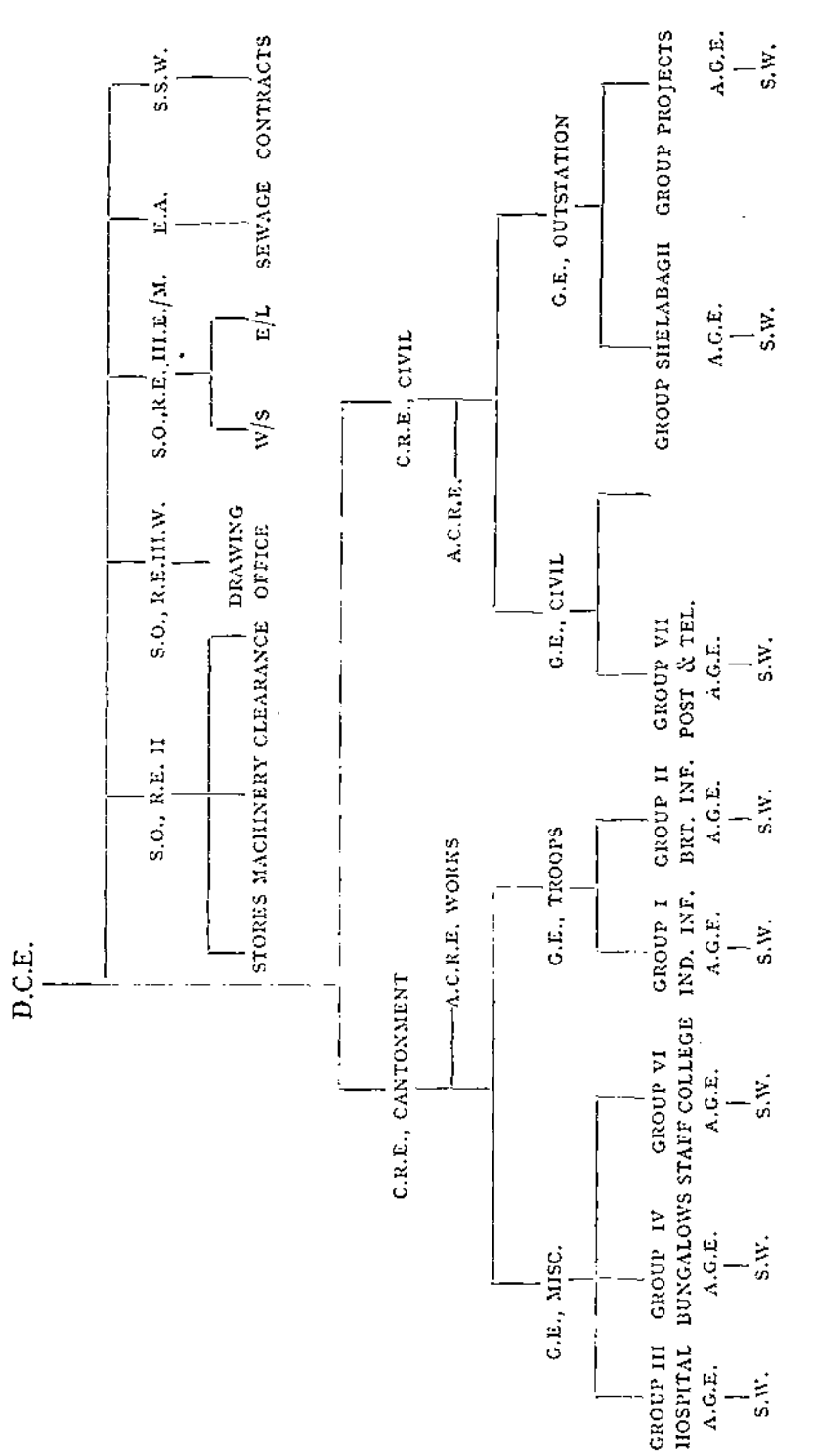
The A.G.E's are thus relieved of all possible routine and administrative work and free to devote all their attention to supervision of work—a task which keeps them fully occupied.

The Stores Inspectorate is responsible for the inspection of all stores, except materials such as sand and stone provided locally. All contractors' stores coming in by train pass into his dump at the special siding. They are inspected there and none is allowed to be issued without a pass slip from the Inspectorate.

The rigid inspection of stores has been rather a surprise to the contractors. Its necessity has been amply proved by the very large number of cases in which inferior materials not up to specification have been discovered. Full use is made of the Government Test House at Alipore and doubtful cases are always referred to them.

The Laboratory for testing concrete was established at Quetta under the direct charge of the S.O.II; it is thus independent of the C.R.E's, whose responsibility is limited to informing the Laboratory staff where concreting is taking place. The staff visit the works and take regular test cubes of concrete, samples of aggregate, etc.; the results of tests are circulated to the staff, immediate information of a doubtful seven-day test being sent to the A.G.E. concerned.

The result of the 28-day test is the deciding factor, though in the one case where large condemnation was necessary, cubes were cut


D.C.E.
S.O., R.E. II
S.O., R.E. III.W.
S.O., R.E. III.E./M.
E.A.
S.S.W.
STORES
MACHINERY
CLEARANCE
DRAWING OFFICE
W/S
E/L
SEWAGE
CONTRACTS
C.R.E., CANTONMENT
C.R.E., CIVIL
A.C.R.E. WORKS
A.C.R.E.
G.E., MISC.
G.E., TROOPS
G.E., CIVIL
G.E., OUTSTATION
GROUP III HOSPITAL
GROUP IV BUNGALOWS
GROUP VI STAFF COLLEGE
GROUP I IND. INF.
GROUP II BRT. INF.
GROUP VII POST & TEL.
GROUP SHELABAGH
GROUP PROJECTS
A.G.E.
S.W.

out of the work itself and tested before the final order was issued.

After many initial vicissitudes, it can now be claimed that the concrete is good, but constant supervision is essential to retain the high standard. A very large amount of valuable data is being compiled in the Laboratory on the subject of concrete; it is hoped to publish this in due course, as it should prove of very general interest.

E/M work is centralized under the S.O. III E/M. The organization is far from ideal, but was introduced for reasons of economy. It works satisfactorily with the necessary good will, but it remains to be seen whether the amount of work which will arise when the large central heating scheme of the hospital starts will not need a larger staff than is available at present.

The number of Surveyors of Works needs perhaps a word of explanation. Had all the contracts been firm lump sums, their numbers could have probably been reduced. With the special system of contracts, not only do all actual buildings have to be measured up, either on the work or from plans, but the taking-off of Bills of Quantities of the many key buildings doubles their work. This staff is fully employed and could with advantage be increased.

CONTRACTORS.

The contrasting methods of the three main contractors provide a most interesting comparison.

i. One contractor intended to carry out the work by most primitive methods. He insisted on the inclusion of a clause in his contract that he would be paid a certain sum down if he used mechanical mixers. His presumed intention was therefore to carry out a big concrete job by hand-mixing. Needless to say the mixers were provided at once.

ii. Another contractor used mixing machines from the start, but at first failed to apply modern—or commonsense—methods in other parts of his work. He has now installed a woodworking shop with modern machinery and is naturally extremely pleased with the results, not only from the point of view of the standard of work produced, but also from that of economy.

iii. The third contractor adopted modern methods, a central mixing plant for concrete, steel shuttering and vibrators. It is unfortunate that the adoption of this method has brought to light many difficulties arising from the design of the buildings. The chief difficulty is the narrow four-inch wall with reinforcement in it; the reinforcement prevents the concrete from consolidating properly and the contractor is faced with the costly necessity of chipping and patching: the difficulties have not yet been overcome. A

full report on this method will be made in due course and it appears to be a matter of considerable interest in the general concreting world.

One of the real big mistakes made by the first two contractors was their failure to appreciate the necessity for care in the design of shuttering. Most concrete engineers must know that the cost of shuttering is one of the most important things to watch. In spite of this, at the beginning of the work the contractors merely employed carpenters with an unlimited amount of material and expected them to produce an economical shuttering without even the assistance of a working drawing. The results were what might have been expected and cost the contractors large sums of money. The lesson was, however, partially learnt and shuttering is now receiving a certain amount of the attention it deserves.

By the end of 1937, results of work should be visible and a number of buildings ready for occupation. Work is now in full swing and good progress is being made, but it cannot be stated that all the difficulties are fully appreciated and arrangements made to meet them. Failure to order some essential article or material has disastrous results since it will take anything up to six months to repair the omission, and by that time the outside building season may be nearly over.

Completion of the Project.

The original intention was to complete the work in about six years, spending up to 1½ *crores* per annum, the maximum that would have been possible from the engineering point of view. At the end of 1936, however, a change in financial policy occurred. The grants for Quetta were drastically reduced owing to financial stringency and the programme had to be recast accordingly. The policy is not settled in detail, but it is probable that the project will not be completed till 1945 at the earliest.

Rebuilding comes at an unfortunate time. The many changes of organization in the army as a whole have immediate repercussions on building, since establishments of many units are in the melting-pot. In this respect the delay will help, as time to reach a decision will now be available. The recent phenomonal rise in world prices has had a most unfortunate effect on work in Quetta. Certain contractors have been badly caught owing to their failure to cover themselves for their commitments, and even those who took this elementary precaution are finding great difficulty in getting their supplies.

The future progress of the project is therefore uncertain; on the one hand, savings in design based on experience are certain; on the other, the rise in prices must result in higher tenders; opinions differ on which will have the greatest effect; the answer will only be known when fresh contracts are accepted.

ENGINEER WORK IN THE KHAIRDARI BEND.

December, 1916—January, 1917.

By LIEUT.-COLONEL E. V. BINNEY, D.S.O.

INTRODUCTORY.

WHEN in December, 1916, Sir Stanley Maude resumed activity on the Tigris front, the first operation was the advance of the IIIrd Indian Corps into contact with the Turkish positions astride the Hai river, on the right bank of the Tigris. During this move, the 14th Indian Division of that Corps masked a Turkish regiment entrenched across the Khairdari or Abdul Hassan bend of the Tigris, just below and opposite Kut, and, on the 15th December, the Lahore Division of the 1st Indian Corps took their place, and it was decided to clear the enemy out of the bend before the main position on the Hai was attacked.

THE KHAIRDARI BEND POSITION.

The bend enclosed a dead-flat area covered with liquorice scrub about 18 inches high. At the apex was a belt of sandhills, and the Tigris floods were kept out elsewhere by an embankment about 4 feet high, called the *sadd*. Across the bend, about 1,200 yards from the apex, the Turks had constructed a single line of trench, about 2,600 yards long, running roughly north and south, except for 450 yards on the right, where the direction was N.E. to S.W. This line, which was well dug, but only lightly wired, was connected by several communication trenches to a second line, which formed a rough arc of 500 yards radius round the sandhills. Trenches on the sandhills themselves formed a keep.

The flat area enclosed by the Turkish first line was shown in air photographs to be traversed by numerous lines, which were either old irrigation cuts or old trenches of the 1915 fighting. The two most definite of the former, running roughly parallel to the first line and between it and the second, had been named the North and South Brushwood *nalas*. Other points had been designated on the maps by combinations of letters and figures. But, about 200 yards from the right of the first line, it was crossed by a very definite feature—an interrupted double line of mounds, 15 feet high, and slightly diverging from the river—the remains of an ancient irrigation

canal. This had been called the Kut East Mounds. Where the first line crossed them an enclosed work had been constructed, and in its immediate rear, where the take-off of the old canal had been, the ground was much cut up and traversed by three parallel irrigation channels which ran into the river, 400 yards behind the front line. These were named the Triple Nalas.

The only communication established with the left bank was a flying bridge on a wire rope at the keep. The reason why the Turks held this isolated and only moderately strengthened position was believed to be that it gave them the means of flooding our advanced area on the right bank when the Tigris rose. Their possession of the left bank below and above the bend enabled them to enfilade any advance on the position with gun and machine-gun fire; this in fact constituted the main strength of the position.

Opposite the first line and about 1,400 yards from it, across the base of the bend, the 14th Division, during their brief stay, had constructed a single, very straight, untraversed trench; this became the Lahore Division's starting-line.

Plan of Attack.

The Lahore Division mounted its attack with the 8th and 9th Indian Infantry Brigades against a front of 1,100 yards on the Turkish right, where the Kut East Mounds gave considerable cover from enfilade from across the river. There was no great hurry, and a slow advance was preferred to the risk of such failures as had marked the 1916 attacks across similar ground. The attack was, therefore, to be made by a series of advances, each consolidated before the next was commenced, till assaulting distance was reached.

This article deals principally with the advance of the left (9th) Brigade, with which the 18th Field Company, 3rd (now the Royal Bombay) Sappers and Miners worked. Those familiar with other fronts may be surprised at the nature of the work allotted to the engineers, nearly all of which the infantry might have been expected to do themselves. But, at this period, there was a great shortage of engineer materials on the Tigris front, engineer work was necessarily somewhat primitive, and the infantry showed little skill in fieldworks; so a large share of their work on the trenches fell to the engineers.

The 18th Company and " C " Company, 34th Sikh Pioneers, were definitely allotted to the 9th Brigade for the operations. The O.C. had a daily interview with Brigade Headquarters, when the next night and day's operations were worked out in terms of covering, working and carrying parties, tools, materials, hours, etc. The C.R.E.'s chief part was to keep up the supply of materials to forward dumps under company control.

The 9th Brigade consisted of the 1st Battalion, Highland Light

Infantry, the 1/1st Gurkha Rifles (both of whom had been on service with the brigade since August, 1914, and contained few of their original personnel), the 105th Mahratta Light Infantry and the 93rd Burma Infantry. The last named, all Punjabis, were recent arrivals from India; the 105th were a second battalion, just raised to replace the original battalion captured in Kut, mostly recruits, but stiffened by men invalided in 1915. From the sappers' point of view, the H.L.I., both as workers and covering parties, were far ahead of the Indian battalions; of the latter, we preferred the Mahrattas, and this was not entirely due to their being a Bombay regiment. The 18th Company were also new arrivals at the front and composed mostly of recruits, but they understood perfectly well that they had to live up to the reputation of the other sapper companies of the division. The pioneers were good and staunch workers, but their war-time officers had little technical training.

It may be noted that, in 1916, a Sapper and Miner field company had four British and three Indian officers and two R.E. serjeants; there were officially four sections, but in the Lahore Division, the field companies had through bitter experience set up a headquarters section of skilled tradesmen and administrative personnel, and the working strength of the other sections was consequently about twenty-eight. The pioneer company could produce four sections of about the same working strength.

NARRATIVE.

On December 20th, the company went into bivouac beside Brigade Headquarters in the Dujailah Depression, about two miles behind the old 14th Division trench. This, as has been stated, was perfectly straight, and the 9th Brigade was occupying about 1,000 yards of it. On the night of the 21st-22nd, the company dug and wired four strong points into this, and put some traverses into the intervals; this was not easy, as the only revetting material available was the liquorice scrub, which, placed in horizontal layers at 6-inch intervals, held up made earth a little steeper than its natural slope. On the left of the 9th Brigade sector, a deep *nala*, subsequently called the Gun *nala*, ran down to the river. On the 22nd, the sappers built bombing blocks in this, but the same evening plans were changed, and the H.L.I. occupied it, the sappers helping to make fire positions along its northern bank, and that night the real advance was commenced, two strong points being dug and wired by two sections of the company, 300 yards in front of the *nala*, and 400 and 800 yards respectively from the river.

The general plan of the advance was to seize and consolidate a series of lines, each about 300 yards in front of the last, till assaulting distance was reached. Each line normally entailed two nights'

work. On the first night a line of strong points was dug, wired and garrisoned, and communication trenches were dug back to the previous line; on the second night the strong points were connected up into a continuous trench-line. The strong points were closed platoon posts, both fire and communication trenches entering them through bombing blocks. Wiring material was short, and the wire was generally about 20 yards from the parapet. The normal procedure was that the pioneers dug the strong points, the sappers wired them and constructed the bombing blocks, and the infantry dug the fire and communication trenches; the sappers had to lay out the whole of the work, and even extend the other working parties on to it.

The routine was as follows: at each morning conference, when Brigade fixed the night's work, the O.C. company informed the B.M. of the required strength and time and place of *rendezvous* (generally the engineer dump) for (*a*) covering parties, (*b*) carrying parties, (*c*) working parties for each job. The B.M. then issued orders for these and for the garrisons of the completed posts. Before the time fixed, the sapper working party laid out loads of materials and tools for the infantry at the dump in separate places for each work. When all had assembled and loaded up (the sappers and pioneers carried loads as well as their tools), they moved off in the following order: Sapper officer, infantry covering party, sapper tracing party, sapper working party, pioneer working party, infantry carrying party, infantry working party. At first, this army used to straggle up the communication trenches, but as experience of the latter was gained and they became more and more congested with signal wire, a cross-country route was preferred. At the front line, the infantry working party was dropped, and the sapper officer led on the remainder by compass and pacing to where he hoped the brigade commander wanted the post. Here the covering party was pushed out, loads dumped well behind the site, and all lay down except the infantry carrying party, who went back to bivouac, and the tracing party with whom the sapper officer proceeded to lay out the post. When this was done, the pioneer officer got his men on to their work, and the sapper taped out the wire and got his men on to that. He then taped out the communication trench back to the old line, where he found the infantry working party and superintended their deployment on the tape. After that, he was free to see how all of them got on, and to speculate whether they would get finished before the dawn (they always did). At the appointed hour, the garrison would appear, and take over the post, generally with unfavourable comments, and the workers would collect their tools and go back to breakfast. All that remained to do was for the O.C. sapper company to resect the posts, put them on the brigade map, arrange with the B.M. for the next night's work, and, quite often, get some sleep. The next night was the same with modifications.

The diversions to this routine came from the covering parties. Perhaps work dulled the imagination of the sappers and pioneers, but it was sometimes a different matter with the infantry lying out in front. The low liquorice scrub waved gently in the dark and at times became transformed into hordes of Turks crawling up to rush the party. Then came a couple of shots and a rush back to the working parties; the digging pioneers grasped their weapons; the sappers dropped their wire, unslung their rifles and scuttled to the flanks. A tense silence of five minutes followed; the sapper officer whispered to the covering party what he thought about them; the sappers and pioneers amplified it (unluckily the worst offenders could not understand any of the languages used); the covering party pushed out again and the rest resumed their work. Equally trying was it when the covering party returned snipers' fire. The Turks used to fire on principle in the direction where they thought work was going on; it was unaimed and did little harm, except on the Mounds, which gave snipers a good line. But if the fire was answered the Turk had a rough direction in which to point his rifle, which did not much matter to the prone covering party, but was irritating to the sappers standing up to wire.

As already stated, the Mounds were an exception, and it was there that most of the sapper casualties occurred. On the night of January 1st/2nd, a party of fourteen men under Capt. H. W. Wagstaff, wiring a small post about 150 yards from the Turkish line, lost three killed and four wounded; the covering party could not stay out, but the sappers finished their job.

On nights when no advance was made, there was no lack of work; machine-gun posts, high traverses in the communication trench between the Mounds and water-supply points; as each line was completed, pumps were installed on the river, the suction hose being buried against puncture by snipers on the other bank; another constant activity was the salvage of the wire and wooden pickets; we were short of pickets and the infantry of firewood, and it was necessary to do the salvage early.

The sketch shows the progress of advance, till on the night 2nd/3rd January, a line of posts was established about 150 yards from the Turks. Next night the infantry started to connect these, but on the right of the brigade front, they attracted a lot of fire and were withdrawn. As the 9th Brigade was well ahead of the 8th on its right, the sappers and pioneers were put on to sap the fire trench and an assembly trench 10 yards in rear. The sappers took the former and the pioneers the latter; work was done from both ends and on the 6th a strenuous race, in which somewhat unorthodox methods of sapping were employed, ended in a tie, when both trenches joined up. Sapping was then commenced forward across "no-man's-land" to shorten the communication trench, which would eventually be required.

On Christmas Day, the B.O's had a dinner, which was enlivened by champagne. The late Lord Curzon, grasping that amenities were rather lacking in Mespot, sent out sufficient of this wine for all officers to be able to celebrate Christmas. We knew this, but were sceptical about the long line of communication. However, the company got a magnum all right, and three sappers will always have a grateful memory of Lord Curzon and of the fourth member of the mess, who was a teetotaler.

During the sapping period, the 18th Company made a track for wheels down the Gun *nala*, which ended in a deep depression beside the *sadd;* here, a couple of nights before the attack, the C.R.A. installed a whole brigade of field artillery, almost in enfilade of the position to be attacked, and only separated by the river from the Turks on the left bank.

The attack was to be on the 9th, and the night before the 18th Company moved their bivouac from the Dujailah Depression to a trench at the south end of the Mounds.

Attack on the First Line.

The assault of the 8th and 9th Brigades was launched at 8450 hours. The 9th Brigade attacked on a three-battalion front—Burma Infantry, 105th, Gurkhas—the H.L.I. being in support. They went over in waves after a short concentrated bombardment. The Turks, as usual, held their front line lightly, and had massed for counter-attack, one battalion roughly in front of each of our brigades. Both of the latter reached the front line with little loss, capturing a few prisoners. The 8th Brigade, however, was soon counter-attacked; an Indian battalion on their right gave way, and the whole of their gains might have been lost, had not a party of the Sikh Pioneers, who had gone over with them, held fast. As it was the attack was stopped, and they did not make good the whole of their front till the end of the day. On the 9th Brigade front, however, the Mahrattas and Gurkhas pushed straight on to their second objective, the "Triple *nalas*," and met the Turkish left counter-attack in the broken ground between. A dog-fight ensued with bomb and bayonet; the two Indian battalions lost heavily, but the Turks were wiped out, and the brigade made good both its objectives.

As soon as the 9th Brigade had reached the Turks' front line, the 18th Company and the pioneers each ran a communication trench across to it. But scarcely had the sappers finished their trench, when they had to convert it into a fire trench and put bombing blocks into the Turk trenches, since the retirement of the 8th Brigade had left the right flank of the 9th in the air, till the Manchesters

from the 8th came through and recovered their brigade's left flank. During the ensuing night the new brigade front was wired.

ATTACK ON THE SECOND LINE.

The 10th was a quiet day, but at nightfall the 9th Brigade pushed forward and occupied the South Brushwood *ñala*, the sappers wiring this new line.

During the morning of the 11th, Division issued orders for the attack on the Turks' second line. It was believed that their losses on the 9th had been heavy and that they were evacuating the Bend. Actually they had replaced their more badly handled battalions. They also had air superiority, and during the morning two of their planes watched our troops assembling, the efforts of our guns and old aeroplanes to interfere being merely amusing. Consequently, when the assault was launched at 1430 hours, both the Turkish infantry and their guns across the river were quite ready. The H.L.I., advancing on the 9th Brigade front, were checked at the Turkish wire, losing nearly all their officers, and fell back with over 200 casualties. The 93rd, in support, came back with them. The Turks promptly counter-attacked, and were in turn heavily repulsed. The 8th Brigade attack on the right ran a similar course.

As a result of the losses, the sappers and pioneers were employed that evening as reserves to the infantry in the front line, and in carrying up ammunition and supplies to them. As soon as it was dark, the sappers repaired the wire which they had cut for the advance; but a renewal of the deliberate advance had already been decided on, and the same night a new work on the North Brushwood *nala*, at K15C, 500 yards from the river, was dug, wired and connected with our old line by the sappers and pioneers.

On the 12th, the 9th Brigade was relieved by the 7th (1st Connaught Rangers, 2/7th Gurkha Rifles, 27th Punjabis, 91st Punjabis and No. 131 M.G. Company). The 18th Company and the pioneers stayed on. Of the new battalions, the 2/7th were, like the 105th, a new unit raised to replace one lost in Kut. They knew even less Hindustani than most Gurkhas, and it was almost impossible to get anything out of them in the absence of their B.O's; they smiled cheerily, but did nothing.

On the night of the 12th/13th, the whole of the line of the North Brushwood *nala* was occupied with strong points from the junction with the 8th Brigade to the river, the sappers helping the pioneers with digging as well as doing the wire. The Turks' communication trenches were now available and saved much work. Next night the pioneers dug the intervals, and the sappers dug and wired a fresh post still nearer the Turks; there were no covering parties, and we did not know how near we were to the enemy till our wire

began to get mixed up with theirs. On the 14th/15th, the sappers and pioneers completed the new line.

The 7th Brigade was now within assaulting distance, and on 15th/16th there was little work on the front line. The Turks were apparently holding the sandhills only, and, on the night of the 16th/17th, Brigade decided to put in a new post in the part of their second line which they had abandoned, at K16K. This operation was designed on a more ambitious scale than on previous nights. Two companies of the 2/7th formed a covering party, and, as they had not been trained in bombing, a party of bombers from the Rangers was attached. A box-barrage was arranged in case of trouble; and with this formidable escort, half of the 18th Company and half of "C" Company, Pioneers, set forth to do the work.

Events emphatically did not go according to plan. The large covering party moved out, and the sappers and pioneers, who did not wish to suffer unduly from overs, moved up a Turkish communication trench. Suddenly there was a series of detonations in front and in a few seconds the darkness on either side was full of figures retreating in a great hurry. The sapper officer seized one, who informed him in the accents of Galway that the bombing party had been destroyed. The sappers dropped their loads and unslung their rifles. All was now quiet in front and it looked as if the whole covering party had gone back. But a minute later a Gurkha came down the trench with a message that most of the 2/7th anyhow were in position.

It took some time to collect the tools and loads again, and it was very doubtful whether there was time to put the original project through. Brigade then sent up orders to construct a post between the front line and the site originally selected. This was duly commenced at 2200 hours, but at midnight fresh orders came from Brigade to put through the original project. The Gurkhas pushed forward again, and the new work was laid out and commenced. At 0230 hours fresh trouble began. The enemy started bombing along the trench from K15F accompanied by heavy machine-gun fire from the sandhills. The O.C. covering party sent up his Véry lights and down came the box-barrage; so did the fire of every Turkish gun within range. The affair seemed to be developing into a minor battle, and work was impossible. The Gurkhas seemed unable to stop the bombers who were rapidly getting behind us. Under the circumstances the O.C. covering party and the sapper officer decided to abandon the job, and the whole fell back to the post begun earlier in the night, which was completed.

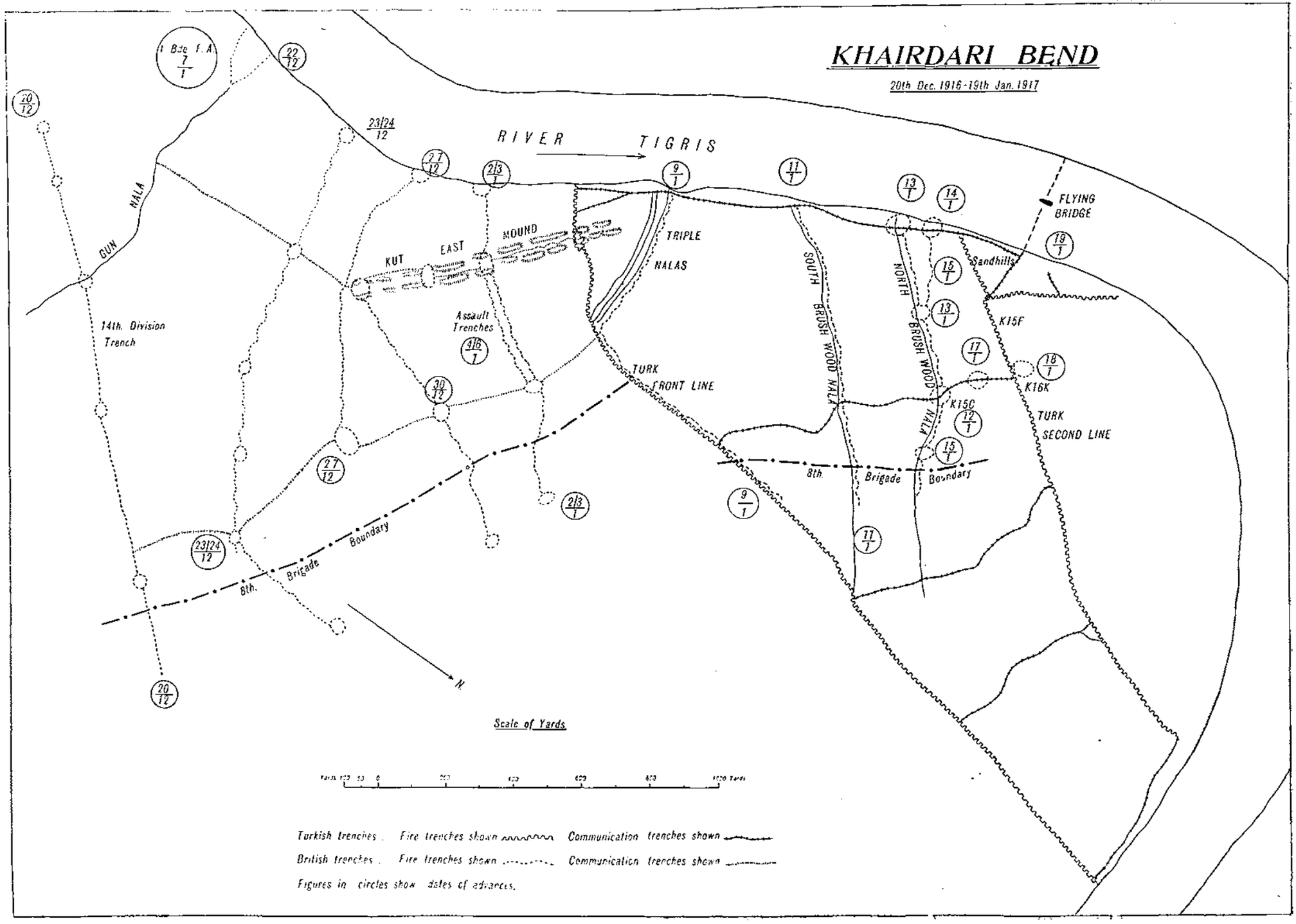
On the next night (17th/18th), half the 18th Company with two covering patrols of the 2/7th, each of four men, went out again and had little difficulty in completing the abandoned work. The fiasco of the previous night was no doubt entirely due to the size of the

covering party alarming the enemy into activity; but it would probably be best not to inquire into the size of the bombing party that caused 400 men to abandon the night's work.

The final attack was fixed for the 19th, and the 18th was spent in bringing the engineer dump as far forward as possible. The attack was to be on a two-battalion front, 2/7th on right, and 27th Punjabis on left. Half of 18th Company and half of "C" Company 34th Pioneers, were to follow them to get communication trenches across as soon as the infantry had reached their objectives. The Turks, however, had evacuated their position, which had, of course, become perfectly hopeless and useless. Information to this effect reached Brigade by a deserter in the early hours of the 19th, and orders were sent to the 27th Punjabis, just before zero hour, to send out patrols to elucidate the position. The sapper officer, who was shepherding the pioneers, heard the O.C. Punjabis appreciating the situation (somewhat vehemently) to the effect that, if the Turks were there, his patrols would be annihilated and, if they were not, his whole battalion could cross. A minute later, the 27th were hoorooshing across in an exact imitation of a pre-war manœuvre charge, and got into the empty trenches before the guns on the left bank got busy; but the pioneers, deploying along the new communication trench, got the benefit of it, and a shrapnel bullet started the sapper officer among others back to India. On the right the 18th Company got their communication trench across without much trouble.

The Khairdari Bend operations were over, and that evening the 18th Company reverted to divisional control; they marched back to more comfortable billets in the Dujailah Depression, and spent the next two days retrieving and bringing back the engineer dump. Their casualties during the month had been two officers wounded (one twice), and nine other ranks killed and 27 wounded.

The technique of the operations is out of date, and it is not suggested that they provide lessons. In fact, the writer in 1927 adopted this story for a lecture at the S.O.S., Belgaum. During its delivery he was embarrassed by the Commandant and Assistant Commandant, who had not served in Mesopotamia, groaning in unison at the thought that such deplorable methods should have been possible in the British Army as late as 1917.


KHAIRDARI BEND
20th Dec. 1916-19th Jan. 1917
1 Bde F.A.
7/1
22/12
20/12
23/24/12
RIVER TIGRIS
27/12
2/3/1
9/1
11/1
13/1
14/1
FLYING BRIDGE
19/1
GUN NALA
14th. Division Trench
KUT EAST
MOUND
TRIPLE NALAS
Assault Trenches
4/6/1
30/12
TURK FRONT LINE
SOUTH BRUSH WOOD NALA
NORTH BRUSH WOOD NALA
Sandhills
15/1
13/1
K15F
17/1
18/1
K16K
K15C
12/1
TURK SECOND LINE
8th. Brigade Boundary
N
Scale of Yards
Turkish trenches . Fire trenches shown Communication trenches shown
British trenches . Fire trenches shown Communication trenches shown
Figures in circles show dates of advances.

AN IMPROVISED RAFTING OPERATION.

By LIEUTENANT J. S. CLOSE, R.E.

INTRODUCTION.

THIS account of a small fieldworks operation has been written for three reasons; the first, the hope that its small weight may be added to the other reasons put forward in *The R.E. Journal*, for the manning of anti-aircraft searchlights by the Royal Engineers; the second, to stress once again the importance of frequent practice in the moving of heavy weights by manual power; the third, that in these days of "Meccano" engineering, with folding-boats and box-girders, improvisation may not be lost to view.

THE PROBLEM.

In order to make the searchlight layout round Alexandria more effective, it was decided that lights were needed in the marshes of Lake Maryut. This had been mooted for some time and two sites on fairly firm ground were known. The only approach to them was by water for at least the last 1,000 yards. The problem of getting the equipment to these sites had been partly considered, but the whole matter had been shelved for some months. To cut a long story short, at about 1800 hours on the 19th May, 1936, the O.C. Composite A.A. Company, R.E., was ordered to have a searchlight in action, for an exercise, at the nearer site in the marsh by 2000 hours on the 21st. His appreciation of the situation was as follows:—

Load to be carried:—About 4½ tons, including engine and generator, light equipment, the detachment and their kit.

Stores available:—The only stores of my own likely to be of use are the six park pickets, the handspike and the 2-inch lashings. Two old iron open-boat pontoons are in the lake near the best site for building a raft. They are not in very good condition. My load should be spread over their bottoms as much as possible. (These pontoons had been got when the problem had first been brought forward.) All the skidding, 12-inch by 12-inch pieces and other repository stores of the Coast Artillery Brigade of the Royal

Marines is at my disposal. I can get tubular scaffolding up to 18-foot lengths if I want it.

Men available :—I can get 20 men at all times up to the time the raft or other carrying craft leaves the shore.

Time and Distances :—I have 48 hours in which to do the job. The bulk of the stores are about four miles from where I expect to load the equipment. The generating set is also about four miles away.

Transport :—I shall have one 30-cwt. lorry of my own available, but it will not be free to work until 1000 hours, as it has to take rations to detachments first. The detachment that is going to run the light can turn out their lorry. I can get a Hathi tractor and trailer to take the generating set to the site of work.

Sites for loading, etc. There are two possible sites :—

(*a*) This has a gentle slope to the water. There is plenty of room for manœuvring vehicles and heavy loads. If this site is used, any loaded raft or boat must pass under the foot and railway bridges (see Photo No. 3).

(*b*) This is the other side of the bridges. Vehicles cannot get nearer than 150 feet to the rafting site. This 150 feet consists of a 6-foot path between a shed and a fish-pond. The latter has about 2 feet of water and at least 2 feet more of mud in it. Use of this site will mean turning the generating set (2½ tons) through an angle of nearly 90 degrees to give it a straight run down to the bank (see upper left-hand corner of Photo No. 1). The slope down to the bank is much steeper than at (*a*).

THE PLAN.

It was decided :—

(*a*) To reconnoitre for and earmark stores that night.

(*b*) To build a raft to carry the load. The buoyancy would be given by the two pontoons. The platform for the load would be supported on crib piers built inside the pontoons (Photo No. 6). These cribs would rest on 14-foot pieces of skidding, about 2 feet 3 inches wide and 3 inches in thickness, acting as spreaders on the flat bottoms of the pontoons.

Diagonal stiffness would be gained by lashing 18-foot tubular scaffolding pieces in pairs to the pontoons with a continuous steel wire lashing, barrel pier fashion (see Photos Nos. 1, 2 and 3). Further stiffness was got by connecting the bows and sterns of the pontoons with steel wire rope (see Photo No. 1).

(*c*) To use site (*b*). The deciding factor here was the clearance of the bridges. Rough calculation showed that the loaded raft would scarcely pass under them. It was not considered wise, in view of their condition, to lower the pontoons in the water by adding more dead weight.

(*d*) Stores would be drawn and the raft built on the 20th.

The generating set would be uncased and cleaned on the 20th and loaded on the trailer.

Loading the raft would take place on the morning of the 21st. As the C.-in-C. was going to inspect the work at 1400 hours on the 21st it was decided to aim at having the raft ready loaded at that time.

Narrative of Events.

19th May.

The reconnaissance of stores was carried out, as planned, on the night of the 19th. By 2130 hours, it seemed clear that all that could be wanted was available, except dogs for fastening the baulks in the crib piers together. These, it was decided, would be made in the company workshops the next morning.

20th May.

Until 1400 hours, all were engaged in loading and off-loading stores except for one N.C.O. and eight men who got the generating set in position, and levered it up an improvised ramp on to the trailer, the winding gear of the Hathi tractor being used as the principal hauling power. The set and trailer were then towed to the detachment's camp where the case was stripped off and the set thoroughly cleaned.

At 1400 hours, work on building the raft began. A crisis arose immediately as a blow from a piece of skidding knocked a hole of about ½-inch diameter in the bottom of one of the pontoons. Attempts to plug the hole only wore away more of the rusted metal. It seemed likely that repairs would take some time as material would have to be "scrounged," but providence in the form of the local coastguards was at hand. They had both materials and tools for mending their own boat, and a patch formed with plates and washers bolted through the hole was put on in three-quarters of an hour; this time included beaching the pontoon and drilling the plates. The patch was not completely watertight, and the rate of making water was observed as the building of the raft went on.

After this the construction was not delayed by any accidents. The O.C. Company, however, distrusted the strength of the patch, and seeing, in his mind's eye, herculean labours to get a sunken engine out of the lake bottom, was inspired to collect two lorry-loads of empty 80-gallon petrol drums lying at the Shell-Mex depot close by.

These were stowed, wherever possible, in the pontoons (see Photo No. 2).

These would give enough buoyancy to hold the engine up in the water if either or both of the pontoons leaked badly.

Darkness fell about 1930 hours, and from then until 2040 hours, when the raft was completed, three Primus lamps, hung on 8-foot telegraph poles gave an adequate light. The stores and raft were then left in charge of a *ghaffir*.

21st May.

On the morning of the 21st the level of water inside the mended pontoon had risen about two inches, so the writer was dispatched to find a pump. Lift and force pumps were not part of the unit equipment. He found a pump with another searchlight company about two miles away. It was a semi-rotary pump which had been used for delivering drinking-water to detachments from a mobile tank. This pump was fitted to a piece of timber nailed to the gunwales of the leaking pontoon (the suction and delivery hoses can be seen in Photos Nos. 1, 2 and 4). This pump, pumping for five minutes at intervals of about an hour, kept the water down.

At 0900 hours the generator was brought as near as possible to the site, and lowered down a ramp of skidding off its trailer. The winding gear of the Hathi tractor was used as a preventer. At the same time the projector and other searchlight equipment including the cable, a very awkward load when off its drum, had been dumped close to the raft.

The generator was then moved with handspikes across skidding, kept slippery with water, along the narrow path mentioned above; it was turned square on to the raft and gently lowered away on to it (see Photo No. 1). The work was slow as no risk of a "loss overboard" could be taken. At 1200 hours it was in position on the raft. Those few hours' work made clear these points.

1. Confidence in this type of work comes only with practice.
2. A little time spent on visualizing the progress of the load, and a little more in preliminary levellings and careful setting out of holdfasts saves much time in the end. The whole job was completed and the raft ready to move at 1300 hours.

   After the "great ones in the land" had inspected the raft, it was towed out to the required position. As a rule the only craft on the lake were feluccas and one of these had been chartered for the job. It so happened that the coastguard's patrol motor-boat was handy at the time of "sailing" and this lent a hand in the towing (see Photo No. 5).

Photo No. 1.

Photo No. 2.

Photo No. 3.

Photo No. 4.

Improvised rafting 1- 4

Photo No. 5.

Photo No. 6.

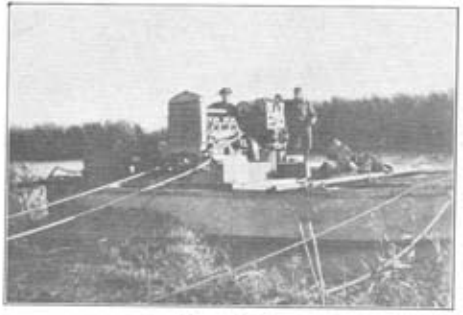


Photo No. 7.

Photo No. 8.

Improvised rafting 5-8

At 1700 hours the light was ready for action, the generator running on the raft (Photo No. 7).

The light took part successfully in the exercise that evening. The next morning, as the mosquitoes were very active in the marshes, the detachment commander got his raft loaded again at 0600 hours, and using the bulk of the generating set as a " sail " in the morning breeze, came gently back to the landing-place (see Photo No. 8). The stream and wind were so slight that the raft was easily brought alongside with breastlines.

Before dismantling, the loaded raft was brought up to the bridges, and it was found that it failed to clear the lower of the two by 1½ inches, so the choice of site (*b*) was justified.

Conclusion.

The writer feels that as regards the second and third reasons mentioned in the introduction the account must speak for itself. In the matter of the first he would like to put forward this line of thought.

1. The operation described, and others of a nature involving more field engineering than is contained in *M.F.E.*, Vol. I, will not be infrequent in the establishment of mobile or semi-mobile anti-aircraft defences.
2. If searchlight personnel are of the Royal Engineers they can be relied on to get their lights into any required position by their own efforts, provided tools and materials are available. If searchlight units are not able to do all their own field-engineering, the work would have to be allotted to some R.E. unit, presumably non-divisional, which doubtless has enough to do in the sphere already allotted to it.

FORESTRY.

By COLONEL F. C. MOLESWORTH.

HAVING, late in his career, come into contact with the theory and practice of forestry, and discovering the extent of his previous deep ignorance on the subject, the writer realized that even a smattering of knowledge would have been useful to him during his military service. Possibly the modicum he has acquired may be of use to those still serving.

He remembers, in preparation for his Shop examinations, having to mug up details of the manufacture of iron and other metals—knowledge long since forgotten, and in any case never used. But of the production of timber, one of our principal raw materials, he was taught nothing; and this is presumably still the case with candidates for the Corps. This is the stranger, since, as Sappers, we have often to plant and tend roadside trees, to maintain woods forming part of a catchment area, to cover over an area liable to landslip or erosion, and to guard forests forming part of a manœuvre area. We are the estate agents to Government for no inconsiderable portion of the country, and as such it behoves us to tend carefully the trees therein. Moreover, the work done by the R.E. Forestry Companies in France during the Great War, is a reminder that we may be called on for similar work in the future. It is true that our primary object is usually to provide shade or to protect the soil, while that of a forester is generally the ultimate sale value of the timber, but the two desiderata can be combined, and there is no reason why we should not benefit our distant successors by giving them trees in as marketable a form as possible.

It is true that, both at home and abroad, the advice of a competent Forest Officer is nearly always available; there is no silvicultural problem we are likely to be up against which a forester has not studied from A to Z; but it is hardly fair to ask a man in charge of a forest area the size of Kent to advise on the planting of a few trees in a pumping station enclosure, however important that may seem to us.

Before discussing the subject of the planting and care of trees, in other words, the art of silviculture, it is advisable briefly to describe the processes at work in a mature tree. All plants require for their growth sufficiency of water, carbon dioxide, a small amount of mineral salts, a modicum of nitrogen, and, above all, light. Water, with the salts and nitrogen necessary, is obtained from the soil;

minute hairs on the youngest of the roots imbibe the mixture which is carried up through the sapwood until it reaches the leaves. The amount so raised in the case of a large tree must be a very large weight, and it may be added that the process by which it is effected is still somewhat obscure.

The leaves are the laboratory in which the first chemical processes involved in the growth of the tree take place. They absorb carbon dioxide from the air, and, releasing the oxygen, abstract the carbon, which combines with the elements of water to form carbohydrates. These the chlorophyll present in the leaves converts, in the presence of adequate sunlight, into more complicated compounds, chiefly sugars. These are the principal factors in the growth of the tree; they pass upwards and outwards into the buds to produce leaves and twigs, and downwards *via* a layer between the sapwood and the bark, known as the cambium, which as it grows transforms its outer layers into bark and its inner into sapwood, while between the two there remains always a layer of cambium.

The newly-formed wood serves for some years as a channel for the flow of sap, hence its name of sapwood; but as it grows older, it ceases to convey sap, and becomes heartwood, which, though not essential for the growth of the tree, gives it its necessary strength.

The above—a brief and incomplete summary of the processes involved—shows the necessity for giving a tree a good start in life. It must first be planted in a suitable soil, its roots must have access to permanently damp strata, its crown of leaves must have a place in the sun, and be big enough to carry out its chemical functions. If any one of these factors receives insufficient attention, the tree will grow up stunted or may die. Needless to say, different trees need different treatment in the matter.

Let us see how a Forest Officer would tackle the planting of an area not previously under forest. His first problem is to discover whether the soil will grow trees at all, and, if so, for which trees it is best suited. They will not, of course, grow in a morass, nor on bare rock, nor, in the United Kingdom, at an elevation of over about 1,600 feet above sea-level, but with these exceptions there is hardly a spot in this country where trees of some sort cannot be made to grow. On some sour soil, where trees planted direct in the ground would not grow, good results have been obtained by removing a sod, upturning it, and planting a seedling in its upturned side. The forester nowadays is guided largely by analysis of the soil which, together with the nature of the vegetation it already carries, tells him what will be the most suitable crop for the area. There may, of course, be trees growing on similar soil in the neighbourhood, but unless they have already reached maturity, it is unsafe to assume that they will do so, though nevertheless they may form the surest guide as to the potentialities of the locality for tree growth.

As regards the species of trees to be planted, the forester is probably considering the ultimate value of the timber for structural purposes. We, on the other hand, generally need a crop that will grow quickly and protect the ground below, both by rapid and deep root growth, and by the production of a thick canopy that will check the effects of heavy rain. The latter consideration points to the use of evergreen conifers; as regards the former, one has to bear in mind that, although most trees, given suitable soil, will send down their roots twenty feet or more, all require a certain minimum depth. Larch, ash, oak and lime, for instance, need a depth of three feet or more, while spruce, beech and mountain ash will do with not more than eighteen inches; birch is one of the most accommodating in this respect; many of the mountain-sides in North Wales are disfigured by unsightly tailings from past and present slate quarries, but these are in many places being covered with self-sown birch. It must be remembered, however, that the shallower the root system, the greater the likelihood of the tree being blown down.

Fortunately, there are many accommodating species of trees which can put up with almost any kind of soil, examples being the Scots pine, most poplars and many kinds of willows. It is important, especially for amateurs, to avoid recently imported exotics, which have not been thoroughly tried and grown to maturity by professionals. In this connection, it is astonishing how many of the trees in this country which we look upon as natives are imports, either deliberately or accidentally, from abroad, for example, larch, sweet and horse chestnut, sycamore, lime and many others. There is, of course, no objection whatever to planting such if otherwise suitable.

The forester has also to decide whether to grow his crop pure or mixed, and, if the latter, in what arrangement; for example, in alternate lines, or with one species entirely surrounding small groups of the other. Mixed groups have many advantages; for instance, the spread of disease by fungus and other pests is checked, while if one kind proves a failure, the other may still provide a paying crop. On the other hand, the difficulties of management are increased, and ultimate exploitation becomes harder. The latter disadvantage does not weigh as heavily with us as with professionals, and it may be said that as far as our problems are concerned, it is generally better to plant a mixed crop. But an important proviso must be made, viz., that since different kinds of trees grow at different rates, a lapse of several years may be advisable between the planting of two or more species in the same area, unless the slower grower can stand shade. Conversely, if it is desired to make a mixed plantation at one sowing, the choice is limited to equally fast growers; here again, however carefully the selection is made, the soil may happen to suit one kind better than the other, which may be dwarfed or killed unless the stronger species is drastically lopped. Here it may be remarked that

oak and beech make a good mixture, or, if faster growers are required, Douglas fir and larch.

The preparation of the ground has next to be thought of; subsoil drainage must be provided if the soil is likely to become waterlogged; it is advisable to clear away large stones, for a tree which has encountered such in its extreme youth will bear the scars to its dying day; digging up the topsoil will usually produce good results. On newly-made embankments, such as we sometimes have to plant, there is seldom any topsoil, and in such cases it is necessary to dig out to some depth and insert good earth and if possible leaf mould before planting.

Then, should the area be sown or planted? There are such obvious advantages in the latter course that, as engineers, it usually pays us to adopt it. In parenthesis, however, it may be mentioned that successful sowing of tree seed in areas almost inaccessible on foot has been carried out by aeroplane. In this country suitable plants can always be obtained from nurseries, and provided that adequate steps are taken to protect them against frost in their early stages, trees so planted will generally thrive.

If a homogeneous and self-sown group of trees in an exposed position be examined, it will be found that those on the windward side are dwarfed and distorted. This is particularly noticeable on the north coast of Devon, where the crowns of trees so situated form an almost perfect hyperbola. The windward trees, however, develop a deeper and stronger root-system than the remainder, which they protect. The forester, therefore, always plants a shelter-belt of deep-rooted and quick-growing kinds on the exposed side of a plantation, otherwise a windfall will tend to spread with disastrous rapidity. The corollary of this is that felling should always proceed from the leeward side inwards. If time permits, it is better to start the shelter-belt some years in advance of the main crop.

The area will in nine cases out of ten require fencing to protect the young growth against animals. In this country, cattle, sheep, mice and rabbits are the greatest enemies; in India, protective measures have to be taken against such diverse creatures as elephants, deer, goats and porcupines.

The actual planting of the young trees needs almost as much care as the gardener bestows on the herbaceous border. The time of year is important; generally speaking, the late autumn is the best season for planting deciduous trees, March and early April for conifers, avoiding, in both cases, periods of frost. The density of planting depends on many factors: the species, the size of the tree when mature, soil, climate, object, together with financial considerations such as initial cost and probable market. In such afforestation problems as we are likely to have to tackle, these can be boiled down to a rough and ready rule of between four and six feet. Care taken in

planting is rewarded by fewer casualties; plants should be transferred with as little delay as possible, a moist cloudy day being chosen if possible. On no account should the roots of transplants be exposed to the drying effect of wind.

It is rare in this country that young trees will need watering, but if it is necessary, they should never be allowed to stand in water as this injures the bark. A useful dodge sometimes employed in India is to bury a porous pot near the root of the young tree, water being poured into the pot as required.

As spring comes on, the plants will have to contend with weeds of all sorts, grass, wild flowers, bracken, brambles and what not, and, especially if the area has formerly been under forest, unwanted trees may be struggling to come up. All these must be ruthlessly suppressed, and the process must continue until the young trees are able to hold their own. For reasons known and unknown, some of the plants will succumb, and will have to be replaced, care being taken to see that only contemporaries of those already in the ground are planted, as otherwise an uneven crop will result; and this should continue until any contemporaries are too old to bear transplanting.

It might be thought that, once teething troubles are over, trees might be left to Nature, but this is far from being the case. It is true that Nature wants your trees to grow, but she also wants birds, caterpillars, squirrels, fungi, borers, creepers and innumerable insect pests to grow as well, and is indifferent whether they live at the expense of your trees or not. As regards birds, the forester has classified all British birds in order of merit, ranging from useful birds such as the cuckoo, which is wholly beneficent in that he destroys the trees' natural enemies, to the wood-pigeon which is entirely given to destruction. The forester will, therefore, keep the latter under control if he can. Caterpillars can sometimes be got at by spraying, and in places, in America, they have been exterminated by dust sprinkled from aeroplanes; it may be remarked that Nature comes to the aid of a tree whose foliage has been eaten by caterpillars, by producing a second crop of leaves in the same year, recording the fact by making a double annual ring. Red and grey squirrels, especially the latter, do a great deal of damage. But in general, the smaller the pest, the greater the damage. The Forestry Commission produces valuable pamphlets on the subject of these pests, giving, where known, means of prevention and cure, ranging in extreme cases to the removal and burning of all trees affected. Fungi are divided into two classes, dead-wood eaters and live-wood eaters. The latter usually enter a tree through a wound, hence the desirability of tarring over such. Dead-wood eaters are liable to spread to timber used in fencing, etc., and so it is advisable to remove all fallen trees and branches, and this is also a useful fire precaution.

Young trees eventually triumph over weeds by "forming thicket,"

as it is termed, shutting out rival growth from light. But no sooner have they obtained this supremacy than they begin a struggle for existence among themselves, each striving for a place in the sun for its canopy, sufficient to enable its leaves to perform their functions. This competition is all to the good, in that it results in straight and therefore marketable trunks. If the trees are too far apart, branches of little saleable value stretch out on every side, while the trunks become bent and gnarled. Incidentally, this was an advantage in the days of wooden ships, and the Forest of Dean, which was planted largely for use in building ships for the Royal Navy, consists now to a great extent of old and bent oak—a forester's nightmare.

Trees in the same plot, for many reasons, will seldom grow up uniformly ; some will outpace their competitors, while some will so fail in the struggle that they will not be worth preserving, and will have to be felled to give the bigger ones an even better chance. Some, known as " wolf-trees," so outdistance their companions that they are better sacrificed. It is often as well to destroy them by ringing or poisoning, rather than by felling, which might endanger the surrounding trees.

During this struggle for existence, the lower branches, being deprived of light, wither and die ; this is specially noticeable in the case of conifers, where the dead branches, if not removed, are thick enough to be a hindrance to movement. If these dead branches are left, they serve as an adit for fungi, etc., and, as the tree matures, they form knots extending from the centre to the circumference ; if they are carefully removed, the cambium will, in the course of a few years, grow completely over the branch-end, and the wood will be knotless from this point outwards. Such removal has to be done carefully, with saws or woodman's knives, or else a bad wound results.

If it is desired, for some such reason as to form a windbreak, to leave the lower branches, one cannot do better than plant Sitka spruce, which in a few years forms a thicket almost impassable without cutting-tools.

Possible damage by fire can be minimized by isolating areas by means of fire-lines at the start, and by periodically clearing the ground of dead sticks and leaves. But it is hard to provide against carelessness and wilful damage. In Government forests, watchers daily visit commanding points, provided with phones, in order to give as early a notice of outbreaks as possible. In the New Forest there are stands of besoms at frequent intervals, for the use of staff and public alike, in fighting fires. It may here be noted that the leaf litter of the birch and false acacia is almost non-inflammable, and for that reason these trees are often planted alongside railway lines.

However carefully plantations are shielded, damage is occasionally caused by wind, especially when combined with snow. In such cases,

damaged branches must be carefully sawn across, and the ends tarred. Fallen trees, as we have already seen, must be removed. As the fall of one tree renders its leeward neighbours more exposed to the wind, there is always danger of a clearing spreading, until the trees have adjusted themselves to the new conditions, by putting out further roots. It may even be advisable to stay the more exposed trees for a time.

Some trees, sometimes for no apparent reason, go "stag-headed," that is to say the upper branches wither. These withered branches must also be removed.

After a time, thinnings will become necessary, an operation which must be performed with great care, the desideratum being to keep the canopy as intact as possible. These thinnings have as a rule some sale value as pit-props or rail posts, and so the plantation ought by this time to be repaying part of its initial and recurring cost.

With the ultimate disposal of the timber we need hardly concern ourselves. The exact time for felling, in order to get the maximum value out of the crop and site, is important, but it is sometimes hard even for the expert to judge the correct time, how much more so for the amateur. But Sappers are, or ought to be, experts in the felling of trees, as well as in their cutting up, removal and subsequent disposal.

Long before the time for felling has arrived, however, the Forest Officer will be planning the next crop. He may decide to leave the area to "natural regeneration," a phrase which explains itself, though it does not mean that everything can be left to Nature; or he may decide to "coppice," a very useful method with ash; or, he may decide to underplant the existing crop some years before it is felled. Some species, such as the beech, will start well under a canopy, and it is in this case advisable to plant close rather than otherwise, owing to probable casualties in felling and clearing the older crop. On the other hand, some kinds, of which the beech is again an example, refuse to allow other trees to grow up under their shade. They compensate for this churlish behaviour, however, by producing excellent leaf-mould, so that a crop started on the site of a recently felled beech wood begins with a great advantage.

The instructions for and notes on the whole cycle of operations are included in a document known as a working plan. The amateur is inclined to shut the book with a groan, when he finds the author writing cheerily of what is to happen 150 or 200 years ahead, for these periods are about the optimum for oak and teak. Methuselah would have made an excellent forest officer.

Each area is divided, for administration purposes, into compartments of from 10 to 25 acres, which may consist of a single crop, but more often of two or three. Compartment boundaries are marked on the ground, but seldom clearly enough to be discernible to any

but the trained forester ; and here it may be mentioned that it would be a great advantage to foresters were these boundaries marked on the 6-inch and 25-inch O.S. plans, where forest areas are at present depicted by a monotonous repetition of the conventional sign.

It will have been gathered from the above that a Forest Officer's job is no light one, and that his training has to be very varied and extremely thorough. He must know a good deal about geology and soil chemistry. He must be a botanist in general and a silviculturist in particular. He must know much about biology and a great deal about entomology. He must be versed in the methods of preserving timber and in its marketing. He must be something of an actuary in order to estimate the probable yield of a crop and compare the value of crops *inter se*. Finally, he must know something of survey and of the simpler forms of engineering, such as road-making and bridging. He must be active and hardy, for his charge is usually a large one, and he has to cover hundreds if not thousands of miles in the course of his annual inspections. In the outlying parts of the world he is not infrequently an *ex-officio* commissioner and magistrate.

The actual work is entrusted to rangers and woodmen ; in this country it is estimated that 100 acres of woodland give constant employment to one man, with additional help at times of planting, thinning and felling.

It would be impossible in the space of a magazine article to treat of forestry overseas. Indian forests alone would need a book. Suffice it to say that our problems there are generally on a much larger scale than at Home ; at the same time, growth is quicker, and it is very pleasant to see, as years pass, trees which one planted as seedlings grow into large shade-givers.

The Forestry Commission in this country has been mentioned in the course of this article. The public generally do not recognize that it is a product of the Great War. The Commission is entrusted with the comprehensive duties of promoting the interests of forestry, the development of afforestation, and the production and supply of timber in Great Britain. The work it has done in the eighteen years of its existence has been colossal. It has taken over the former Crown woods, making, with other forests acquired, an area of 641,000 acres, has planted 350,000 acres, and is continuing to do so at the rate of 20,000 acres a year ; the plantings include 60,000,000 hardwood trees such as oak and beech. That there was need for such an institution is plain when we consider that, before the war, Great Britain was the worst but one forested country in Europe, Portugal being the worst. That while we produce 50,000,000 c. ft. of timber annually, we use 400,000,000 c. ft. ; and incidentally that most of our imports of timber are from outside the Empire. The work of the Commission is helped by the Imperial Forestry Institution at Oxford,

while unofficial bodies such as the Royal English Forestry Society and the Men of the Trees are trying to interest the public in the subject. Finally, forestry is taught to candidates for the various forest services of the Empire at the Universities of Oxford, Edinburgh and Aberdeen, and at the University College of North Wales at Bangor.

SAIL-FLYING.

By CAPTAIN F. J. R. HEATH, R.E.

ON any fine Sunday, crowds of onlookers come to Dunstable Down to watch the London Gliding Club. As an attraction, the flying rivals Whipsnade in popularity, with the additional advantage that there is no charge for admission. From the frequency with which onlookers ask," What happens if you get blown out to sea ? " " Why don't you put a little engine in it ? " and " What use is it ? " it is quite clear that many people do not understand either the powers or the objects of the sail-flying pilot. This article is an attempt to explain both.

Sail-flying was originally developed in Germany as a method of training pilots at a time when aeroplane engines were forbidden to that country under the peace treaty. At first only " gliding " was attempted. Gliding may be described as a sort of aerial tobogganing with progressive loss of height. It later became apparent that if a wind blows on to the side of a steep hill it is deflected upwards. If the sinking speed of an aircraft be less than the upward speed of the wind, the aircraft when launched into this uplift will gain height as long as it remains in the lift zone. This is known as hill soaring and is the first big step forward in sail-flying. Not much more than twice the height of the hill slope can be gained in this way—even on very favourable days—and the flight is limited geographically by the length and width of the belt of uplift. The next discovery to be made was that on many days the air has upward components in its motion quite apart from the effects of hill slopes and that these can be used for sail-flying. These upward components may be due to " cold fronts " or to the differential heating of the earth that occurs when the sun shines:—e.g., marshes and streams remain cool, while ploughed fields and red-roofed houses are heated. One may expect to find rising air over the hot earth and descending air over the cool marshes. Soaring in thermal up-currents other than cold fronts is known as " thermal soaring " and on an unstable day when the air is full of thermal uplift a sail-plane has a very wide freedom of movement. It may be objected that the air cannot be rising uniformly all over the countryside. This is quite true for between columns of uplift the air is found to be descending. Therefore the sail-flying pilot circles in a thermal up-current until he can gain no more height and then sets off across country for the next adjacent patch of

uplift. He flies fast through the descending air so as to cross it with as little loss of height as possible.

The question immediately arises—how to discover areas of thermal uplift and how to stay in them when discovered. The cold front type of uplift associated with thunder clouds can easily be seen, for thunder clouds are prominent objects. A cold front occurs when a wedge of cold air meets an area of warmer air. The warmer air being lighter is forced up and in suitable conditions thunder clouds form at the condensation level. If, therefore, a sail-plane can be launched into the uplift area, which travels in front of a thunderstorm, the pilot can cruise along the front of the storm and proceed across country with it. It is not recommended that pilots fly in the thunder clouds unless they are trained in blind-flying and are equipped with blind-flying instruments and a parachute. The inside of a thunder cloud contains up-currents of great turbulence and it is extremely difficult to maintain steady flight in a cloud unless equipped and trained for blind-flying. The combination of these two facts leads to the possibility of the aircraft breaking up as a result of being flown too fast in the very turbulent conditions which exist. This has been known to happen more than once and a parachute is therefore a very useful insurance.

Thermal uplift other than that due to cold fronts may be a little more difficult to discover. In the first place cumulus clouds are produced by moisture condensing out of rising air currents. Consequently it follows that uplift may be looked for under cumulus clouds that are forming. This uplift extends right up through the cloud and sometimes even above it, but the remarks that were made about flying in thunder clouds apply equally to cumulus. Consequently, the pilot who is not equipped with a parachute keeps away from the cloud base, for there is a real risk of being drawn up into the cloud as if by the hand of God. There are, however, many thermal up-currents which form no cloud at all. There are two factors which are of use in discovering these—an instrument and reasoning. The instrument is called a Variometer and is in effect a sensitive leaky barometer which is calibrated to read in feet per second, rise or fall. If the pilot is lucky enough to fly straight into an area of uplift, the variometer will register 3–5–10 or more ft./sec. climb. The pilot then starts to circle—as vultures are often seen to do—in order to remain in the uplift. If the variometer gives a fairly constant reading all round the circle, then the centre of the circle is approximately in the centre of the uplift, but if the variometer reads considerably more at one side of the circle than the other then it is clear that the circle is out of centre and the pilot should edge the circle over towards the side where the lift is greatest, until the variometer reading remains steady. It is not usual to fly straight into a thermal as described above. What usually

happens is that one wing goes into the uplift and is raised so that the machine tends to slide away from the area in which the pilot wants to be. He must, therefore, turn immediately towards the lifted wing, wait until the variometer shows he is well into the thermal and then start to circle. In looking for areas of thermal uplift it is always worth while to look round and see if any birds are soaring and also to study the ground underneath for, as has been said, ploughed fields, red-roofed houses and many other factors may be quite sufficient to set up thermal currents. If the supply of thermal uplift deserts the pilot for a time he may be able to reach a hill slope up which the wind is blowing and he will then stay up on hill lift until some more thermals come along. If there is neither thermal nor hill lift to be found, the pilot has no alternative but to land.

Having indicated what the sail-plane pilot tries to do it is now proposed to describe how he learns to do it. The method of instruction usually followed is still substantially the same as that developed in Germany and is carried out almost entirely in single-seater machines although a certain amount of dual instruction is given at some clubs. Gliders and sail-planes have controls similar to those found in power-driven aircraft except that having no engine there is no throttle control, and as flying speeds are lower the controls are less sensitive. All machines have a joystick or wheel which controls the ailerons and elevator and a rudder-bar or rudder pedals. Advanced machines may have lift spoilers as well and flaps are included in recent designs. Lift spoilers are small sheet-metal rectangles, which can be erected along part of the upper surface of the wing so that the air, instead of flowing smoothly over the wing, is caused to form eddies. In this way, part of the lift is destroyed. These are intended to steepen the angle of glide so that the very efficient machines may be easier to land in small fields.

Since pupils with no flying experience at all are frequently accepted and taught to fly, the elementary machine on which they learn must be robust (see Fig. 1), have a steep gliding angle so that the early flights will be of short duration (thus shortening the time in which mistakes can be made), and the controls must have but little effect so that in the event of violent movements in the wrong direction, small harm results. In addition, there is no shock-absorbing material between the landing-skid and the seat (spring landing-skids are fragile!) so the pupil feels the full shock of landing and is thus encouraged to land accurately! The pupil is strapped into the seat, has the use of the controls explained to him and is launched for the first time. In order to launch the machine a rubber catapult is used. Two, three or four men hold the machine back by its tail, one holds the wing horizontal and two, three, four or five men haul on each leg of the catapult—an equal number on each side. On the

command " Walk " the catapult numbers walk away stretching the rubber. After six or eight paces they are told " Run " and after another eight to twelve paces the command " Release " is given, when the men on the tail let go and the aircraft moves off. Other methods of launching by motor-car tow, winch, or aero-tow are all used but call for rather more experience on the part of the pilot. On the occasion of the first launch, so little tension is given to the catapult before releasing that the machine never rises at all. The pupil is merely being given experience in getting used to the launching acceleration. After that, " ground-hopping " sets in in earnest and the pupil is gradually allowed to get 2, 5, 10, 20 feet above the ground as he improves in confidence and learns the use of the controls. Steady flying at one stage must be acquired before it is safe to proceed to the next. After three or four good steady straight flights at some 30 feet or more above the ground the pupil is ready for his first test. This is a gliding flight exceeding in duration 30 seconds, which is the qualifying flight for an " A " certificate. At Dunstable, the hill top used for launching, once the ground-hopping stage is passed, is about 250 feet above the landing-ground and the pupil—slightly scared—is pushed off into 250 feet of nothing for the first time in his life (see Fig. 2). It must be pointed out that a long " ground-hop " lasts less than 15 seconds and the pupil's total flying experience when he makes his " A " certificate flight may, therefore, amount to something like 10 or 20 minutes. It is very difficult to get from the top to the bottom of the hill in less than 30 seconds. Thereafter, the pupil has to do two flights exceeding in duration 45 seconds before he is allowed to attempt his " B " certificate, which is a gliding flight exceeding in duration one minute and including a right- and a left-hand turn.

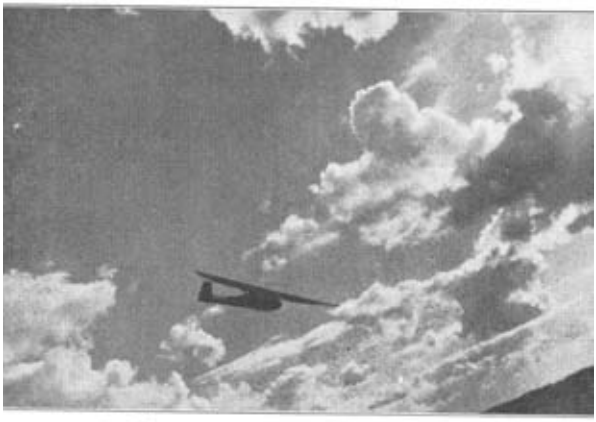
Some time after getting his " B " certificate the pupil is allowed to fly a " faired-in " primary (see Fig. 3), which having a flatter gliding angle may be expected to soar on suitable days. At this stage the pupil must be able to make turns with certainty or he may well find that he cannot get into the landing-ground, for the machine travels much farther on a straight glide, owing to its flatter gliding angle. In this machine the pupil takes his " C " certificate, for which the qualification is a soaring flight carried out above the point of departure exceeding in duration five minutes. For all three certificates the flight must be followed by a normal landing in order to qualify ! Thereafter, as the pupil acquires experience he is gradually promoted to more efficient machines—first intermediate machines and then sail-planes. Aircraft with a sinking speed of 3 feet/second or less are normally classed as sail-planes. Before being allowed to fly sail-planes the pupil should be familiar with the art of side-slipping and other methods of spilling height, for on thermally active days it may call for a little ingenuity to bring an

1.—A primary or training Glider.

2.—Launched into 250 ft. of nothing.

Sail-flying 1& 2

3.—A "faired in" primary.



4.—The next step is to own one's own machine.

5.—All sail-planes are designed to fold into a trailer.

efficient machine down through the uplift. It is highly amusing for the onlookers to see a slightly inexpert pilot get down to some 50 feet from the ground and then be carried up again to 200 or 300 feet but it is very irritating for the pilot.

From now on the pilot begins to reap the reward for his strenuous days of "ground-hopping." To be able to fly in silence without noise, vibration or smell, like a gull over a cliff, is grand indeed. As the ability to use thermal currents is acquired, the interest and pleasure to be obtained from sail-flying becomes ever greater.

The next qualification to be obtained is a "Silver C" certificate and this is a big jump. The qualifications are—a cross-country flight of more than 50 kilometres, a height of more than 1,000 metres and a duration of more than 5 hours. The first and the last of these may not be done in the same flight. It should be noted that the training method outlined above is based chiefly on that employed at the London Gliding Club—different clubs and even different instructors at the same club hold different opinions as to what is sound, but the general principles indicated are fairly universally followed.

It is often asked whether experience in power flying is a help to the sail-plane pilot and the answer is undoubtedly yes. On the occasion of the first few ground-hops it may appear a handicap for the power pilot is so frightened of stalling that he cannot believe it possible to fly as slowly as is required. Training gliders have a stalling speed of about 25 miles an hour and should be flown at about 28 miles an hour. In fact the would-be sail-flying pilot must learn to fly accurately at 2 or 3 miles an hour above the stalling speed. Once a power pilot has cured himself of diving hastily for the ground he will find his knowledge of the air a real help. Power pilots with as little as 100 hours' experience have been known to take their "A" certificate after only twelve ground-hops, where pilots without power experience had had over 90, and as the pilot qualifies for better types of machine, the advantage becomes more apparent. This is because the better machines have more positive controls and are more like a power-driven machine to fly. The power pilot, too, has a wholesome regard for the value of landing dead into wind and without drift, which tends to make him kinder to his machine when landing than are those without power flying experience.

It may be of interest to give some idea of how much it costs to learn to soar. Most clubs have an entrance fee of £1 1s., plus an annual subscription of £3 3s. Flying instruction is charged at something like 3s. 6d. a day during the ground-hopping stage, and 3s. 6d. for half an hour's soaring when the pupil can do it. Sail-planes may be charged at as much as 4s. 6d. for the first half-hour, but flights of one hour or more are charged at the rate of 6s. an hour. The real difficulty and expense in learning is the "ground-hopping" stage.

Since it takes thirteen individuals to make one launch by the catapult method, students are arranged in groups and take it in turns to launch each other. This means that on a good day the student may get as many as 5 ground-hops if he works hard. (Assuming 15 seconds for each "ground-hop," this works out at the rate of £8 8s. an hour in the air !) If he attempts to learn at week-ends only he is liable to forget during the week most of what he learned last time and little or no progress is made. The best thing to do is to join one of the training camps, lasting a fortnight, which most of the gliding clubs organize. The charge is generally about £12 12s. for the fortnight and this covers accommodation, food and flying instruction. Even damage to machines is included, providing it is not the result of disobedience of instructions. In most club flying (apart from camps) the pupil is expected to pay the first £5 of any damage, but damage is surprisingly rare. If the pupil has any aptitude for the sport, a fortnight's camp should see him ready to soar or even soaring if he has been lucky in his weather conditions.

Once the pupil has graduated on to sail-planes, the next step is to own one's own machine (see Fig. 4). This is desirable because flying for more than half an hour in a club machine is often impossible, owing to the queue of people waiting to fly and because some clubs do not welcome the use of their machines for cross-country flying. A machine is best shared by a syndicate of two or three as this ensures a team for erecting the machine and a friend who will come and fetch you with car and trailer after a cross-country flight. (All sail-planes are designed to fold into a trailer, which can be towed behind a car, (see Fig. 5).) Sail-planes cost from £120 to about £250 new and second-hand they may be had from £50 upwards.

A trailer may cost anything from £12 to £40 according to type and size. It is, of course, possible to make one's own sail-plane, but it will be found that this takes at least three times as long as was expected and costs as much as buying a reconditioned second-hand machine. It is no doubt a good education to do so but it is *not* a quick way of owning one's own machine !

Once the machine is purchased, running costs will depend on the pilot. Insurance (3rd party only) costs about £5 a year and storage at a flying club may cost another £5 a year. Certificate of airworthiness costs £1 11s. 6d. to obtain and £1 1s. a year to renew. Maintenance is low providing the machine is carefully handled and is not crashed !

It is interesting to note that in this country the duration record is 13 hours, the longest distance achieved is 104 miles and the greatest height 8,400 feet. All of these could be exceeded in favourable conditions. The world records are 38 hours, 310 miles and 14,100 feet, so we still have a long way to go. As regards distance flights it may be pointed out that in Germany it is possible to go a long way

farther than in Britain before the coast is reached and this is an important factor, for a number of British distance flights have stopped at the coast.

If soaring birds in flight are watched it is seen that they make use of hill lift and thermal lift. It appears possible that some birds achieve dynamic soaring, *i.e.*, they obtain lift from variations in the horizontal velocity of the wind. The sail-flying pilot has not yet achieved dynamic soaring and it seems likely that scale-effect may prevent his ever doing so, but even without it there is plenty for him to learn and he has a wide range of activities.

It is hoped that the foregoing will satisfactorily have disposed of the fear of being blown out to sea. As to why sail-flying pilots don't want a little engine—it can only be said that they are learning to fly with their wits. They do not like being dragged through the air by a fan, for that is a dull method of progression. One manufacturer has incorporated a retractable two-stroke engine and half an hour's petrol supply in one of his designs, so that the machine may be flown off an aerodrome to 1,000 feet or 1,500 feet, from which height thermal soaring is possible on suitable days. This works excellently, but a wing span of nearly 60 feet is needed to support the extra load while one of 50 feet or less gives similar performance without the engine. The extra span does not help the problem of trailer design and towing, so both on grounds of expense and convenience the " little engine " outlook does not appeal to the sail-flying pilot. As to what use it is—if it were no more use than a game of golf it would still be well worth while, for it encourages a great deal of exercise (launching, helping to rig, running up and down hill, etc.) in a pleasant country locality and it is jolly good fun. Those who need a justification for their activities may like to think that no sport can offer better training of an " eye for ground " for the safety of the pilot will often depend on such an eye. Moreover, few sports call in so high a degree for the ability to make the right decision quickly. The air is very intolerant of mistakes. But let it be emphasized in the last sentence that, to the pilot who has once started soaring, no such justifications seem necessary—he doesn't care what use it is, he only knows that it is well worth while.

QUARRYING—NUR ES SHEMS, PALESTINE, 1936.

By LIEUTENANT H. R. CARR, R.E.

1. During the period July-November, 1936, the 42nd Field Company had the running of a Government limestone quarry at Nur es Shems near Tulkarm in Palestine.

2. A dozen to eighteen Sappers were continuously employed here together with some 300 Arab convicts.

3. The Sappers lived in the Convict Camp and helped to defend it against external attack, which was almost nightly.

4. The Camp was about 300 yards distant across a valley from the quarry.

5. The quarry was served by dual gauge railway. The trucks being filled by hopper direct from the three stone crushers which were at a higher level. The crushers were in turn fed by a dozen converging decauville tracks from the quarry face.

6. *Working Organization.*

The labour normally available was organized as follows:—

(*a*) *R.E.*:—

(i) Two compressors, each with two drills worked by a crew of four drillers and one fitter-driver per compressor ..	10
(ii) General supervision and administration	4
Total	14

(*b*) *Natives*:—

(i) Breaking down large boulders by hand boring ..	20
(ii) Breaking down large stone by sledges	20
(iii) Collecting and carrying stone to decauville tracks ..	160
(iv) Pushing trucks 100 yards from quarry face to crushers	18
(v) Operating crushers, etc.	12
(vi) Hand shunting railway wagons	10
(vii) Overhauling tools, etc.	6
(viii) Spare	4
Total	250

7. *Comparison of R.E. and Native Boring Output.*

(*a*) The working day was $7\frac{1}{2}$ hours.

(*b*) During this time each compressor could produce 30 five- to six-foot holes in the hard limestone.

1.—Looking from quarry towards prison camp.

2.—Work at quarry in full swing.

3.—Looking down from quarry face.

Quarrying Nur es Shems, Palestine 1- 3

4.—A sapper giving a convict a lesson in drilling.

5.—Firing a batch of charges.

6.—Drilling operations well up quarry face. The road from Tulkarm to Nablus below.

Quarrying Nur es Shems, Palestine 4 - 6

(*c*) At times when the compressors were laid off for overhaul, convicts bored by hand, producing one hole five to six feet deep per jumping bar manned by two men per day. (Eight-foot bars nearly two inches diameter.)

(*d*) One compressor with two drills and five Sappers therefore did the equivalent of 60 trained native borers per day.

(*e*) As far as possible, an even and vertical face was worked to and holes were bored at six to seven feet apart and lines of holes at six- to seven-foot interval.

8. *Compressors generally.*

(*a*) Each compressor normally worked six days a week.

(*b*) Average amount of petrol used daily on a compressor was twelve gallons, which at service rates cost 9s. 3d. approximately.

(*c*) Average amount of oil used per compressor day was two pints, which at service rates cost 3d.

(*d*) The compressors worked satisfactorily throughout with an average cylinder pressure of 50 pounds per square inch with two rock-drilling machines working. The oil used in sump was M.220 and was changed once a month.

(*e*) The performance of the compressor engines was good. The few minor breakdowns which occurred were repaired the same day. Engines worked seven hours a day, six days a week on the average.

The engine oil was M.220 and appeared to be satisfactory. It was changed every three weeks.

(*f*) The only fault I have to find with the compressors is that they are top heavy as two-wheelers and are very liable to take charge and tip over forward or backward while being man-handled. If of the trailer variety at all, they should be four-wheelers.

9. *Rock-Drilling Machines.*

(*a*) These worked well. The only trouble experienced was with the ratchet pauls which, when the original ones had become unserviceable, were supplied by "Mammer Works" at Haifa. The life of these local pauls was short owing to their tempering being too hard.

The oil used was M.80.

If thicker oil is used the machines fail to work properly and stick up, as was experienced on one or two occasions when M.80 was not available and M.220 was substituted.

(*b*) *Drills.* These were satisfactory, especially the round type which has a larger blow-hole down the centre.

(*c*) *Bits detachable.* Quite a number of these were lost in process of drilling, owing to the weakness of the male portion of the

screw. This loss was reduced by half by inserting an ⅛-inch thick copper washer between the bit and the drill. These washers to a certain extent also saved the bottom of the drill from being damaged when the bit sheared off.

(*d*) *Hose.* The type used was reinforced rubber. After one month's wear it became practically useless, owing to exposure to sun, by heat and constant use over rocks.

(*e*) Convict manning of drilling machines was tried on occasions under Sapper supervision when the R.E. detachment had to leave the quarry to participate in raids, repelling attacks or repair of roads and bridges.

The convicts never learned to handle the tools properly. A large number of drills were stuck and had to be blasted out.

10. *Blasting.*

(*a*) The charges varied from 12 ounces to 1½ pounds, the average being one pound of blasting gelatine in two-ounce cartridges.

(*b*) Ignition was either by No. 6 Commercial Detonators with commercial safety fuze (coloured white), or electrical, also with a commercial type of detonator.

(*c*) Work started in the quarry daily at 0600 hours. Loading of boreholes started at 1000 hours, and by 1330 hours 60 holes were bored, loaded, fuzed, tamped and ready for firing.

(*d*) Five feet—two and a half minute fuzes were allotted. One man had to light eight fuzes and was allowed one minute for this, which on the warning being sounded gave him one and a half minutes to get clear.

(*e*) For lighting the fuzes cigarettes were found to be 100 per cent. more rapid and reliable than matches.

(*f*) Safety-fuzed charges were normally loaded by a special gang of natives. Electrical firing when carried out was done by Sappers.

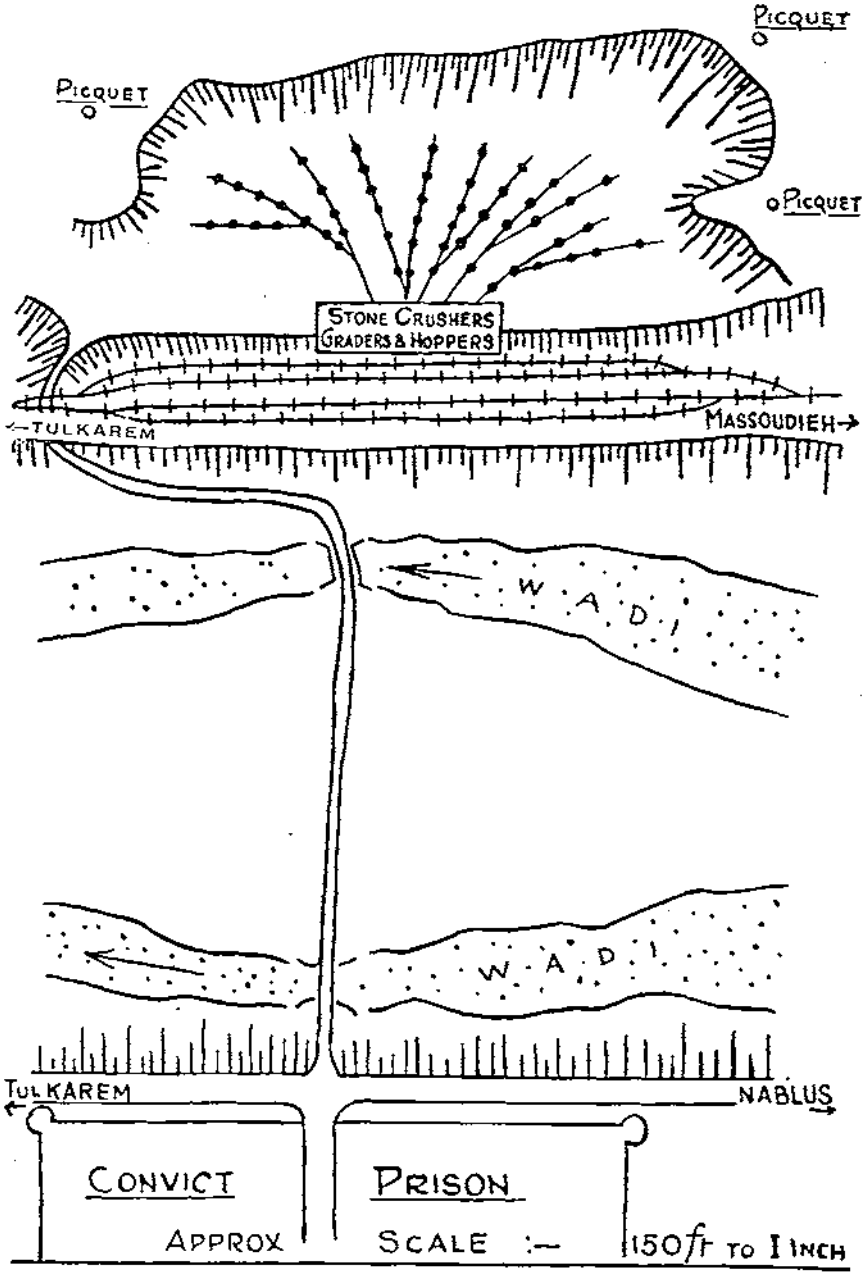
(*g*) The average output of each bore was four cubic yards of stone. Electrical firing seemed to extract about 50 per cent. as much stone again as safety fuze—supposedly due to the simultaneous shock of several dozen charges going off close together.

11. *Output of Quarry.*

(*a*) The average number of railway wagons filled daily with stone of all grades, two crushers working, was 40 12-tonners. A maximum of 70 wagon-loads was occasionally reached.

(*b*) In the early days of the disturbance, this stone chiefly went to the railways, but towards the end it was largely diverted to the P.W.D. for road-work.

NUR ES SHEMS QUARRY, PALESTINE. 1936.



12. *Summary.*

14 Sappers.
2 Compressors at two drilling machines each assisted by :—
250 Expert native quarrymen.

3 Power stone crushers.
60 Pounds explosive
produced on the average (over four months working)—40 12-ton railway wagon-loads of stone daily.

13. *Company Equipment—Air Compressors.*

1. *Description of Air Compressor, Type A.P.V.4.*

Air compressor trailer engine, make—"Oil pumps, Ltd., No. 2, T.S.20 Type," two-wheeled, 31 hundredweight.
Make of engine—Coventry Climax. 4-cylinder.

2. *Tools, pneumatic.*

Concrete Breaker	1 complete.
Hammers, drill	1 without drills.
Machines, wood boring	1 complete.
Picks, light	2 complete.
Drills, steel, 20-inch	4.
„ „ 40-inch	4.
„ „ 60-inch	4.
Detachable bits 1½-inch	48.
„ „ 1⅜-inch	48.
„ „ 1¾-inch	48.
Concretors hose ¾-inch	6.
Pneumatic hose ¾-inch × 50 ft.	6 lengths.

3. *Bits.*

The life of bits varied according to the kind of rock and temper of the bits. On the average, bits had a life of ten working hours.

14. *The lighter side.*

Employment at Nur es Shems was much sought after by the Sappers.

There were many interludes to relieve the monotony of six days a week at the quarry face, such as—chasing escaping convicts; removing land mines and booby traps laid by the Arabs in neighbouring roads and railway tracks, and unloading or destroying them in the quarry; blowing up houses in village raids, and nightly entertainment of preventing the Arabs outside the prison from getting in to release the Arabs inside.

It is related, but the account is probably apocryphal, that an early visitor to the prison one morning after a lively night on the defences, found a dozen weary Sappers fast asleep on the fire steps of the breastworks, each Sapper being shaved by a husky convict, whilst alongside each was a gang of convicts busy cleaning buttons and rifles, clipping up empties, wiping the gore off bayonets, rolling puttees, blacking boots and brewing the Sappers early morning tea. No wonder there was a run on that sunny spot—Nur es Shems!

"ILEX," R.E.Y.C.

A History of the Ship from 1926–1936.

By CAPTAIN L. R. E. FAYLE, R.E.

NOTE.—In Part I of this History, published in the June issue of *The R.E. Journal*, the following errors occurred :—
Page 250, diagram, "Carnegie & Nicholsons, Ltd." should read "Camper & Nicholsons, Ltd."
Page 253. Against the passage in Sept., 1926, from Portsmouth to Gillingham. "30 hours, 31 minutes" should read "31 hours, 30 minutes."

PART II.

7TH FASTNET RACE, 1931.

Starters :—*Neptune*, *Highland Light* (U.S.A.), *Mistress* (U.S.A.), *Patience*, *Jolie Brise*, *Viking*, *Lexia*, *Water Gypsy* (U.S.A.), *Amaryllis*, *Brise-Vent* (France), *Noreen*, *Ariel* (France), *Maitenes II*, *Skal* (U.S.A.), *Amberjack II* (U.S.A.), *Dorade* (U.S.A.) and *Ilex*.

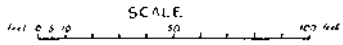
Crew of *Ilex* :—Capt. G. L. Watkinson (skipper), Capt. O. S. G. Sheppard, E. F. Parker, Capt. R. H. B. Longland, Capt. H. F. Barker, D. W. Price, R. P. H. Langrishe, C. A. Biddle and Carter (paid hand).

Course :—As for 1926.

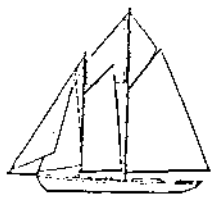
In 1931 the change foreshadowed in 1928 had come over the race, for the specially designed deep-sea racing yacht was well represented in the American contingent. The old regulars were there too, and two fine new British yachts, *Patience* and *Lexia*.

The race started in a calm, but a light air soon came from the westward. In the beat down Channel in light to moderate breezes *Ilex* lost her new hollow topmast, and the spinnaker boom was rigged as a jury. But the delay occasioned dropped her back into 15th place at the Lizard, where *Water Gypsy* led, followed closely by *Dorade*, these two having cleverly worked their tides inshore. From the Lizard it was a quick reach to the Fastnet with a freshening breeze, and the leaders, *Water Gypsy*, *Patience*, *Dorade*, *Highland Light*, *Lexia* and *Mistress*, all rounded the rock within a few hours of one another, about three days out from Cowes. These leaders had an incredibly quick reach and run back to Plymouth, the new Nicholson boat *Patience* finishing first, just ahead of *Highland Light* ; close on their heels came *Water Gypsy*, *Dorade*, *Mistress* and *Lexia* ; *Dorade* had been magnificently sailed to keep up with the far larger

SOME OCEAN RACING YACHTS, 1931-1934




AMBERJACK II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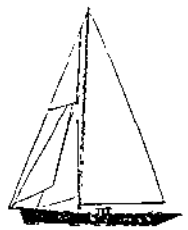
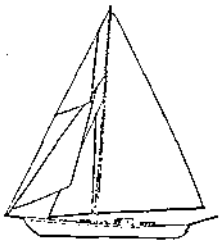
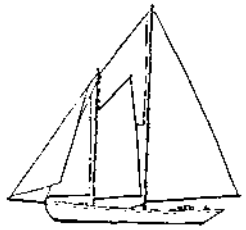

CARMELA (1931)


DORADE

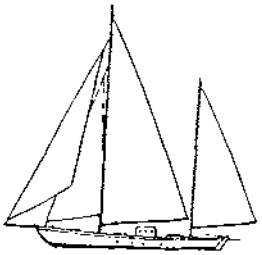

DYARCHY


FLAME

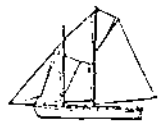

HIGHLAND LIGHT


HYGIE


ILEX (1933-34)


LANDFALL


LEXIA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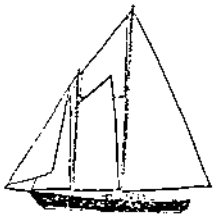
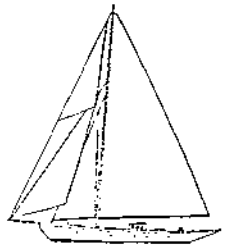

MISTRESS


PATIENCE


WATER GYPSY

and more powerful boats and she took the Fastnet Cup easily on time allowance, while all the other prizes went to Americans.

Ilex was in the second group to round the Fastnet, some twelve hours behind *Water Gypsy*; before she had made the Cornish coast on the return journey, the wind had backed and was blowing a gale, and the ship had a bad hammering before she rounded the Longships and ran up the Cornish coast before a high and confused sea. She finished at Plymouth more than a day behind the leaders and was placed eighth. *Maitenes II*, also in the second group, hit an even worse patch between the Fastnet and the Longships, and while tending oil bags, her part-owner, Col. Hudson, was washed overboard and drowned; the rest of *Maitenes*' crew were taken off by a trawler which towed the ship to Swansea.

The last group in the race met the gale in the neighbourhood of the Fastnet. Some had to heave to, while others got driven off their course, with the result that their times were fantastically long. *Viking*, the last boat home, took over nine days to get round the course.

It had been a great race, marred by the appalling weather in its later stages, which had caused the tragedy of *Maitenes II* in the loss of her gallant part-owner.

Results: Fastnet Race, 1931.

Start at 11 a.m. on 11th August, 1931.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Cut.	Patience ...	45	H. E. West ...	4 5 13 0	4 5 13 0	6th
Bm. Cut.	Highland Light ...	53	Dudley F. Wolfe ...	4 5 14 18	4 3 11 18	4th
Bm. Sch.	Water Gypsy	39	W. MacMillan ...	4 5 35 18	3 18 39 18	2nd
Bm. Yawl	Dorado ...	20	R. and O. J. Stephens	4 6 17 18	3 10 38 33	1st
Bm. Sch.	Mistress ...	52	G. E. Roosevelt ...	4 6 41 25	3 23 0 10	3rd
Cutter	Lexia ...	40	Major T. P. Rose-Richards	4 8 23 57	4 4 58 57	5th
Cutter	Jolie Brise	44	R. Somerset ...	4 21 17 43	4 12 24 43	7th
Yawl	Amaryllis ...	37	R. N. College, Dartmouth ...	5 6 39 53	5 2 23 38	10th
Cutter	Ilex ...	20	R.E.Y.C.	5 9 17 6	4 22 21 6	8th
Cutter	Brise-Vent	33	G. Fortin	5 10 45 6	5 1 22 6	9th
Cutter	Neptune ...	62	Lt.-Col. Chambers	5 10 54 12	5 7 39 27	11th
Cutter	Skal ...	25	R. F. Lawrence ...	6 6 44 42	5 18 47 12	12th
Bm. Cut.	Ariel ...	26	G. Baldenweck ...	7 21 27 28	7 12 13 58	14th
Bm. Sch.	Amberjack II	25	P. D. Rust ...	7 23 2 31	6 15 46 46	13th
Cutter	Viking ...	41	Lt. R. Lindsay Fisher	9 8 12 36	8 11 11 51	15th
Bm. Yawl	Norcen ...	28	M. A. Belleville ...	Gave up	——	—
Bm. Sloop	Maitenes II	25	Lt. W. B. Luard and Col. Hudson ...	Gave up	——	—

2nd Haaks Race, 1932.

Starters:—*Hygie* (France), *Frolic* and *Ilex*.

Crew of *Ilex*:—D. N. B. Hunt (skipper), H. S. Francis, P. L. Wilkinson, T. P. Brown, Capt. H. F. Barker, K. N. Wylie, M. W. Prynne, R. C. Orgill, and Carter (paid hand).

Course :—Burnham-on-Crouch—Smiths Knoll L.V.—Haaks L.V. —Maas L.V.—Harwich. Distance 320 sea miles.

The North Sea races had been inaugurated in 1931, but this year was the first in which *Ilex* took part in them. However, by now the effect of the slump had been reflected in the poor entries for the races. Of the three starters, *Hygie* was a big French Bermudian schooner, and *Frolic* a sturdy ex-Bristol Channel pilot cutter.

The race started with a fresh W.S.W. breeze, and *Ilex* went quickly into the lead : she lost her spinnaker boom in the early stages, but luckily a spare boom had been borrowed, for after the first day the weather was light and variable.

At the Smiths Knoll, *Hygie* was in the lead with *Ilex* last, and a freshening breeze with poor visibility gave a dead beat to the Haaks, round which *Ilex* led, the other two having lost much time in looking for the lightship. In light airs and calms *Ilex* kept her lead round the Maas, but on the last leg, *Hygie* took the lead in a freshening breeze, and finished first, with *Ilex* second, and *Frolic* third. On corrected time, the order was reversed.

This was Dennis Hunt's last race in *Ilex*. In the seven ocean races in which he had skippered the ship, she had won five prizes—one first, two seconds, and three thirds.

RESULTS : HAAKS RACE, 1932.

Start at 4 p.m. on 13th May, 1932.

Rig.	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Sch.	Hygie	... 60	A. Verliac	3 2 23 0	3 2 23 0	3rd
Cutter	Ilex	... 20	R.E.Y.C.	3 4 46 0	3 2 11 20	2nd
Cutter	Frolic	... 35	J. S. and N. A. Bacon	3 5 34 0	3 1 55 20	1st

5TH CHANNEL RACE, 1932.

Starters :—*Hygie* (France), *Patience*, *Vera Mary* and *Ilex*.

Crew of *Ilex* :—H. S. Francis (skipper), Capt. V. F. Craig, Capt. P. L. Wilkinson, E. F. Parker, T. P. Brown, Capt. H. F. Barker, H. Carrington Smith, K. N. Wylie, J. M. Guyon and Carter (paid hand).

Course :—Cowes—Royal Sovereign L.V.—Havre L.V.—Cowes. Distance 234 sea miles.

The Channel race had been held annually since 1928 for small yachts, and now that the Fastnet had become a biennial event, there was a class for larger yachts in the non-Fastnet years. *Ilex* was unfortunate in experiencing a dead beat against heavy South Westerly weather in her passage from Chatham to Cowes, with the result that she arrived at Cowes too late for the start, and crossed

the line over three and a half hours behind the other competitors. In the run to the Royal Sovereign she made good speed, but the wind eased, and light and fickle weather was met round the rest of the course. Though she overhauled some of the small class, she never made up her lost time on the big boats, and took third place in her class, *Vera Mary* having given up.

Results: Channel Race, 1932.

Start on 29th July, 1932. Big class at 10.45 a.m. Small class at 11 a.m.

Rig	Name	Rig	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
			BIG CLASS.			
Bm. Cut.	Patience ...	45	H. E. West... ...	1 14 6 34	1 14 6 34	1st
Bm. Sch.	Hygie ...	60	A. Verliac	1 22 5 36	1 19 49 6	2nd
Cutter	Ilex ...	20	R.E.Y.C.	2 8 42 58	2 4 33 22	3rd
Sch.	Vera Mary	36	V. M. Hamilton-Fletcher	Gave up	——	—
			SMALL CLASS			
Cutter	Spica ...	22	Mr. and Mrs. Hunt	1 20 16 43	1 14 10 7	1st
Bm. Cut.	Windhover	8	Maj. G. Henderson	2 10 43 10	1 21 31 28	2nd
Cutter	White Heather	13	W. H. Watkins ...	2 12 7 43	1 23 7 43	3rd
Cutter	Altair ...	14	Maj. N. M. Vibart	2 19 20 8	2 14 47 8	4th
Cutter	Illawarra ...	8	J. F. B. Gage ...	Gave up	——	—

In order to bring the corrected times of the small class in keeping with those of the big class, a time corresponding to the difference in rating between the scratch boats of the big class and of the small class has been subtracted from the official corrected times for the small class. This applies also in the case of the results of the 1934 Channel Race and of the 1935 Belle-Ile Race as given in this article.

1st Heligoland Race, 1933.

Starters:—*Frolic*, *Cornubia*, *Duet*, *Jenny Wren*, *Ilex*, *Curlew*, *Lora*, and *Falcon*.

Crew of *Ilex*:—Capt. W. M. Blagden (skipper), J. de V. Hunt, Capt. J. A. Davies, R. P. H. Langrishe, A. N. Clarke, W. R. G. Walker, and Carter (paid hand).

Course:—Burnham-on-Crouch—Sunk L.V.—Heligoland. Distance 310 sea miles.

In 1933 the Haaks Race was discontinued, and the more popular race to Heligoland took its place. There were eight starters, though these were all of the ordinary cruiser type. The race was sailed in fine settled weather with light Easterly and North Easterly breezes and smooth sea, and close hauled work the whole way across. *Duet*, *Frolic*, and *Ilex* walked away from the others from the start, and literally had a race on their own.

At the Sunk, *Duet* led with *Ilex* second and *Frolic* third, but later *Frolic*, by judicious sailing, managed to get into the lead. She finished first at Heligoland with *Duet* a close second. *Ilex* got a flat calm for the last few miles and was placed third, finishing about two hours after *Frolic*. *Lora*, the fourth boat home, reached Heligoland more than a day after *Ilex*.

It had been an easy and pleasant sail in fine weather.

RESULTS: HELIGOLAND RACE, 1933.

Start at 5 p.m. on 2nd June, 1933.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Frolic ...	35	J. S. and N. A. Bacon	2 13 25 53	2 13 25 53	1st
Yawl	Duet ...	22	A. Courtauld ...	2 13 52 59	2 13 42 39	2nd
Cutter	Ilex ...	20	R.E.Y.C.	2 15 27 36	2 14 56 36	3rd
Sch.	Lora ...	16	J. Scrivens and F. Venning	3 17 53 15	3 9 47 35	5th
Cutter	Jenny Wren	22	C. & T. Davey ...	3 18 28 48	3 12 52 58	6th
Cutter	Cornubia ...	33	Lord Churston ...	3 18 53 38	3 17 36 8	7th
Ketch	Falcon ...	12	C. F. and K. Mason	3 19 25 0	3 8 13 20	4th
Cutter	Curlew ...	18	Dr. E. Williams ...	3 21 8 32	3 18 18 2	8th

8TH FASTNET RACE, 1933.

Starters :—*Brilliant* (U.S.A.), *Lexia*, *Grenadier* (U.S.A.), *Flame*, *Dorade* (U.S.A.), and *Ilex*.

Crew of *Ilex* :—H. S. Francis (skipper), Capt. P. L. Wilkinson, J. de V. Hunt, L. R. E. Fayle, K. N. Wylie, J. M. Guyon, P. N. M. Moore, and T. P. Watkins (cook).

Course :—Cowes—Needles—Fastnet Rock—St. Catherines—Spithead. Distance 720 sea miles.

The Fastnet Race of 1933 was different in every way from its predecessors. It was sailed in July, instead of in August, the normal month for the event. The course had been lengthened by over 100 miles to finish in the waters of the Wight, and the slump had brought down the total number of starters to six, of which three were Americans. It was a small field, but the standard of the starters was high.

The race started in warm sunny weather, and these conditions, with fickle breezes from the west, and patches of calm, lasted for the first three days. *Flame* and *Dorade* went right ahead and fought out a race on their own. *Ilex* and the three others were in company off and on down to Land's End. Here *Ilex* hit a softer patch of weather and fell back into last place.

Half-way over to the Fastnet, the wind improved and the big jib blew out. *Ilex* was still about 60 miles short of the rock, *Dorade* and *Flame* had rounded 6 to 8 hours before and the other three were then on the point of rounding. Worse still, as the Irish coast was approached the wind fell light and headed *Ilex* so that she finally rounded the Fastnet twelve hours after the fifth boat, *Brilliant*.

Light weather continued for a few hours after rounding, but soon a grand North Easterly breeze sprang up, and the ship started to travel, averaging nearly 8 knots for a whole day. Off Start Point the breeze died and then came from the South West, giving a fast spinnaker run to St. Catherines and a close reach to the finish.

Flame was first home and took third prize on corrected time: *Dorade*, second to finish, won the Fastnet Cup for the second time and the new Jolie Brise Cup as well. *Ilex*, last to finish, had closed on the leaders on the homeward trip but failed to save her time on any of the starters.

It had been the first really light weather Fastnet Race.

Results: Fastnet Race, 1933.

Start at 11 a.m. on 22nd July, 1933.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Bm. Cut.	Flame ...	33	C. E. Nicholson ...	5 18 15 6	5 15 51 6	3rd
Bm. Yawl	Dorade ...	20	R. and O. J. Stephens	6 0 23 15	5 4 59 15	1st
Sch.	Brilliant ...	46	W. Barnum ...	6 1 12 23	5 16 48 23	4th
Bm. Sch.	Grenadier	39	H. A. and S. Morss	6 1 14 37	5 12 14 37	2nd
Cutter	Lexia ...	40	Major T. P. Rose-Richards	6 2 31 56	6 2 31 56	5th
Cutter	Ilex ...	20	R.E.Y.C.	6 13 44 0	6 2 44 0	6th

2nd Heligoland Race, 1934.

Starters:—*Nanette III*, *Nebula*, *Carmela*, *Cornubia*, *Karin III*, *Zoraida*, *Dyarchy*, *Duet*, *Goodewind* (Holland), *Ilex*, *Curlew*, *Thalassa*, *White Heather*, and *Isis*.

Crew of *Ilex*:—Capt. W. M. Blagden (skipper), Capt. P. L. Wilkinson, J. de V. Hunt, Capt. G. C. MacM. Kavanagh, Capt. J. A. Davies, R. P. H. Langrishe, H. Carrington Smith, and Carter (paid hand).

Course:—As for 1933.

The 1934 Heligoland Race was a great improvement on the previous year's event, for there were fourteen entries including several fast ships as well as some of the old stagers.

The race was sailed throughout in light to moderate South Westerly breezes, giving a reach and run for the whole course.

Nebula and *Nanette III*, the two big boats, quickly drew ahead and made a great race of it the whole way across. A second group was formed by *Carmela* (the new Watts cutter), *Ilex*, and the old straight stemmer *Zoraida*. *Ilex* was well navigated and gave nothing away, with the result that she finished an hour after *Carmela* and half an hour ahead of *Zoraida*. She had averaged 6·5 knots over the course, and saved her time on the big boats, but the fair and freshening breeze brought the long handicap boats in close on her heels so that

she took fourth prize on corrected time, the first three prizes going to *Isis*, *White Heather* and *Thalassa*.

RESULTS: HELIGOLAND RACE, 1934.

Start at 1.30 p.m. on 18th May, 1934.

Rig	Name	Tons	Owners	Elapsed Time d.	h.	m.	s.	Corrected Time d.	h.	m.	s.	Place
Bm. Cut.	Nanette III	50	C. C. McNiel ...	1	19	5	32	1	19	5	32	11th
Bm. Cut.	Nebula ...	50	F. G. Mitchell ...	1	20	24	1	1	19	48	31	12th
Bm. Cut.	Carmela ...	35	G. E. W. Potter ...	1	22	36	43	1	16	12	19	7th
Cutter	Ilex ...	20	R.E.Y.C.	1	23	40	22	1	14	43	33	4th
Cutter	Zoraida ...	28	Capt. F. Ratsey ...	2	0	24	17	1	15	58	59	6th
Bm. Yawl	Thalassa ...	16	G. Napier Martin ...	2	1	36	15	1	14	39	3	3rd
Bm. Ketch	Goodewind	21	C. Bruynzeel ...	2	1	58	44	1	15	26	20	5th
Yawl	Duet ...	22	A. Courtauld ...	2	3	32	14	1	18	55	50	10th
Cutter	White Heather	13	W. H. Watkins ...	2	3	49	31	1	10	2	36	2nd
Cutter	Isis ...	12	W. B. de St. Croix	2	4	29	46	1	9	6	46	1st
Cutter	Dyarchy ...	24	R. A. P. Pinckney	2	5	30	2	1	16	34	32	8th
Cutter	Karin III ...	30	Miss E. I. Dorrien-Smith	2	6	25	31	1	17	26	23	9th
Cutter	Curlew ...	18	Dr. E. Williams ...	2	8	2	34	1	21	10	32	13th
Cutter	Cornubia ...	33	Lord Churston ...	2	8	13	15	1	21	56	52	14th

7TH CHANNEL RACE, 1934.

Starters (big class) :—*Ilex* and *Lucette*.

Crew of *Ilex* :—Capt. P. L. Wilkinson (skipper), L. R. E. Fayle, Major B. E. C. Dixon, D. W. Price, K. N. Wylie, P. N. M. Moore, T. P. Watkins, R. G. H. Phillimore, and Carter (paid hand).

Course :—As for 1932.

The entry for the big class was very disappointing, though the small class mustered fourteen starters. *Lucette*, our only competitor, was a much smaller and slower boat than *Ilex* ; we had to allow her over seven hours, and did not expect to see much of her. Our chief interest lay in an unofficial race with Mr. Hunt's *Spica* in the small class.

The start was in a moderate Westerly breeze, and *Ilex*'s jackyarder was torn when hoisting, so the jib header replaced it. *Ilex* quickly dropped *Lucette* as soon as she got going, but *Spica* in the small class starting 15 minutes after us was only 10 minutes behind at the Owers L.V. At the Royal Sovereign, *Ilex* still led by 10 minutes, the wind having fallen light, but on the leg to the Havre *Spica* passed her and got a commanding lead which she increased on the return journey with the wind freshening and heading.

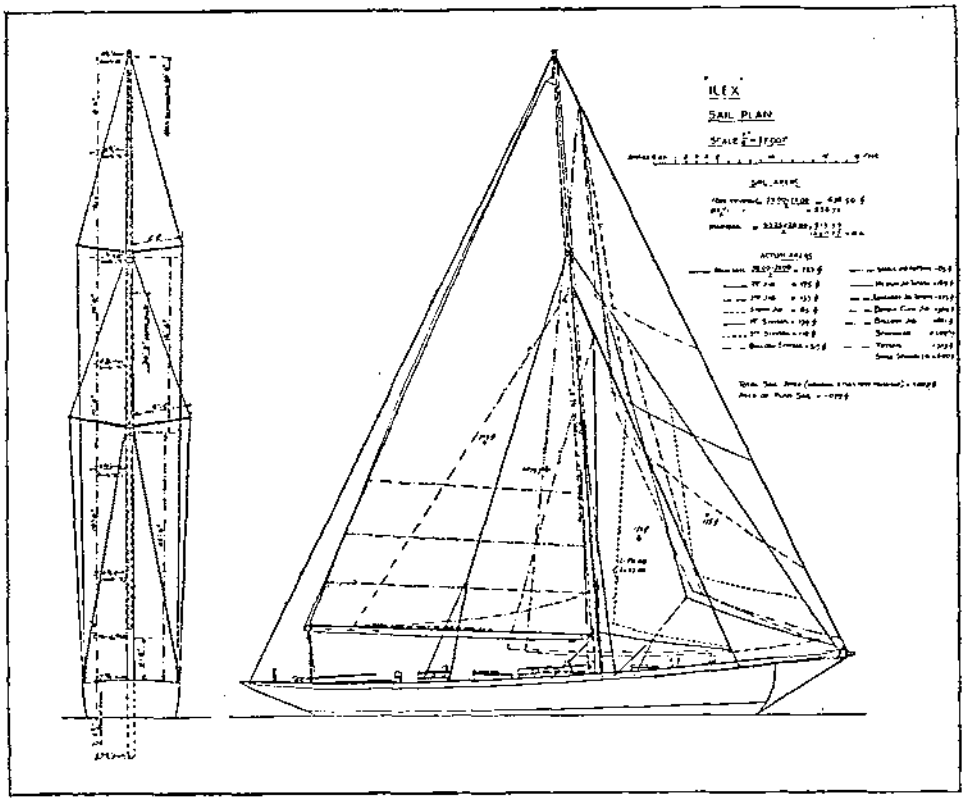
In the final beat up Spithead to Cowes against a falling breeze and foul tide, *Ilex* did badly, and she was actually passed by *Iolaire* in the small class before making the finishing line.

Lucette, whom we had not seen since the Owers, arrived about 10 hours after us, so *Ilex* won in her class, though half of the small class could have saved their time on her. This was a somewhat unimpressive victory for the ship in her last race as a gaff-rigged boat.

RESULTS: CHANNEL RACE, 1934.

Start on 3rd August, 1934. Big class at 10.15 a.m. Small class at 10.30 a.m.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s	Corrected Time d. h. m. s.	Place
			BIG CLASS.			
Cutter	Ilex ...	20	R.E.Y.C.	1 19 22 0	1 19 22 0	1st
Sch.	Lucette ...	19	J. C. Ponsonby ...	2 4 50 0	1 21 44 7	2nd
			SMALL CLASS.			
Cutter	Spica ...	22	Mr. and Mrs. Hunt...	1 16 18 21	1 16 9 46	3rd
Cutter	Iolaire ...	17	Col. J. S. Alston ...	1 18 57 28	1 17 26 59	5th
Bm. Yawl	Thalassa ...	16	G. Napier Martin ...	1 19 53 33	1 18 9 25	7th
Cutter	Nona ...	18	H. E. Sadd ...	1 20 43 15	1 16 31 42	4th
Cutter	White Heather	13	W. H. Watkins ...	1 21 25 28	1 14 32 4	1st
Bm. Cut.	Gauntlet ...	12	H. G. May	1 23 21 23	1 15 11 9	2nd
Ketch	Singora ...	18	M. R. K. Jerram ...	2 1 30 0	1 22 59 27	10th
Bm. Cut.	Windhover	8	Maj. G. Henderson	2 2 26 0	1 18 1 7	6th
Yawl	Bruna ...	12	G. B. Ash	2 6 43 30	2 3 15 14	15th
Yawl	Dozmare ...	9	Miss U. M. Carver	2 6 49 0	1 19 53 48	9th
Bm. Cut.	Aimée Leone	10	R. Chetwode ...	2 6 56 0	2 0 18 35	12th
Cutter	Sunshine ...	8	C. F. King	2 7 14 30	1 18 32 50	8th
Bm. Cut.	Cygnet ...	13	G. D. Lock	2 8 29 0	2 0 23 3	13th
Cutter	Alethea II	8	R. Radcliffe ...	2 9 32 0	2 0 45 6	14th
Sch.	Meriel ...	9	A. H. Fynn	2 9 58 30	1 23 46 59	11th



Sail plan of *Ilex*. Bermudian cutter rig. As re-rigged in the winter of 1934–35.

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3RD HELIGOLAND RACE, 1935.

Starters :—*Asta* (Germany), *Ettsi IV* (Germany), *Carmela*, *Rose*, *Kaptein Harm* (Germany), *Jupiter* (Germany), *Senta* (Germany), *Das Wappen von Bremen* (Germany), *Goodewind* (Holland), *Ilex*, *Scharhorn* (Germany), *Sybilla*, *Larry*, *De Ruland von Bremen* (Germany), *Cooya*, *Lora* and *Hajo* (Germany).

Crew of *Ilex* :—M. T. L. Wilkinson (skipper), Capt. D. R. Crone, D. W. Price, K. N. Wylie, R. E. Gabbett, Capt. J. A. Davies, Capt. J. A. B. Grylls, Capt. F. J. R. Heath, and Carter (paid hand).

Course :—As for 1933.

This year, owing to the splendid number of entries, including nine German ships, the race was started in three classes, and prizes were given for each class. *Ilex* was in the middle class, her rivals being *Jupiter*, *Senta*, *Goodewind* and *Larry*.

The year produced conditions for a fast passage such as can hardly be expected again in a lifetime, with strong South Westerly breezes blowing for the whole trip, reaching moderate gale force and more at times. *Ilex* made a late start under her new Bermudian main, double reefed, but was soon up to the others in her class. In the run down the Whittaker Channel, with the boats yawing wildly at over eight knots, collisions with *Larry* and *Goodewind* seemed imminent, but the moments of tension were soon past as open water was reached. *Senta* and *Goodewind* went ahead and *Larry* kept in close company with *Ilex*, but *Jupiter* dropped astern.

There was a rough sea for the whole passage and two men were required at the helm at times, moreover *Ilex* was somewhat out of trim and could not work up to her maximum speed. The reaching staysail was set as a spinnaker for a time, and towards the end of the race one reef was shaken out and the big spinnaker set with the wind taking off.

Larry got ahead of *Ilex* before the finish, and took first prize in the middle class, and third for the combined classes. Her performance had been phenomenal, for, though only 33 feet on the waterline, she had averaged 8·41 knots for the whole course. *Ilex* averaged 8·36 knots and took third prize in her class and sixth in the combined classes. *Hajo* in the small class was winner of the combined classes, but her performance, though excellent, was hardly as meritorious as *Larry's*.

The scratch boat, *Asta*, had finished first and averaged nearly 11 knots, but on corrected time she was nowhere.

This was the fastest ocean race yet sailed.

RESULTS: HELIGOLAND RACE, 1935.

Start on 7th June, 1935. Big class at 2.20 p.m. Middle class at 2.40 p.m. Small class at 3.0 p.m.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Yawl	Asta ...	75	Marine Regatta Verein	1 4 38 24	1 4 38 24	14th
Yawl	Rose ...	32	C. F. King	1 8 56 15	1 2 15 50	12th
Bm. Cut.	Carmela ...	35	G. E. W. Potter ...	1 9 18 54	0 23 39 43	5th
Bm. Kth.	Kaptein Harm	31	J. Haltermann ...	1 11 18 54	1 1 2 31	9th
Ketch	Senta ...	28	H. Schmidt ...	1 12 19 25	0 22 3 18	4th
Cutter	Larry ...	17	W. H. Watkins ...	1 12 48 45	0 21 19 47	3rd
Bm. Kth.	Goodewind	21	C. Bruynzeel ...	1 12 52 35	1 0 9 59	7th
Bm. Kth.	Ettsi IV ...	55	Wassersportliche Vereinigte Alter Corpsstudenten	1 12 59 52	1 6 0 51	17th
Bm. Cut.	Ilex ...	20	R.E.Y.C. ...	1 13 4 31	0 23 57 7	6th
Bm. Kth.	Das Wappen von Bremen	23	S.K. "Das Wappen von Bremen" ...	1 17 35 10	0 19 56 16	2nd
Bm. Kth.	Jupiter ...	31	S.K. "Das Wappen von Bremen" ...	1 17 49 58	1 2 56 8	13th
Sch.	Lora ...	16	F. Norman ...	1 18 13 33	1 1 2 48	10th
Bm. Yawl	Scharhorn II	18	H. W. Petersen ...	1 19 5 37	1 4 56 44	16th
Bm. Kth.	Hajo ...	15	Dr. Perlia and Dr. Lutowski	1 19 31 52	0 19 19 0	1st
Yawl	Cooya ...	16	E. Gore-Lloyd ...	1 21 5 14	1 0 18 32	8th
Bm. Kth.	De Ruland von Bremen	17	S.K. "Das Wappen von Bremen" ...	2 1 59 0	1 4 43 21	15th
Ketch	Sybilla ...	18	H. M. Duff-Still ...	2 3 35 14	1 1 40 35	11th

9TH FASTNET RACE, 1935.

Starters:—*Hygie* (France), *Trenchemer*, *Kismet III*, *Carmela*, *Banba*, *Foxhound*, *Brise-Vent* (France), *Rose*, *Tai-Mo-Shan*, *Stormy Weather* (U.S.A.), *Amy*, *Emmeline*, *Maud*, *Ilex*, *Isis* (France), *Macnab*, and *Thalassa*.

Crew of *Ilex*:—Capt. W. M. Blagden (skipper), Capt. H. S. Francis, Capt. H. A. Macdonald, J. de V. Hunt, Capt. L. R. E. Fayle, K. N. Wylie, Capt. A. MacG. Stewart, J. H. Gillington, and Carter (paid hand).

Course:—Yarmouth (Isle of Wight)—Needles—Fastnet Rock—Plymouth. Distance 585 sea miles.

The Fastnet Race of 1935 was probably the most successful that has yet been sailed. Not only were the latest and fastest ocean racers well represented in the starters, but, as in 1931, no less than seventeen yachts came to the line. The new British cracks were *Foxhound* and *Trenchemer*; *Stormy Weather*, the American entry, was an improved and more powerful *Dorade*, and a dark horse was the new and untried French racer, *Isis*. With these competitors and many others scarcely less dangerous, the chances of the 36-year-old *Ilex* for a place seemed remote, even with her smart new Bermudian sail plan.

The race started with a light South Westerly breeze which soon died,

and for the first 30 hours of the race the winds were very light and variable, with much spinnaker drill. By this time, the light weather boats had pulled away from the others, and the leaders were down beyond the Prawle. *Stormy Weather* led, followed by *Kismet III*, *Trenchemer*, *Rose*, *Emmeline*, *Ilex*, *Foxhound* and *Carmela* in that order, with the rest nowhere. *Ilex* had done well in the light airs.

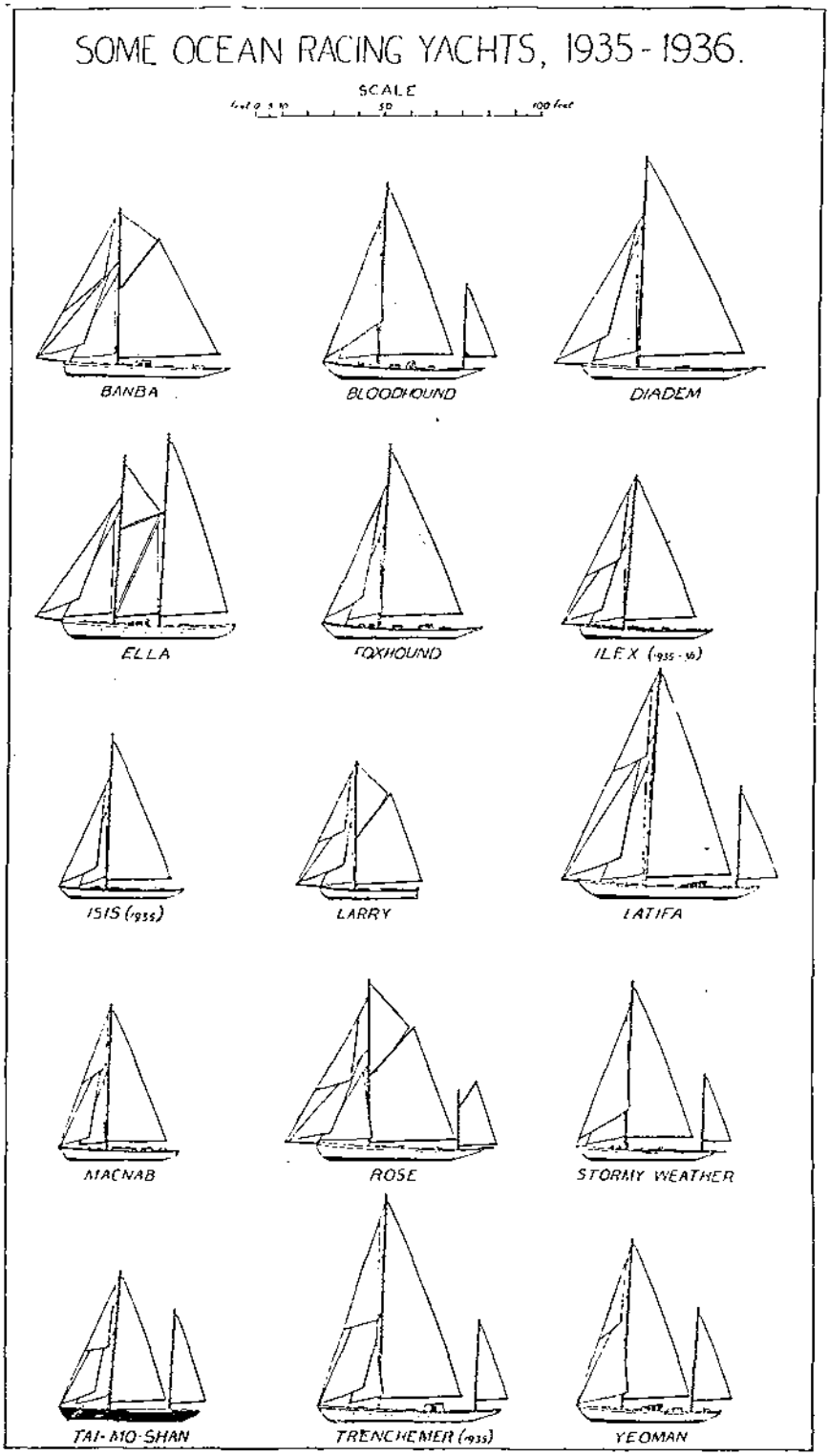
The breeze now came from the N.W. and freshened; *Ilex's* bobstay carried away off the Eddystone, and while a jury was being rigged, *Foxhound* and *Carmela* went ahead. Clear of the Lizard it was practically a dead beat to the Fastnet, with a slowly freshening and backing breeze. *Ilex* was lying eighth, but, like *Foxhound*, she made her westing early, before the wind backed in earnest. For the last 120 miles she was able to lay the Fastnet in one tack, carrying double clew jib, staysail, and full main, and making 7 to 8 knots against a fresh breeze and lumpy sea.

Foxhound, showing her true form, was first to round the rock, with *Kismet III*, *Trenchemer*, and *Stormy Weather* after her within one hour. *Ilex* was next, five hours later, having got well ahead of *Rose*, *Emmeline* and *Carmela* on the beat. A quick reach took her back to the Longships, where the wind died and she lay kedged in a foul tide for 3 hours while *Rose*, holding a faint breeze out to sea, came up from astern and went ahead. The leaders found light airs and calms up the Cornish coast, and *Kismet III* finished first, with *Trenchemer* and *Stormy Weather* close behind. *Foxhound* had thrown away her chances by getting too much to the northward at the Longships, and she finished ten hours after *Stormy Weather*. *Ilex* crawled to the Lizard and then had a freshening North Westerly breeze which brought her to Plymouth soon after *Rose*. After she had finished, the

RESULTS: FASTNET RACE, 1935.

Start at 3 p.m. on 7th August, 1935.

Rig	Name	Tons	Owners	Elapsed Time d.	h.	m.	s.	Corrected Time d.	h.	m.	s.	Place
Bm. Cut.	Kismet III	50	Colin Newman ...	4	11	1	54	4	11	1	54	5th
Bm. Yawl	Trenchemer	50	W. D. M. Bell ...	4	12	31	58	4	3	9	23	2nd
Bm Yawl	Stormy Weather	28	P. le Boutillier ...	4	12	44	15	3	20	40	57	1st
Bm. Cut.	Foxhound	33	Isaac Bell	4	22	32	51	4	10	59	37	4th
Yawl	Rose ...	32	C. F. King	5	0	54	54	4	18	10	21	11th
Bm. Cut.	Ilex ...	20	R.E.Y.C.	5	2	7	24	4	7	7	25	3rd
Bm. Sloop	Emmeline	25	F/O G. R. Canavan	5	3	14	18	4	18	4	24	9th
Bm. Sch.	Hygie ...	60	A. Verliac	5	3	40	20	4	18	43	6	12th
Bm. Cut.	Carmela ...	35	G. E. W. Potter ...	5	5	33	3	4	16	41	4	8th
Bm. Yawl	Thalassa ...	16	G. Napier Martin	5	10	38	11	4	11	32	33	6th
Bm. Cut.	Isis ...	19	G. Baldenweck ...	5	10	49	48	4	11	33	36	7th
Bm. Cut.	Macnab ...	18	J. J. Joass	5	20	58	46	4	18	8	24	10th
Bm. Kth.	Tai-Mo-Shan	30	The Admiralty ...	5	20	59	1	4	20	27	46	13th
Cutter	Brise-Vent	33	G. Fortin	5	22	28	31	5	5	45	14	14th
Cutter	Amy ...	28	Sub.-Lt. McGeogh	7	6	1	12	Not known				15th
Cutter	Banba ...	34	A. Rosling ...	Gave up				——				—
Ketch	Maud ...	21	Gp. Capt. B. A. Playne	Gave up				——				—


SOME OCEAN RACING YACHTS, 1935 - 1936.
SCALE
50
100 feet
BANBA
BLOODHOUND
DIADEM
ELLA
FOXHOUND
ILEX (1935 - 36)
ISIS (1935)
LARRY
LATIFA
MACNAB
ROSE
STORMY WEATHER
TAI-MO-SHAN
TRENCHEMER (1935)
YEOMAN

breeze held and brought the tail enders in rapidly, but on corrected time *Stormy Weather* was the winner, with *Trenchemer* second and *Ilex* third.

It had been the most exciting Fastnet yet, in which *Ilex's* new rig had fully justified itself. Her performance against new boats had been a surprise, for in addition to her third prize, she won the Jolie Brise Cup as well.

2ND BELLE-ILE RACE, 1935.

Starters: (big class):—*Hygie* (France), *Trenchemer*, *Lelanta* (U.S.A.), *Diadem*, *Lexia*, *Venture IV*, *Carmela*, *Banba*, *Foxhound*, *Zig-Zag* (France), *Brise-Vent* (France), *Rose*, *Karin III*, *Iroise IV* (France), *Yanna* (France), *Ilex*, *Isis* (France) and *Chough*.

Crew of *Ilex*:—Capt. H. S. Francis (skipper), D. W. Price, K. N. Wylie, Capt. R. B. Emerson, A. F. M. Jack, J. H. S. Bowring, W. A. Shaw, B. G. Bloomer and Carter.

Course:—Plymouth—Le Palais (Belle-Ile). Distance 251 sea miles.

The Belle-Ile Race had been inaugurated in 1934, and its popularity was shown in the big field for the 1935 race. Most of the Fastnet cracks except *Stormy Weather* came to the line, as well as a number of French yachts.

The start was in a moderate South Westerly breeze and *Ilex* did well until her bobstay carried away once again less than an hour after the gun. Repairs were quickly carried out, *Ilex* made up most of her lost ground in a falling breeze, and on the morning of the second day at sea she was less than three miles behind the leading yacht, *Trenchemer*.

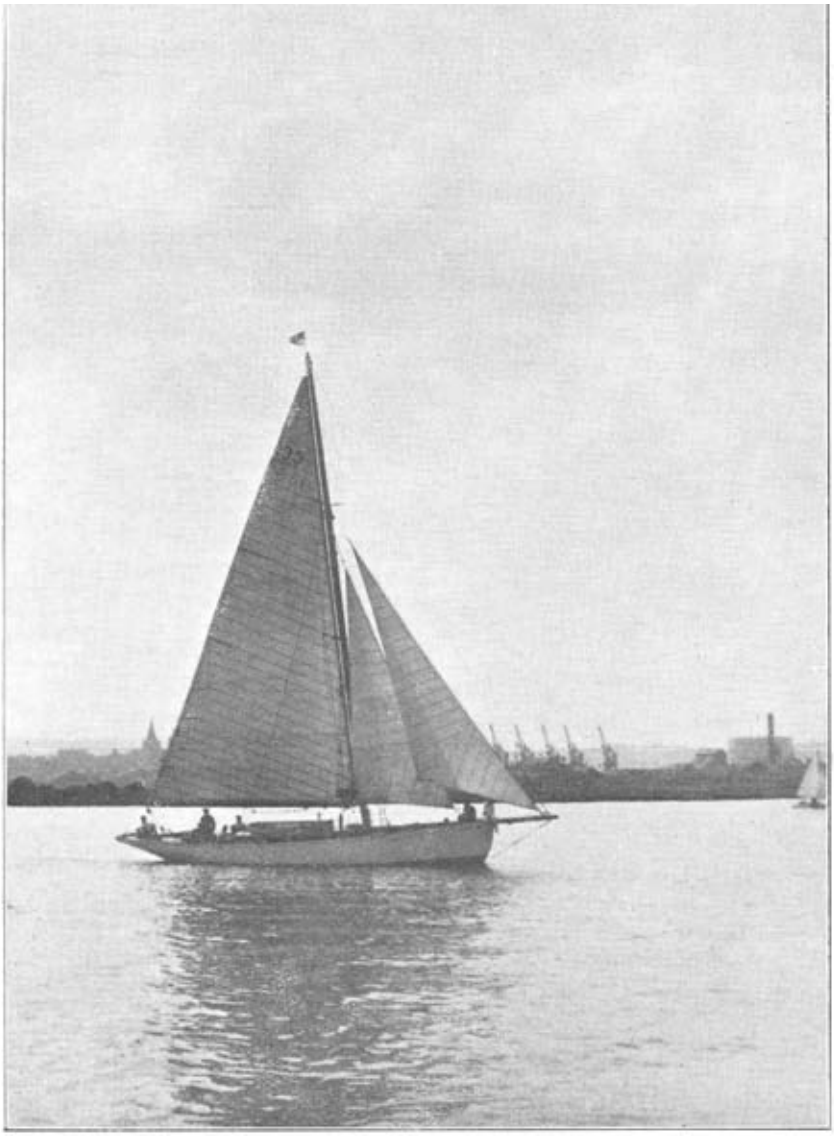
Light airs and calms were met with over the whole course. *Trenchemer* and *Foxhound* worked a good lead on the rest, but *Ilex* was generally well placed in the second bunch, which included *Rose*, *Diadem*, *Carmela*, and *Lelanta*. She was lucky enough to catch her tide off the Ar-Men buoy, but light airs in the last stage of the approach to Belle-Ile made the finish a tedious one. *Trenchemer* and *Foxhound* easily took first and second places respectively, while *Ilex*, seventh to finish, took third prize on corrected time.

It had been an exceptionally light weather race, the slowest in which *Ilex* has yet sailed.

There followed a race from Le Palais to Benodet in which *Ilex* was placed third, while on corrected time for the two races combined, she won the Coupe Challenge Interclub.

3.—"Ilex" as a Bermudian Cutter under Genoa and main in the Le Palais-Benodet Race, August 1935.

Ilex - 3



4.—"Ilex" as a Bermudian Cutter under Plain Sail in the Medway. R.E.Y.C. Rowing Regatta, 1936.

RESULTS: BELLE-ILE RACE, 1935.

Start on 17th August, 1935. Big class at 11 a.m. Small class at 11.15 a.m.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
			BIG CLASS.			
Bm. Yawl	Trenchemer	50	W. D. M. Bell ...	2 16 39 40	2 15 22 16	1st
Bm. Cut.	Foxhound	33	Isaac Bell	2 18 16 25	2 16 2 58	2nd
Yawl	Rose ...	32	C. F. King	3 2 37 20	3 2 27 43	5th
Bm. Cut.	Carmela ...	35	G. E. W. Potter ...	3 4 15 48	3 1 41 26	4th
Bm. Cut.	Diadem ...	41	Ralph Hawkes ...	3 4 18 43	3 4 18 43	7th
Sch.	Lelanta ...	50	R. St. L. Peverley...	3 6 10 5	3 3 37 49	6th
Bm. Cut.	Ilex ...	20	R.E.Y.C.	3 6 26 38	3 1 3 41	3rd
Cutter	Banba ...	34	A. Rosling	3 6 47 47	3 4 54 35	8th
Cutter	Lexia ...	40	Major T. P. Rose-Richards	3 6 53 15	3 5 9 26	9th
Bm. Cut.	Isis ...	19	G. Baldenweck ...	3 15 1 0	3 6 42 46	10th
Bm. Sch.	Hygie ...	60	A. Verliac	3 15 27 0	3 14 20 29	12th
Cutter	Karin III ...	30	Miss E. Innes Dorrien-Smith ...	3 17 45 0	3 7 28 23	11th
Bm. Sch.	Zig-Zag ...	33	Robert Zunz ...	3 17 45 11	3 16 16 30	13th
Cutter	Brise-Vent	33	G. Fortin	4 8 40 0	4 4 13 31	14th
Bm. Sch.	Iroise IV ...	26	Dr. J. Gouin de Roumilly ...	4 9 45 0	4 6 31 44	15th
Ketch	Venture IV	36	E. R. Barrow ...	Gave up	——	—
	Yanna ...		A. Samzun	Gave up	——	—
Bm. Cut.	Chough ...	17	W. A. Mein ...	Gave up	——	—
			SMALL CLASS.			
Cutter	Spica ...	22	Mr. and Mrs. Hunt...	3 7 1 0	3 3 5 29	1st
Bm. Cut.	Chinkara ...	15	Dr. J. M. Brydone	4 8 25 0	4 4 28 22	4th
Yawl	Cooya ...	16	E. Gore-Lloyd ...	4 10 5 0	3 21 29 57	3rd
Ketch	Sybilla ...	18	H. M. Duff-Still ...	4 10 25 0	3 20 17 28	2nd
Yawl	Wych ...	14	Dr. C. E. Pepper ...	Gave up	——	—

4TH HELIGOLAND RACE, 1936.

Starters:—*Asta* (Germany), *Orion* (Germany), *Trenchemer*, *Ingorata* (Germany), *Boekanier* (Holland), *Banba*, *Rose*, *Kaptein Harm* (Germany), *Edith* (Germany), *Jupiter* (Germany), *Tai-Mo-Shan*, *Karin III*, *Senta* (Germany), *Das Wappen von Bremen* (Germany), *Spica*, *Stoertebeker* (Germany), *Ilex*, *Narwal* (Germany), *Sybilla*, *Larry*, *De Ruland von Bremen* (Germany), *Cooya*, *Lora*, *White Heather* and *Isis*.

Crew of *Ilex*:—Capt. D. R. Crone (skipper), R. E. Gabbett, Major E. E. Read, Capt. F. C. Nottingham, Capt. A. M. Anstruther, M. W. Prynne, J. H. Carver, J. W. G. Whyte, and Carter (paid hand).

Course:—As for 1933.

The Heligoland Race seemed to be growing in popularity, for twenty-five starters came to the line, a record for this side of the Atlantic, and with many of the 1935 ships and such fine vessels as *Trenchemer* among the entries, there was a prospect of a fine race. As in 1935, the race was started in three classes to avoid confusion.

At the start, there was a moderate North Westerly breeze blowing, but before nightfall it backed and fell very light, and the spinnaker was carried for several hours. On the evening of the second day,

however, the wind went round to the North East and freshened so much that two reefs had to be tied in the main—very hard work. The ship settled down to a weary beat in a lumpy sea, and it was not till the evening of the third day that the wind had moderated sufficiently for the reefs to be shaken out. During the last 24 hours of the race, *Banba*, *Senta*, and *Larry* were at times in company with *Ilex*.

The wind fell light near the finish, and *Ilex* finally crossed the line sixth out of twenty-five starters, taking third prize on corrected time. *Larry*, finishing soon after *Ilex*, took first prize, with *Senta* second, and *Trenchemer* fourth.

This was the first Heligoland Race in which hard head winds were encountered, and these conditions are reflected in the results, for eight of the twenty-five starters gave up.

RESULTS: HELIGOLAND RACE, 1936.

Start on 29th May, 1936. Big class at 5.30 p.m. Middle class at 5.45 p.m. Small class at 6 p.m.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Yawl	Asta ...	75	Marine Regatta Verein	2 4 15 38	2 7 41 6	8th
Bm. Cut.	Trenchemer	50	W. D. M. Bell ...	2 8 2 20	2 2 14 18	4th
Yawl	Rose ...	32	C. F. King ...	2 8 41 47	2 3 16 15	5th
Wishbone Ketch	Senta ...	28	H. Schmidt ...	2 12 42 39	2 0 25 11	2nd
Cutter	Banba ...	34	A. Rosling	2 14 49 30	2 6 10 26	7th
Bm. Cut.	Ilex ...	20	R.E.Y.C.	2 15 16 0	2 2 4 48	3rd
Cutter	Larry ...	17	W. H. Watkins ...	2 15 27 50	2 0 0 15	1st
Bm. Kth.	Kaptein Harm	31	J. Haltermann ...	2 17 45 15	2 8 3 34	9th
Bm. Kth.	Tai-Mo-Shan	30	The Admiralty ...	2 20 39 18	2 3 46 36	6th
Bm. Sch.	Boekanier	46	W. Ruys	3 3 50 0	2 18 43 0	15th
Bm. Kth.	Narwal ...	18	Marine Regatta Verein	3 6 25 26	2 11 9 19	10th
Ketch	Ingorata	47	W. Colsman ...	3 12 25 45	2 21 10 45	17th
Bm. Kth.	Das Wappen von Bremen	23	S.K. "Das Wappen von Bremen" ...	3 12 44 0	2 13 11 5	13th
Bm. Cut.	Stoertebeker	21	Marine Regatta Verein	3 13 10 54	2 19 34 0	16th
Sch.	Edith ...	31	Akadem S. Zu Greifswald ...	3 13 31 0	2 16 57 59	14th
Ketch	Sybilla ...	18	H. M. Duff-Still ...	3 15 41 0	2 11 27 9	11th
Bm. Kth.	De Ruland von Breman	17	S.K. "Das Wappen von Bremen" ...	3 16 36 37	2 12 2 24	12th
Bm. Slp.	Orion ...	50	Marine Regatta Verein	Gave up	——	—
Bm. Kth.	Jupiter ...	31	H. Noltenius ...	Gave up	——	—
Cutter	Karin III ...	30	Miss E. Innes Dorrien-Smith ...	Gave up	——	—
Cutter	Spica ...	22	Mr. and Mrs. Hunt...	Gave up	——	—
Yawl	Cooya ...	16	E. Gore-Lloyd ...	Gave up	——	—
Sch.	Lora ...	16	F. Norman ...	Gave up	——	—
Cutter	White Heather	13	J. H. Widham ...	Gave up	——	—
Cutter	Isis ...	12	W. B. de St. Croix	Gave up	——	—

9TH CHANNEL RACE, 1936.

Starters: (big class):—*Ella*, *Latifa*, *Trenchemer*, *Bloodhound*, *Banba*, *Yeoman*, *Vagus*, *Varuna*, *Rosemary IV*, *Neith*, *Ilex*, *Isis* (France), *Chough* and *Dolly Varden*.

Crew of *Ilex* :—Capt. L. R. E. Fayle (skipper), E. F. Parker, Capt. A. MacG. Stewart, T. M. T. Bostock, Major C. C. Duchesne, R. G. H. Phillimore, W. A. Shaw, J. H. S. Bowring and Carter (paid hand).

Course :—Southsea—Royal Sovereign L.V.—Havre L.V.—Spithead. Distance 221 sea miles.

This year the big class in the Channel Race was well supported for a change, and moreover the starters, which included *Trenchemer* and the two new ocean racers *Bloodhound* and *Latifa*, were, as a whole, of Fastnet calibre.

At the start, a strong West South West wind was blowing and visibility was poor. The whole fleet, except *Rosemary IV*, *Chough* and *Vagus*, which gave up in the early stages, made a fast run to the Royal Sovereign in a biggish sea. *Ilex* at that point lay fifth to *Trenchemer*, *Latifa*, *Bloodhound* and *Ella*. On the leg to the Havre the wind remained fresh, and *Ilex*, still carrying full main, laying the lightship without tacking, and luckily finding it in the poor visibility without difficulty, rounded fourth, just ahead of *Ella*.

On the homeward leg, the wind headed and became light and fluky, and visibility became good. *Ilex* got into a soft patch, and *Neith* and *Banba* overhauled her : off the Nab she repassed them but was in turn overhauled by *Ella*. *Trenchemer* finished first but took second place to *Bloodhound* on corrected time. *Ilex* finished fifth, beating *Latifa* and *Ella* on corrected time, but taking fifth place when *Dolly Varden* and *Isis* came in within an hour of her to save their time for third and fourth prizes.

This was the fastest Channel race so far sailed, though the heavy weather in the early part of the race caused fourteen of the twenty starters in the small class to give up.

Results : Channel Race, 1936.

Start on 31st July, 1936. Big class at 11 a.m. Small class at 11.15 a.m.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
			BIG CLASS.			
Bm. Yawl	Trenchemer	50	W. D. M. Bell ...	1 7 9 52	1 4 14 52	2nd
Bm. Yawl	Bloodhound	34	Isaac Bell	1 8 1 31	1 3 27 40	1st
Bm. Yawl	Latifa ...	53	M. H. Mason ...	1 9 1 20	1 6 22 48	6th
Bm. Sch.	Ella ...	56	W. R. S. Bond ...	1 13 47 25	1 8 46 59	10th
Bm. Cut.	Ilex ...	20	R.E.Y.C.	1 13 59 54	1 6 4 27	5th
Cutter	Banba ...	34	A. Rosling	1 14 2 33	1 8 46 14	9th
Cutter	Neith ...	21	Maj. G. Henderson	1 14 4 2	1 8 46 6	8th
Bm. Cut.	Dolly Varden	17	T. C. Ratsey ...	1 14 31 28	1 5 7 39	3rd
Bm. Cut.	Varuna ...	28	R. R. C. Vernon ...	1 14 31 40	1 8 25 18	7th
Bm. Cut.	Isis ...	19	G. Baldenweck ...	1 14 59 54	1 5 57 16	4th
Bm. Kth.	Yeoman ...	30	O. A. Aisher ...	1 17 22 15	1 9 8 48	11th
Cutter	Vagus ...	29	E. J. Pratt ...	Gave up	——	—
Bm. Slp.	Rosemary IV	25	S. S. Taylor ...	Gave up	——	—
Bm. Cut.	Chough ...	17	W. A. Mein ...	Gave up	——	—

SMALL CLASS.

Rig	Name	Tons	Owners	Elapsed Time d. h. m. s.	Corrected Time d. h. m. s.	Place
Cutter	Larry ...	17	W. H. Watkins ...	1 17 23 10	1 7 18 12	3rd
Bm. Cut.	Macnab ...	18	J. J. Joass... ...	1 17 24 15	1 6 35 21	Disq.
Bm. Cut.	Driac ...	13	M. H. Jones ...	1 19 54 30	1 7 9 10	2nd
Bm. Cut.	Lady Maud	10	H. C. Devitt and A. G. Wilson ...	1 22 22 31	1 9 59 1	4th
Cutter	Nona ...	18	H. E. Sadd ...	1 22 27 15	1 10 21 10	5th
Yawl	Lady Belle	8	B. G. A. Scott ...	1 22 31 9	1 4 56 6	1st
Cutter	Spica ...	22	Mr. and Mrs. Hunt...	Gave up	——	—
Ketch	Sybilla ...	18	H. M. Duff-Still ...	Gave up	——	—
Bm. Yawl	Sylvia ...	12	Norman Jones ...	Gave up	——	—
Bm. Cut.	Viola ...	12	A. R. Lapthorn ...	Gave up	——	—
Bm. Cut.	Greengage	12	F. A. Pitel	Gave up	——	—
Bm. Cut.	Osprey ...	12	O. Hook	Gave up	——	—
Bm. Cut.	Gauntlet ...	12	Lord Churston ...	Gave up	——	—
Cutter	Venture ...	12	L. Bruford ...	Gave up	——	—
Cutter	Coquette ...	9	Miss M. E. Wiles ...	Gave up	——	—
Bm. Sch.	Meriel ...	9	A. H. Fynn ...	Gave up	——	—
Bm. Kth.	Alethea III	9	J. G. H. Cockburn	Gave up	——	—
Cutter	Alethea II	8	R. Radcliffe ...	Gave up	——	—
Cutter	Lady Beatrice	8	C. M. B. Cumberlege	Gave up	——	—
Bm. Slp.	Blue Bird	6	Lt.-Com. Illingworth and others ...	Gave up	——	—

An attempt has been made to show in these brief accounts how ocean racing has progressed from small beginnings to a great and international sport, and how the R.E.Y.C. has tried, with *Ilex*, to contribute to the progress. That *Ilex* has had some measure of success so far is well known, but she will be hard put to it to hold her own in the future. Apart from the increasing competition all round, other Service yacht clubs are now taking a hand: the Royal Navy's *Tai-Mo-Shan* has raced against us already: the Gunners had much success with *Cygnet* last year in the small classes, and now Col. King has presented them with our old friend *Rose*. The Highland Brigade Yacht Club are understood to be bringing *Saladin* back into the game, and things will not stop at that. Racing is likely to be keener than ever, and one can only hope that *Ilex* will continue to be sailed hard and with judgment. Those who, like the writer, love the old ship, want to see her continuing to worry the newer and faster yachts for many years to come: but when she is finally outclassed, it is hoped that the R.E.Y.C. may be able to build a new ocean racer to carry on the tradition that *Ilex* has started. We may, however, hope that that day is still far distant, and with this thought in mind, this article may be closed with a quotation from Mr. Alfred F. Loomis' excellent book *Ocean Racing*—perhaps the nicest compliment that has ever been paid to the old ship: "As the years go on, and bigger and better pumps are built, the old lady will continue as the most consistent threat in any race for which she enters."

Bibliography.—The foregoing brief accounts of ocean races may be supplemented by the following longer accounts :—

Fastnet Race, 1925.—"Fulmar in the Ocean Race," by Capt. R. M. H. Lewis, M.C., R.E., *R.E.J.*, March, 1926, Vol. XL, pp. 112–121.

Fastnet Race, 1926.—"Ilex in the Ocean Race," by One of the Crew, *R.E.J.*, March, 1927, Vol. XLI, pp. 146–154.

Fastnet Race, 1928.—"The Fastnet Cup Race," by Capt. B. E. C. Dixon, M.C., R.E., *R.E.J.*, December, 1928, Vol. XLII, pp. 668–673.

Fastnet Race, 1929.—"Ilex in the Fastnet Race," by One of the Crew, *R.E.J.*, December, 1929, Vol. XLIII, pp. 648–656.

Santander Race, 1929.—"Ilex in the first Plymouth to Santander Race, August, 1929," by Capt. W. G. Fryer, R.E., *R.E.J.*, March, 1930, Vol. XLIV, pp. 112–121.

Fastnet Race, 1930.—"The Fastnet Race, 1930," by Anon., *R.E.J.*, June, 1931, Vol. XLV, pp. 296–301.

Santander Race, 1930.—"The Queen of Spain's Cup," by Helmsman, *R.E.J.*, March, 1931, Vol. XLV, pp. 118–124.

Atlantic Race, 1931.—"The Transatlantic Venture," by Capt. W. G. Fryer, R.E., *R.E.J.*, December, 1931, Vol. XLV, pp. 656–676.

Fastnet Race, 1931.—"The Fastnet Race, 1931," by Capt. R. H. B. Longland, R.E., *R.E.J.*, June, 1932, Vol. XLVI, pp. 274–280.

Haaks Race, 1932.—*Supplement to R.E.J.*, June, 1932, Vol. XLVIII, pp. 155–157.

Heligoland Race, 1933.—*Supplement to R.E.J.*, September, 1933, Vol. XLIX, pp. 240–241.

Fastnet Race, 1933.—"The Fastnet Race, 1933," by Lieut. L. R. E. Fayle, R.E., *R.E.J.*, March, 1934, Vol. XLVIII, pp. 127–136.

Heligoland Race, 1934.—*Supplement to R.E.J.*, September, 1934, Vol. L, pp. 269–271.

Channel Race, 1934.—*Supplement to R.E.J.*, September, 1934, Vol. L, pp. 271–272.

Heligoland Race, 1935.—*Supplement to R.E.J.*, July, 1935, Vol. LI, pp. 217–219.

Fastnet Race, 1935.—"Ilex in the Fastnet Race, 1935," by Capt. L. R. E. Fayle, R.E., *R.E.J.*, December, 1935, Vol. XLIX, pp. 603–613.

Heligoland Race, 1936.—*Supplement to R.E.J.*, July, 1936, Vol. LII, pp. 212–215.

Channel Race, 1936.—*Supplement to R.E.J.*, September, 1936, Vol. LII, pp. 275–278.

LEADING PARTICULARS OF YACHTS SAILING IN OCEAN RACES IN WHICH *ILEX* OR *FULMAR* HAVE TAKEN PART.

Yacht	Date Built	Tons T.M.	Len. O.A. ft.	Len. W.L. ft.	Beam ft.	Draught ft.	Rig	Y.R.A. Sail Area sq. ft.
Aimée Leone	1934	10	36·7	29·1	9·0	6·0	Bm. Cutter	
Alethea II	1910	8	31·5	25·0	8·5	5·5	Cutter	497
Alethea III	1935	9	34·5	26·0	9·0	5·0	Bm. Ketch	
Altair	1909	14	38·0	30·0	10·0	6·5	Cutter	
Amaryllis	1882	37	63·0	53·0	13·0	10·2	Yawl	2280
Amberjack II (U.S.A) ...	1931	25	45·7	34·5	12·9	6·2	Bm. Sch.	1188
Amy	1887	28	48·0	44·0	13·0	7·5	Cutter	1210
Ariel (French)	1930	26	53·1	43·0	12·6	7·2	Bm. Cutter	
Asta (Germany)	1895	75	88·8	59·3	15·9	14·0	Yawl	3621
Avocet	1897	52	71·8	58·0	14·5	9·1	Yawl	
Banba	1898	34	64·3	50·8	12·9	9·7	Cutter	2010
Banba IV	1911	20	38·0	34·2	12·0	7·0	Ketch	
Bloodhound	1936	34	63·4	45·0	12·5	9·1	Bm. Yawl	1595
Blue Bird	1910	6	34·3		6·9		Bm. Sloop	573
Boekanier (Dutch)	1929	46	64·7	44·8	14·6	7·5	Bm. Sch.	2177
Brilliant (U.S.A.)	1932	46	61·5	49·0	14·7	8·8	Schooner	*2040*
Brise-Vent (French) ...	1928	33	49·9	45·9	13·8	7·7	Cutter	1820
Bruna	1894	12	45·6	32·0	9·1	5·7	Yawl	
Cariad	1905	32	51·7	42·0	13·4	7·8	Cutter	

Yacht	Date Built	Tons T.M.	Len. O.A. ft.	Len. W.L. ft.	Beam ft.	Draught ft.	Rig	Y.R.A. Sail Area sq. ft.
Carmela	1934	35	59·0	46·6	13·3	7·8	Bm. Cutter	1900
Chinkara	1903	15	46·6	34·7	10·3	7·9	Bm. Cutter	
Chough	1891	17	38·6	36·0	10·8	7·7	Bm. Cutter	
Content	1914	19	40·9	38·0	11·0	7·6	Cutter	
Cooya	1914	16	40·3	33·0	11·5	6·5	Yawl	
Coquette	1900	9	35·0	26·0	8·8	6·0	Cutter	823
Cornubia	1911	33	50·5		13·8		Cutter	1562
Curlew	1876	18	44·0		11·0	6·5	Cutter	1271
Cygnet	1907	13	32·4	31·6	10·6	6·8	Bm. Cutter	769
Das Wappen von Bremen (German)		*23*	40·7	33·4	12·2		Bm. Ketch	936
De Ruland von Bremen (German)		*17*	36·8	31·1	11·1		Bm. Ketch	632
Diadem	1907	41	67·0	49·0	13·7	9·7	Bm. Cutter	2210
Dolly Varden	1872	17	36·8	35·3	11·2	6·5	Bm. Cutter	1132
Dorade (U.S.A.)	1930	*20*	52·2	37·0	10·3	7·7	Bm. Yawl	*1160*
Dozmare	1898	9		28·5	9·2		Yawl	
Driac	1930	13	39·5	30·5	10·0	6·2	Bm. Cutter	858
Duet	1912	22	50·0	38·0	11·1	6·5	Yawl	1575
Dyarchy	1901	24	41·0	39·0	12·7	7·5	Cutter	*1250*
Edith (German)		*31*	50·8	38·2	13·9		Schooner	1690
Ella	1935	56	67·2	54·0	15·0	10·2	Bm. Wishbone Sch.	2381
Emmeline	1912	25	60·0	36·8	11·1		Bm. Sloop	1348
Ettsi IV (German)	1923	55	65·2	48·8	14·4		Ketch Bm. Ketch	2463
Falcon	1906	12		30·5	9·6		Ketch	878
Flame	1900	33	63·5	48·0	12·1	8·2	Bm. Cutter	1741
Foxhound	1935	33	63·2	45·0	12·5	9·1	Bm. Cutter	1501
Frolic	1905	35	55·0	48·0	13·4	9·3	Cutter	1557
Fulmar	1901	14	41·0	33·0	9·7	6·5	Cutter	918
Gauntlet	1934	12	36·7	30·5	9·5	5·5	Bm. Cutter	
Goodewind (Dutch)		*21*	49·4		11·2		Bm. Ketch	
Greengage	1935	12	36·7	30·5	9·5	5·5	Bm. Cutter	687
Grenadier (U.S.A.)	1931	*39*	59·4	43·1	13·8	8·2	Bm. Sch.	
Grey Fox	1897	33	60·0	48·0	12·6	8·5	Ketch	
Gueurveur (French) ...		48	63·3		15·9		Yawl	
Gull	1897	18	49·5	37·1	10·1		Cutter	1483
Hajo (German)		*15*	37·4	30·8	11·5		Bm. Ketch	559
Halloween	1926	51	70·5	46·6	14·5	8·8	Bm. Cutter	*2750*
Highland Light (U.S.A.) ...	1931	53	61·8	50·0	15·3	9·2	Bm. Cutter	2585
Hope	1895	29	47·6	42·5	13·5	8·2	Cutter	
Hygie (French)	1930	60	67·0	53·0	16·0	10·0	Bm. Sch.	2640
Ilex	1899	20	51·0	41·5	10·4	7·5	Yawl Cutter Bm. Cut.	1565 1420 1290
Illawarra	1924	8	30·0	27·5	8·5	4·5	Cutter	
Inconnue (French)	1930	49	61·8	47·0	15·8	8·5	Schooner	
Ingorata (German)		*47*	59·2	45·5	15·5	8·1	Ketch	2092
Iolaire...	1905	17	45·5	35·0	10·5	7·5	Cutter	
Iroise IV (French)	1935	*26*	50·5	41·3	12·1	7·8	Bm. Sch.	
Isis	1909	12	31·7	30·3	10·5		Cutter	987
Isis (French)	1935	*19*	48·1	35·2	11·1	7·0	Bm. Cutter	1012
Jenny Wren	1926	22	38·6	36·0	12·5	6·3	Cutter	1204
Jessie L.	1887	27			13·3		Bm. Cutter	
Jolie Brise	1913	44	56·1	48·0	15·7	9·5	Cutter	
Jupiter (German)		*31*	52·8	41·3	13·4		Bm. Ketch	1176
Kaptein Harm (German) ...		*31*	63·2	41·9	12·4	9·3	Bm. Ketch	1407
Karin III	1919	30	41·5		14·3	6·0	Cutter	1484
Kismet III	1909	50	75·0	49·8	13·7	9·5	Bm. Cutter	2236
L'Oiseau Bleu (French) ...	1896	18		37·1	10·1		Cutter	
La Goleta (U.S.A.)	1927	29	54·0	39·0	12·7	7·3	Schooner	
La Railleuse (French) ...	1929	50	61·0	45·9	15·9	8·5	Schooner	
Lady Belle	1909	8	28·0	26·8	9·1	6·6	Yawl	635
Lady Beatrice		8	27·5	26·7	9·0		Cutter	550

Yacht	Date Built	Tons T.M.	Len. O.A. ft.	Len. W.L. ft.	Beam ft.	Draught ft.	Rig	Y.R.A. Sail Area sq. ft.
Lady Maud	1907	10	38·7	28·0	9·0	7·0	Bm. Cutter	828
Landfall (U.S.A.)	1931	91	71·0	59·9	18·0	10·8	Bm. Ketch	*2950*
Larry	1907	17	38·3	33·0	11·0		Cutter	1217
Lassie	1894	29		48·3	11·7		Yawl	
Latifa	1936	53	69·7	52·5	15·3	10·2	Bm. Yawl	2639
Lelanta (U.S.A.)	1930	50	65·5	46·5	14·6	8·8	Schooner	2494
Lexia	1931	40	64·0	49·7	13·4	8·8	Cutter	*2180*
Lismore (U.S.A.)	1920	*61*	72·0	56·0	15·8	9·0	Ketch	
Lora	1907	16	42·2	35·0	10·3	6·0	Schooner	861
Lucette	1922	19	39·5	36·0	11·4	5·0	Schooner	
Macnab	1935	18	46·7	35·0	10·7	7·0	Bm. Cutter	*990*
Magnet	1928	34	51·0	44·0	14·0	8·0	Cutter Schooner	
Maitenes	1907	17	46·7	32·0	10·3	5·8	Cutter	
Maitenes II	1929	25	49·8	38·0	12·1	7·8	Bm. Cut. Bm. Sloop	1417 1286
Mamago		19		40·5	10·5		Cutter	
Maria del Carmen (Spanish)	1925	68	76·0		16·5	10·0	Schooner	
Maud	1899	21	42·1	35·0	11·4	6·6	Ketch	
Meriel	1930	9	32·0	27·7	8·2	5·7	Schooner Bm. Sch.	679
Mistress (U.S.A.)	1930	52	60·5	50·0	15·6	9·7	Bm. Sch.	2326
Mohawk (U.S.A.)	1928	*44*	60·4	46·2	14·4	8·7	Schooner	*2260*
Morwenna	1914	28	55·0	44·0	12·1	6·7	Schooner	
Nanette III	1910	50	75·2	*49·0*	13·6	9·0	Bm. Cutter	2449
Narwal (German)	74·0	*18*	45·1	32·6	11·1	4·9	Bm. Ketch	897
Nebula	1907	50	74·0	55·3	14·2		Bm. Cutter	2803
Neith	1908	21	52·8	37·6	10·6	7·5	Cutter	1553
Nellie	1887	12	36·6	31·0	10·0	5·0	Cutter	
Neptune	1918	62	60·4	49·2	16·2	10·0	Cutter	
Nicanor (U.S.A.)	1927	*39*	57·7	42·4	14·5	7·7	Schooner	
Niña (U.S.A.)	1928	49	59·0	50·0	14·9	10·0	Bm. Sch.	2167
Nona	1900	18	41·0		11·9		Cutter	1195
Noreen	1917	28	64·0	39·4	11·0	8·3*	Bm. Yawl	
North Star	1925	37	48·7		14·6		Ketch	
Orion (German)		*50*	78·7	59·0	13·2	11·4	Bm. Sloop	1907
Osprey	1936	12	36·7	30·5	9·5	5·5	Bm. Cutter	687
Patience	1931	45	68·0	50·0	13·8	9·3	Bm. Cutter	*2510*
Penboch	1901	12	33·9	31·0	9·4	7·0	Cutter	
Primrose IV (U.S.A.) ...	1923	*28*	50·0	40·0	13·2	7·0	Schooner	*1390*
Rose	1899	32	65·0	47·6	12·1	8·7	Yawl	2313
Rosemary IV	1928	25	54·0	36·3	11·8	7·2	Bm. Sloop	1249
Saladin	1907	33	49·0	43·2	14·2	8·5	Cutter	
Saoirse	1922	20	42·0	37·0	12·2	6·8	Brigantine	
Scharhorn II (German) ...		*18*	45·3	32·8	10·9		Bm. Yawl	918
Senta (German)		*28*	53·1	37·7	13·1		Ketch Wishbone Ketch	1371 1512
Shira	1904	21	45·0	36·5	11·5	6·0	Cutter	
Singora	1897	18	45·0	35·0	10·7	6·4	Ketch	
Skal (U.S.A.)	1930	25	48·0	37·5	12·5	7·0	Cutter	1445
Spica	1915	22	50·0	34·0	11·5	6·2	Cutter	
Stortebeker (German) ...		*21*	48·3	36·9	11·3		Bm. Cutter	928
Stormy Weather (U.S.A.) ...	1934	28	53·9	39·7	12·5	7·9	Bm. Yawl	*1290*
Sunshine	1931	8	27·6		9·0		Cutter	502
Sybilla	1905	18	39·0	34·5	11·4		Ketch	964
Sylvia	1898	12	42·6	31·0	8·8	6·3	Bm. Yawl	718
Tai-Mo-Shan	1933	30	54·7	42·0	12·2	8·4	Bm. Ketch	*1060*
Tally Ho	1910	29	47·6	44·2	12·7	7·5	Cutter	502
Thalassa	1906	16	47·5	35·0	10·2		Yawl Bm. Yawl	1044
Trenchemer	1934	50	72·0	53·5	14·8	10·5	Bm. Yawl Bm. Cutter	2242 2062
Uraba III (Colombian) ...	1928	22	53·5	41·0	11·8	7·2	Yawl	
Vagus		29	41·7	39·0	14·0		Cutter	1127

Yacht	Date Built	Tons T.M.	Len. O.A. ft.	Len. W.L. ft.	Beam ft.	Draught ft.	Rig	Y.R.A. Sail Area sq. ft.
Varuna	1909	28	60·0	42·0	11·5	7·5	Bm. Cutter	1462
Vega (French)	1928	*29*	52·4	37·7	13·7	6·9	Bm. Sch.	
Venture		12	35·0	34·0	9·5		Cutter	864
Venture IV	1925	36	53·0	43·0	13·8	7·3	Ketch	
Vera Mary	1932	36	61·0	43·5	13·4	9·0	Bm. Sch.	
Viking	1925	41	48·3	41·0	15·3	7·5	Cutter	
Viola	1908	12	41·0	28·0	9·4	6·2	Bm. Cutter	790
Water Gypsy (U.S.A.) ...	1931	*39*	59·1	43·2	13·8	8·0	Bm. Sch.	1990
White Heather	1907	13	35·7	30·6	11·2	6·3	Cutter	
Windhover	1904	8	32·2	27·5	9·0	5·2	Bm. Cutter	
Wych	1880	14	36·5	31·5	11·0	6·0	Yawl	
Yanna (French)								
Yeoman	1936	30	56·0	40·5	12·7	8·2	Bm. Ketch	1469
Zoraida	1888	28	52·0		12·7	6·7	Cutter	1653
Ziz-Zag (French)	1924	33	60·0	46·5	13·0	7·1	Bm. Sch.	

Note :—Italics indicate approximate figures.

(*Concluded.*)

Maj Gen R N Harvey CB CMG DSO

MEMOIRS.

MAJOR-GENERAL R. N. HARVEY, C.B., C.M.G., D.S.O. COLONEL COMMANDANT R.E.

MAJOR-GENERAL ROBERT NAPIER HARVEY, who died at his home at Pyrford on February 15th, 1937, was one of the R.E. officers who made a marked contribution to the success of the British military operations in the war. He was a man of strong character and physique and of untiring energy. He had a very kind heart, combined with a deep sense of duty and a hatred of all forms of pretence or of any kind of inefficiency.

These qualities made him a loyal and affectionate friend, but possibly rather a hard taskmaster to those with whom he had to find fault.

He never spared himself and his combination of ability and vast industry caused one of his staff to write: "He really knew everyone's job better than they did themselves."

As a young officer, his cheeriness and equanimity made him a charming companion, and hence the nickname of "Ducky" which stuck to him for the remainder of his life. It must be acknowledged that the name may have appeared incongruous to those who, of late years, may only have seen the sterner side of his character.

He was born in 1868, the son of Mr. John Harvey of Bristol, the head of a well-known private firm of wine importers, whose brown sherry, appreciatively known as Bristol milk, will be remembered by many of his brother officers.

He was educated at Marlborough and at Redcliff House, Clifton, and passed into Woolwich, obtaining his commission in the Royal Engineers in February, 1888.

From Chatham he was posted to a Field Company at the Curragh commanded by Fowke, to whom he became greatly attached and under whom he was destined to work again more than once in after life.

His first tour of foreign service was spent in Bermuda and Halifax (Nova Scotia), at both of which stations he became very popular.

On his return home, he was appointed O.C. Field Depot at Aldershot and in 1899 was promoted Captain. It was from here he sailed, in October of that year, for active service in South Africa.

In August, 1900, he was appointed *A.D.C.* to Major-General

Elliot Wood, the Engineer-in-Chief, and was present at the actions of Belfast and Gillikats' Nek, and subsequently became Staff Officer, R.E., at Headquarters and continued in that capacity, after peace was signed, till April, 1903. For his services he had been mentioned in dispatches and awarded the D.S.O. He remained in South Africa, his services having now been lent to the Civil Government, and was employed in the Public Works Department of the Transvaal under his former Commanding Officer, now Colonel Fowke.

He did not return to England till the end of 1905, and was then employed in the War Office in the office of the Director of Fortifications and Works, an appointment he held for four years, being meanwhile promoted Major.

It was during this time, in 1909, that he married Mabel, the daughter of Mr. Bourchier Hawksley, a union which ensured not only his happiness, but also much of his success in after life.

Not long afterwards Harvey moved to Bordon to take over the command of the 26th Field Company, and he had only held this post two years when in March, 1912, he was appointed Chief Instructor of Fortifications at the S.M.E. and promoted Brevet Lieutenant-Colonel in the following year.

He was therefore so employed when war broke out in 1914 and, as might have been expected, his first job at the front was in connection with Defence Works.

On September 29th, he left in a destroyer, at a few hours' notice, to report on the Defences of Antwerp. He found much room for improvement, and so advised the Belgian Staff. A force of British marines arrived, followed by the Naval Division, and, with Winston Churchill, he helped them to take up their positions, and managed with difficulty to supply them with tools. He had only been in Antwerp a week when, on October 8th, orders were given for the evacuation of the town.

He left by car with Jack Seeley and spent three days at Ostend organizing the defences, to cover the retreat of the troops, and then went on to Dunkerque where he found the H.Q. IV British Corps. His services as a special service officer were applied for by this Corps, but on October 16th he received orders to report to G.H.Q. at St. Omer for work under his old Commander, General Fowke, the Chief Engineer.

It was now his province to deal with front-line problems resulting from the transition of mobile to stationary warfare, as Harvey put it " The siege of Germany."

The Germans had prepared for this eventuality, we had not, and it was necessary to improvise a large number of weapons and missiles for trench warfare, which began to be used by the enemy and of which we were totally deficient.

An experimental section was formed under the Chief Engineer to

design, test and manufacture these in the first instance, and this came under Harvey's supervision.

Early in 1915 the problem of mining became acute owing to severe losses caused by German mines, and Harvey became associated with Major Norton Griffiths in the formation of the Tunnellers, who contributed so largely to the success of our mining operations in France and the complete domination of the enemy's subterranean efforts. The recruitment of these units was extraordinarily rapid and underground warfare commenced on an extended scale, but frequent moves of Corps, and consequent changes in directing staff, often rendered much of the work nugatory.

Accordingly, at the beginning of 1916, Harvey was appointed Inspector of Mines at G.H.Q., with the temporary rank of Brigadier-General, with a Controller of Mines in each Army under him. He was made Brevet Colonel for distinguished service in the field in June.

Central Control directed with Harvey's intense energy led to a vast improvement in efficiency, culminating in the historical exploit of Messines in July, 1917.

The number of companies under Harvey's direct administration was at this time thirty-two, including seven from the Dominions and totalling many thousand men.

In January, 1918, he was appointed Chief Engineer VI Corps, Third Army, commanded by Lieut.-General Sir A. Haldane, and found a further opportunity for displaying his outstanding qualities in the momentous events of that year.

His influence with Corps H.Q. was quickly established, and he was largely instrumental in organizing an effective defensive system against the German attack which was imminent.

The VI Corps front, centred ten miles south-east of Arras, was near the northern limit of the original main German offensive of March 21st, 1918, and consequently the withdrawal of our troops was far less pronounced in that sector than farther south. The subsequent German attack on Arras failed and the line was stabilized at the end of the month. When the tide turned and our advance began in August, Harvey was completely successful in dealing with bridging problems, road-work and supply of water to the troops, which offered immense difficulties in his corps area. The notable Hopkins Bridge over the Canal du Nord at Havrincourt came under his direct supervision. This bridge had a span of 180 feet over a chasm 90 feet deep and was completed in eight days, by the New Zealand tunnellers and R.E. detachments, thus establishing, perhaps, a record in bridge building in the field.

For his services in the war he was awarded the C.M.G. in 1916 and the C.B. in 1917, and was mentioned in dispatches five times. His personal and official diaries, kept regularly throughout the war in

spite of incessant work, are remarkable documents, and in times of great crisis in 1918 he recorded his actions with notes and comments almost hour by hour.

After the Armistice, he accompanied the VI Corps to the Rhine.

On relinquishing his appointment he returned home in March, 1919, and was employed in the first instance in revising the *R.E. Training Manuals* at the War Office. Six months later he was appointed Chief Engineer, Portsmouth, a temporary post which he left to become Chief Engineer, Aldershot, in June, 1920, thus fulfilling one of his chief ambitions in the service.

He had been promoted to the substantive rank of Colonel the previous January and was appointed *A.D.C.* to His Majesty in August, 1921. His promotion to the rank of Major-General early in 1923 caused him to relinquish his post and gave him a well-earned rest.

He had been on half-pay for a year when he was offered the appointment of Engineer-in-Chief in India. He had never previously served in the East and hesitated for some time before accepting the appointment. He had, however, not only been selected for the post by the War Office authorities, but had also been applied for by the Commander-in-Chief in India.

The engineer services in India had been very much disorganized as a result of the war, and required a complete overhaul. Harvey realized that he was expected to act as a new broom and it was probably with some misgivings that he accepted and sailed for India in the summer of 1924.

As was to be expected, he attacked his problem with immense energy and toured the country both in the hot and cold weather, and could boast before he left the country that he had visited practically every station in India. That his visits should, under the circumstances, be universally welcomed, was not to be expected.

In collaboration with General Stuart Wortley, the Quartermaster General, he carried out many schemes for the improvement of the living conditions of the British troops in India, notably extensions to the installation of electric lighting and punkahs to barracks, and General Stuart Wortley writes of him : " He was indeed an example of the best type of Royal Engineer, and in my opinion, there could be no higher praise."

He retired in January, 1929, but not to rest, for, in addition to serving on numerous local bodies, he became Chairman of the R.E. Old Comrades' Association that year, and expended all his energies in promoting the well-being of those who had left the Corps for civil life.

In addition he was elected to the Council of the Institute of Royal Engineers, becoming Vice-President in 1935, in which year he was also appointed Colonel Commandant R.E.

His latter days were clouded by the death of his eldest son, a charming and very promising young officer who was killed at polo in India. He never really recovered from the blow. His courage, however, and deep sense of duty would not permit him to curtail his work on this account, and this no doubt hastened his end.

The dominant features of Harvey's career were his whole-hearted devotion to his duties and the interests of the Corps in which his whole service was passed, and his intense striving for efficiency. Few men have acted so closely up to Lord Kitchener's motto of "Thorough."

His example widely influenced the conduct and training of many who served with or under him and through them will influence the generations who are following on.

F.G.F.

MAJOR-GENERAL F. H. KELLY, C.B., C.M.G.

IN the memoir, published in the June *R.E. Journal* on page 293, it was stated that, in the spring of 1916, "he (General Kelly) carried out a reconnaissance with Colonel Swinton and selected a training-ground in his divisional area near Thetford, in which to train with the utmost secrecy certain new machines."

It is pointed out by a correspondent that this is not correct. The selection of the site was made by Major (now Colonel) M. O'C. Tandy, who, under the orders of Colonel (now Major-General Sir Ernest) Swinton, toured the South of England to find a suitable area for the secret training of the "Heavy Section, M.G.C." and selected Elveden in General Kelly's Divisional Area. General Kelly afterwards gave all possible help in the preparation of the secret area.

MAJOR-GENERAL E. R. KENYON, C.B., C.M.G.

WE regret to record the death, which occurred on Monday, May 17th, 1937, of Major-General Edward Ranulph Kenyon, of Beech House, Sutton Road, Shrewsbury.

Major-General Kenyon, who was 82, underwent an operation about a month ago, and seemed to be making a good recovery, but he suffered a relapse a few days ago, and died in a Shrewsbury Nursing Home.

By his passing, Shropshire loses a member of one of its best-known county families who had had a most distinguished military career before returning to the county in retirement to take a full interest and active share in many of its public affairs.

Major-General Kenyon was well-known in all parts of the county, but particularly in the Shrewsbury area, where he had resided for a number of years, and where much of his public work was done. He was a great personality, with fine strength of character, and was one of thoughtful nature who was firm in his convictions and at all times ready to support them. He took a deep interest in religious matters, and gave of his time and effort unsparingly in many worthy causes. He will be greatly missed by very many friends in Shropshire.

Born on November 3rd, 1854, he was the second son of the late Mr. John Robert Kenyon, Q.C., of Pradoe, his mother being the daughter of the late Mr. Edward Hawkins, who was for some time keeper of antiquities at the British Museum. He was a direct descendant of Baron Kenyon, who was at one time Lord Chief Justice of England, and was a brother of the late Mr. R. Lloyd Kenyon, who was for many years Recorder of Oswestry, Chairman of Salop Quarter Sessions, and an Alderman of the Salop Council.

Major-General Kenyon was educated at Winchester, where he was an exhibitioner and went on to the Royal Military Academy, Woolwich, where he took prizes in classics, mathematics, and military history. He began what was to be a long and brilliant military career when he was commissioned in the Royal Engineers in 1874. Five years later he served in the Public Works Department in Cyprus, and in 1883 he became Commissioner of the Kyrenia District, Cyprus, holding that position for three years. Then, in 1886, he returned to England and became assistant-instructor in fortifications at Chatham from 1888 to 1894, after which he served at St. Lucia, West Indies, until 1896. For five years after this he was Superintendent Engineer of H.M. Dockyard, Devonport, following this with service as C.R.E. at Salisbury Plain. In 1906 he became Chief Engineer at Gibraltar, remaining there until his retirement, with the rank of Colonel, in 1911.

Maj Gen E R Kenyon CB CMG

With the outbreak of the Great War, he again entered the service in September, 1914, being appointed Deputy-Chief Engineer, Southern Command, but shortly afterwards he became C.R.E. of the 20th Division, serving as such until February, 1916, when he became Chief Engineer of the IV Corps. In July of the same year he was appointed Chief Engineer of the Third Army, continuing in this position until December, 1917, when he became Deputy-Controller of the Chemical Warfare Department in England until May, 1918. For some months after this he was on special duty in France, retiring with the rank of Major-General. Major-General Kenyon was five times mentioned in dispatches. He was awarded the C.B. in 1916 and the C.M.G. in 1918, and his decorations also included that of Commander of Crown of Italy, which he was awarded in 1917. He was wounded when serving at Arras in 1917.

After the war, Major-General Kenyon resided in Shrewsbury for some years, and became closely identified with a number of public organizations. He was a strong supporter of county charities, and in particular was a great friend of the Shropshire Orthopædic Hospital. For the Shrewsbury clinic of this hospital he worked with great vigour, carrying on the secretaryship of it with marked ability for some years, and it was for the Orthopædic Hospital as a whole that his greatest work was done.

A staunch churchman, he was associated with many church activities, not only in the district, but in the wider sphere. He was particularly interested in missionary work, and was vice-president of the Church Missionary Society, of the South American Missionary Society and the Church Army, while he was for many years chairman of the Church of England Zenana Missionary Society.

In 1921 he led a small C.M.S. commission to Egypt, the Sudan and Palestine, to examine into post-war missionary problems.

Major-General Kenyon was an interesting writer, and had several publications to his credit. Among these were *Notes on Land and Coast Fortifications* (1902). *Gibraltar Under Moor, Spaniard and Briton* (1911), and the Gibraltar section of *Malta and Gibraltar*, by Alistair McMillan (1915), while he had published a number of articles in the R.E. and R.U.S.I. Journals, and edited "A Lady's Experiences in the Great Siege of Gibraltar (1779–83)," published in *The R.E. Journal*, 1912.

Major-General Kenyon married, in 1880, Katherine Mary McCrea, daughter of Major-General J. C. de Butts, R.E. His wife died about 30 years ago, and he is survived by one son, Lt.-Col. H. E. Kenyon, of Pradoe, and four daughters.

In 1931, Major-General Kenyon left Shrewsbury to take up residence at Pradoe, where he remained for some time before returning to Shrewsbury a year or so ago, his son residing at Pradoe.

The foregoing obituary notice from *The Border Counties Advertiser* is published almost intact because, in addition to details of his career, it proves that General Kenyon, after retirement, showed the same mental and physical vitality and the same powerful personality which were so apparent during his service in the Army.

In the preparation of this memoir, the extraordinary fact stands out that, of the five officers who had served under Kenyon at Gibraltar and elsewhere, and have been asked to record their experience, all, in addition to the writer, are unanimous in stating that Kenyon was the most competent and soundest officer under whom or with whom they ever served—and some have added that he had the finest character. It may be noted that all these served under him and should be able perhaps to judge best. Of these, one is a late, and one is a serving Colonel Commandant, one now holds a high position at the War Office and two, apart from their military services, were eminent as sportsmen and promoters of sport.

The first adds: "He was a man who took it for granted that everyone was doing his best, though he knew better than anyone the true value of an officer and who was a fool and who was not. He therefore got the best out of an officer under him and was always listened to by his equals and superiors. He was sure of himself, and inspired confidence in others. His manner was quiet—he never got fussed or worried. *He ought to have gone much farther than he did*, but he never pushed himself or worried to get on."

The following is an extract from the second's letter:—

"I was S.O.R.E. to Kenyon when he first came out to Gibraltar as C.E. and though I was not very long with him, I agree with you that he was quite the most efficient officer I ever served under."

To quote an extract from a letter of one of the latter: "At any pow-wow he always seemed to hit the right nail on the head, and any wise man who spoke after him always followed in the same line. I met him a few times in France when he was C.E. of a Corps and I was C.R.E. of a Division and his physical energy was wonderful; no day tramping round seemed too long for him. Whenever I met him either at home or abroad he was the same, always cheery and never down on his luck."

Another officer who had not served under him writes:—"You probably know that after employing Kenyon as an Umpire on Salisbury Plain, Sir Ian Hamilton conceived such a high opinion of him that one day he gave him a side to command and Kenyon was very successful."

It is understood that when Kenyon was C.E., IV Corps, and the Germans attacked and captured most of its frontage on the Vimy Ridge, it was he who took charge, organized the resistance and held up the Advance—also that he planned the counter-attack which was finally cancelled.

It was owing to the reputation he had made that Lord Allenby applied for Kenyon as C.E. 3rd Army, in spite of the fact of his being a retired officer.

The Major-General G.S., 3rd Army, when it was commanded by General Sir Julian Byng, writes :—

"The news of the death of Major-General E. R. Kenyon, C.B., C.M.G., will be much regretted by all members of the Third Army, B.E.F., who had the honour and pleasure of being associated with him. General Kenyon was Chief Engineer of the Third Army for nearly 18 months, during which time the Battle of Arras was fought. His unfailing cheerfulness coupled with his ready co-operation with the other departments of Staff made him a very valuable member of headquarters. I personally enjoyed the benefit of his company and experience for nine months before, to my great regret, he moved on to other activities. His memory will live long in the hearts of his comrades."

It is significant that after General Kenyon had been reverted home from C.E., 3rd Army, at the end of 1917—apparently on account of his age and the movement then raised for the advancement of younger men—he again went to France at the request of G.H.Q. there in May, 1918, on special duty in preparing lines of defence for the Second Army, west of Hazebrouck.

In spite of being negligent in dress, due to his entire unself-consciousness, he commanded respect from those who were normally meticulous in such matters.

When all the above is considered, it is hoped that those who did not know him will realize the exceptional credit which Kenyon brought unostentatiously on the Corps.

A.I.S.

All Reviews of Books on military subjects are included in the provisions of K.R. 535c (*1935*).

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

HISTORY OF THE GREAT WAR. MILITARY OPERATIONS.

France and Belgium, 1918. March-April: continuation of the German Offensives. Compiled by Brigadier-General Sir JAMES E. EDMONDS, *Kt.*, C.B., C.M.G., HON. D.LITT. (Oxon), R.E. (retired), *p s.c.*

Maps and Sketches compiled by Major A. F. BECKE, HON. M.A. (Oxon), R.F.A. (retired).

(Macmillan & Co., Ltd., London, 1937. Price 12s. 6d.)

THE first part of this review (see *R.E. Journal*, June, 1937) concluded with the failure of the German attack against the Third Army front on 5th April, 1918.

Realizing the failure, Ludendorff that evening ordered the abandonment of "Michael," the most formidable onslaught of the war, whereby he had intended to settle summarily with the British before their French Allies could come to their aid.

The problem now was, where will he make his next attempt?

He still had a useful reserve in hand, so it did not seem likely that he would allow the operations to stagnate once more in trench warfare without some further attempt to force a decision.

"The Germans," writes Sir James Edmonds, "might well think that another blow would finish the British. If so, it must be delivered quickly before the French mass of divisions, arrayed between La Fère and Montdidier over against the long and exposed German flank created by the advance, could take counter-action."

Ludendorff lost no time. He immediately ordered six divisions to attack next day—6th April—the salient near La Fère created by the retirement of the French Fifth Army; thus threatening the right flank of the new French front and, incidentally, drawing attention to that quarter. This was the original "Archangel" attack by which it had been planned to support and extend "Michael" on the left, as "Mars" (Arras) and "Valkyrie" (Lens) were intended to do on the right.

Sir James Edmonds goes on to trace how Ludendorff's original plans had been modified by intervening events since he decided—on 21st January, 1918—to make "Michael" the main operation. It will be remembered that, from the initiation of the discussions, Lieut.-Colonel Wetzell, Ludendorff's strategist, had recommended adopting the attack proposed by Crown Prince Rupprecht, and subsequently known as "George," as a "second act" to "Michael." In communicating his decision to Crown Prince Rupprecht, Ludendorff had directed him to continue his preparations for "George"—an attack between the La Bassée Canal and Armentières—and had warned him that it might be combined with a subsidiary attack—"George II"—against the Ypres salient, and with "Mars" (Arras) and "Valkyrie" (Lens). Ludendorff had followed up his Order of 21st January with another somewhat

confusing one on 10th February, which was interpreted by Crown Prince Rupprecht to mean that a frontal attack was contemplated against the British First Army, to be followed by converging attacks against the British Second Army to isolate and destroy it: the idea being that if the line of the Flanders hills (Mont Rouge, Mont Noir, etc.) between Kemmel and Godewaersvelde was secured, the Ypres salient must either be evacuated by the British or their troops holding it must be surrounded. In describing the various attacks to be launched in combination with the main "George" offensive, Sir J. Edmonds remarks.—"These schemes may sound fantastic to lay readers; but offensive plans invariably set forth a maximum: they may sometimes envisage failure: but they seldom take into account partial success, for that would usually open up an infinite number of possibilities." It might be added that the weak spot in German leadership has generally been the inability to improvise a new plan when a meticulously prepared scheme has gone awry. Both they and their pupils, the Japanese, have on such occasions missed opportunities which more adaptable brains might have turned to advantage by rapidly improvising a new plan.

The modified scheme was now as follows:—The German Sixth Army was told that it could rely on only 20 additional divisions at the most, and the Fourth Army was warned that the only part of "George II" (against the Ypres salient) which would in all probability be now carried out simultaneously with "George," would be an attack, "Hare Drive," against the Messines Ridge. It was impressed on both Armies that the "George" operations could only be carried out after transfer from the Somme area of such of the "battering train" as could be made available at the conclusion of "Michael."

Such were the plans in the north when "Michael" was launched on 21st March against the British Fifth Army. It gradually became evident that a decisive success of this offensive might be ruled out of the question, and as early as the 22nd March orders were issued to complete the preparations for "Valkyrie" (Lens). Crown Prince Rupprecht is reported to have expressed the hope that the "Mars" (Arras) attack, followed a day later by "Valkyrie" (Lens), would make "George" and "George II" unnecessary, especially as by the 24th March the British seemed by their increased artillery strength to be expecting an attack where these would fall.

The Fourth and Sixth German Armies were subsequently directed to continue their preparations for "George" and "George II" on a modified scale, to which operation the code name "Georgette" was assigned; and General von Quast was informed that he could now be given only ten additional divisions for the Sixth Army offensive.

On 26th March, Lieut.-Colonel Wetzell urged Ludendorff to drop "Mars" and carry out "George" in its place; but on the 27th it transpired that on account of difficulties of dumping sufficient ammunition and supplies, "George" could not be attempted for ten days as only half the necessary ammunition had so far reached the sector. Referring in his book to these changes of plans, General von Kuhl remarks that the idea of quickly regrouping troops for "a second act" as proposed by Lieut.-Colonel Wetzell is "very attractive, but very difficult to translate into reality."

When "Mars" had failed at Arras on 28th April, "Valkyrie" was abandoned; "Georgette" again came into the foreground and the preparations for it were ordered to be accelerated, Ludendorff adding that "the sooner it could be carried out the more likely it was to surprise the Portuguese in the valley of the Lys." Perhaps his Intelligence Staff were aware of the impending relief of the 2nd Portuguese Division! General Haking actually ordered the relief to take place on the night of the 7th–8th April; it was postponed for 48 hours, but probably it had been common knowledge for some days in the Portuguese trenches that they were shortly to be relieved.

Ludendorff, also as a result of the failure of "Mars," on 28th April, now directed the

Fourth Army to extend its attack northwards from Dixmude to the coast; and he allotted seven additional divisions to the Sixth Army, making 17 in all as against the 20 originally promised to it, so as to allow "Georgette" to be made on as broad a front as possible. He could do no more in view of the fact that the March offensive had added 33 miles to the German front in the west.

On 2nd April, Ludendorff gave 8th April as the date for launching the "George" attack, but at the request of General von Kuhl it was postponed to the 9th as the Sixth Army was not ready.

O.H.L. were optimistic and hoped that even in its modified form a shattering blow might be dealt to the British. Ludendorff realized, however, that if he did not succeed, further attempts to beat the British must be postponed until after diversion attacks had been made against the French front.

The sector selected for penetration by the Sixth Army was the Portuguese front, and the confidently anticipated breach was to be widened northwards towards Armentières in order to compel the British to fall back behind the Lys. The main weight of the Sixth Army was to be directed against the railway junction at Hazebrouck. The Fourth Army was to be ready to advance against the Messines Ridge as soon as the British front, north of Armentières, began to waver; and if this operation went well, its attacks prepared farther north would take place to exploit the success already gained.

Eventually it was decided, on the evening of the 8th April, that the Fourth Army should attack the Messines Ridge on 10th April, the day following the advance of the Sixth Army.

O.H.L. gave out that—"Enveloped on both flanks it was expected that the enemy position between Frélinghien and Fromelles, with the town of Armentières, would fall without being directly attacked."

Such were the German plans. Turning to the defence, Sir J. Edmonds, after giving a very clear description of the terrain of the battlefield, remarks:—"In general, according to experience gained in 1917, the difficulties of movement in Flanders left the balance of advantage in favour of the defence, only to be overcome by the engagement of numerical superiority in men and guns; but during the early part of 1918 the weather had been exceptionally dry, with the result that movement was easier than it had been in any other spring of the War years." Later on he records that the Germans said that they had the greatest difficulty in moving their guns and ammunition forward owing to the state of the ground—"over the muddy and bottomless watered area."

The German attack on the 9th April fell on the centre and left wing of the British First Army. Its XI Corps (Haking) and XV Corps (Du Cane) held the water-logged sector between the La Bassée Canal and Houplines, the 17 miles being equally divided between them. The attack did not extend to the right of the Second Army until the next day. The XI Corps had the 55th Division (Jeudwine) and Portuguese 2nd Division (Gomes da la Costa) in front line with the 51st Division (Carter-Campbell) in reserve near Busnes. The XV Corps had the 40th Division (Ponsonby) and 34th Division (C. L. Nicholson) in front line, and the 50th Division (Jackson) in reserve in and behind Esterre. The 55th Division had not been engaged since the Cambrai battle in November, 1917, but the 51st, 40th, 34th and 50th Divisions had all been in the March battle on the Somme, and were for the most part scratch teams in which the officers and men were unknown to each other, a not unimportant factor, Sir James Edmonds remarks, in the operations which were to follow. The 34th and 40th Divisions were without their artillery; and were supported by the batteries of the 38th and 66th Divisions. The 50th Division had no artillery until that of the 34th Division, which had just arrived, came to its support at 4 p.m. on 9th April.' It was not till the evening of that day that the artillery of the 51st joined its Division. On the right, Givenchy, on an outlying spur of the Aubers Ridge, was the key of the

position, and no risk could be run of losing it. The 21st Tunnelling Coy., R.E., had been engaged in elaborating its defences for several months. A great feature of the organization was a well-ventilated tunnel, 300 yards long, connecting Givenchy Keep with Marie Redoubt due south of it, off which there were dugouts to accommodate two battalions with forty feet of cover over them, and plenty of exits to the support line. The 55th Division had worked hard to augment the already existing defences, and the men practised daily in leaving the tunnels and dugouts to man their fighting positions with the utmost speed. As a whole, the defence of the 55th Division depended on strong points for complete platoons with old wire entanglements well hidden in the coarse grass and much new wire constructed, so as to herd attacking enemy towards the zone of machine-guns, all of which fired in enfilade and were protected on the front side. Great stress had been laid on local counter-attack: every platoon was either a garrison or a counter-attack unit, and every man had been practised in his allotted task and taught to depend on his rifle. A Line of Resistance had been selected to be denied to the enemy at all costs. "On the right wing of the 55th Division, this line was actually coincident with the front line: on the left wing, in which the defences were sandbagged breastworks on marshy ground, constantly levelled by German artillery fire, the Line of Resistance had to be set back, and run along a subsidiary line (front line of the battle zone) in front of the villages of Le Plantin and Festubert, known as the 'Village Line.' North of this, 'B' Line, now nominally the rear line of the Forward Zone, averaging 600 yards behind the front line, was the Line of Resistance, connected to the village line on the one hand, and the battle zone of the XV Corps on the other by switches."

"The Portuguese held their front by a series of small posts at intervals in a well-constructed, continuous line of breastworks—in a bad state, however, owing to constant shelling. They were only expected to man 'A' and 'B' lines, the latter to be the Line of Resistance, the reserve brigade being employed to counter-attack from the front of the battle zone, which would be garrisoned, if necessary, by British troops. Until a few days before the battle, nothing more than heavy raids had been expected against this sector."

The sectors of the 40th and 34th Divisions were defended, much like the Portuguese, by strong points and breastworks of varying size. But the sector of the 40th Division had been devised for defence by two divisions, one of which would be responsible for the forward zone and forward part of the battle zone; the rear line of the latter zone was the line of bridgeheads, which, with the line of machine-guns on the north bank of the Lys behind it, and the reserve, should have been provided by the second division. The 40th Division, therefore, was not strong enough to garrison the defences. Moreover, it contained over 6,000 reinforcements in its ranks. There were so many trenches unoccupied that the enemy profited by their existence. The disadvantage of having a river in rear of the sector was lessened by the construction of many temporary bridges—pontoon, barrel and cork-float—which were moored alongside ready to be swung.

The 55th Division, with its nine infantry battalions, held 4,000 yards of front; the Portuguese, with sixteen battalions, 10,000 yards, the 40th and 34th, with nine battalions apiece, 7,500 yards each.

Comparing the distribution with that of the 21st March, there were 22 battalions in the forward zone, 10½ in the battle zone, and 11 in the Green Line. In the Fifth Army the figures had been 36⅔, 43⅓ and 29⅓. That is, the forward zone of the XI and XV Corps was more strongly held, half the troops being therein, whilst the Fifth Army, often reproached for holding its front zone too strongly, had no more than one-third.

The disparity in the artillery of the two forces on April 9th was considerable. The total of the heavy and medium guns was small on the British side, 122 in the XI Corps and 78 in the XV. Two of the five brigades of heavy artillery of the XI Corps were in support of the 2nd Portuguese Division which had only field guns of its own, 64 in number. The artillery of the German Sixth Army numbered 195 field batteries and

230 heavy and super-heavy batteries, so the artillery of the attack was at least four times as powerful as that of the defence.

Throughout the night of the 7th–8th April, an intense gas bombardment, including mustard gas, had been directed on Armentières. It was estimated that between 30,000 and 40,000 shells were fired into the town. The 34th Division had over nine hundred gas casualties, and the 207th Field Coy., R.E., and a Company of Pioneers who were working in the town were practically put out of action. The 8th April was a quiet day, almost uncanny, and it is recorded that General Haking remarked to his G.O.C. R.A. that he feared the Germans would attack just as he was getting the Portuguese out of the line. On the 9th April, as on the 21st March, there was a heavy mist over the battlefield with a visibility not exceeding at first forty yards, and as gas masks had to be worn for a couple of hours, the range of vision was small.

The German bombardment programme was practically identical with that on the 21st March, but less gas ammunition was fired and the duration was slightly shorter, from 4.15 a.m. to 8.45 a.m., instead of from 4.40 a.m. to 9.35 a.m. The bombardment was under the direction of Lieut.-Colonel Bruchmüller, the expert who had devised the bombardment of the Fifth Army on 21st March, but as that officer points out in his book *Artillerie beim Angriff*, there had been only nine days to prepare it whereas on the former occasion the whole of their artillery had had seven weeks.

The Headquarters of the 55th Division had been in Locon, but as their position was shown on a German map captured in the middle of March, they were moved outside the village to Les Caudrons. Locon was heavily shelled on 9th April ! The first shell which fell on Lestrem struck the quarters of General da Costa, and naturally upset the running of the Portuguese headquarters for a time. Generally, signal communications, mostly well-buried cable, supplemented by dispatch riders, were practically uninterrupted during the day. It says much for the accuracy of the German gunners that although the areas round the bridges were shelled heavily by the Germans, the bridges required for their advance were not hit.

The assault was made by eight German divisions in front line, and six in second line. Of these none had been engaged in the March offensive, thirteen came from east and the fourteenth had been in the line since January.

Although a Portuguese withdrawal had been anticipated, its speed upset all the carefully rehearsed plans for such a contingency, except those of the 55th Division.

The Commanders of the XI and XV Corps were as fully prepared as their means allowed to meet the emergency of the Portuguese retirement, and with their small reserves they actually filled the gap in good time ; but within two hours of the German assault an entirely new situation had arisen. The Portuguese 2nd Division had left the field. On the right of the gap thus formed the 55th Division was established on its Line of Resistance : on the left the 40th Division, weak and shaken after its experiences in the March offensive, now attacked in flank and rear from the Portuguese area, had been hurtled back, and had hastily found a defensive flank through Fleurbaix facing south. Between the 55th Division and the 40th Division a thin line had been formed in the front line of the Portuguese battle zone by the 11th Cyclist Battalion, 1st King Edward's Horse and the 151st Brigade. Towards this line the 152nd and 153rd Brigades of the 51st Division were moving up, while the 120th Infantry Brigade which should have continued a defence northwards, was midway in the space between the 151st Brigade and the rest of its own 40th Division. Behind the new front of defence, the line of the rivers Lawe and Lys and the bridgeheads were held by reserves. In several places parties of Germans had filtered through and approached to within 200 yards of field-guns in action, which were pulled out of their pits and fired point-blank against them, whilst the gunners opened with rifles and Lewis-guns.

Thus after fighting at close range throughout the day and after a troubled night, the XI and XV Corps, by exhausting all their reserves had succeeded in forming a thin line round the great pocket, ten miles long and five and a half miles deep, which the Germans had made in their front.

" The disasters of the day," Sir J. Edmonds says, " must be attributed to the failure to relieve the Portuguese 2nd Division, which, though weak, was holding a longish line after a miserable winter in a waterlogged area. There had been every desire on the part of G.H.Q. to relieve them, but this could only be done, first, by very tired divisions from the Somme which could hardly arrive in time: secondly, by withdrawing divisions from the Second Army and giving up part of the Ypres salient, against which General Foch had already raised great objection verbally (confirmed in writing on 10th April): and, thirdly, by bringing north British divisions to be relieved by the French south of the Somme, which General Foch refused to sanction."

Foch's confidence that the British would hang on somehow or other was no doubt justified, yet they could not do so indefinitely. It may be argued that the time had not come for any counter-offensive in the south, and that it was wiser to wait until British reinforcements had arrived and the American Army was in the line.

It will generally be agreed, however, that by his consistent refusals to be moved by Sir Douglas Haig's demands, General Foch showed his qualifications for the supreme command, and that his judgment was correct. Sir Douglas Haig was quite right to put forward those demands, and it will not be out of place to anticipate here what was proved in the final Allied Offensive in the autumn, that Sir Douglas proved to be the perfect " Chief of the Staff " to Foch during these defensive operations, as he subsequently proved himself to be during the final advance—so far as the British Army was concerned.

" On this occasion," writes Sir J. Edmonds, " fog probably assisted the defence: for, in face of the difficult ground of the Lys country, the German infantry could not advance as fast as had been calculated, so that the creeping barrage very soon ran away from them. On the other hand, fog delayed the British reinforcements in reaching their positions and masked their guns. From one peril, unknown at the time, the Allies were fortunately saved. The Germans brought up a number of tanks; but the ground was too soft for the new heavy German tanks, while of the ten captured English machines which had been 'sent to the right sector of the II Bavarian Corps, one stuck and, lying across the road, upset an approach march. Of the others, information fails' (*Rupprecht*, Vol. II, p. 375.)."

Sir J. Edmonds reprints (on p. 190) a memorandum, written on the evening of 9th April by the Director of Military Intelligence, W.O., who was at G.H.Q. in France on that day, for the C.I.G.S., which, though it might have impressed Mr. Lloyd George—already perhaps a little upset by the results of his refusal to reinforce the British Army during the winter—would seem to have been somewhat belated. In it he reminds the C.I.G.S. that Germany is endeavouring to destroy the British Army and decide the War by concentrating all her available reserves against the British front, and points out that both the British and French Armies must provide adequate reserves, by withdrawing all troops from Italy, Macedonia, Egypt and Mesopotamia. The alternative being " a decisive defeat." He might have substituted " Governments " for " Armies."

As a result of the German attacks on the 9th April, the frontage of the British First Army had been extended from 16 to 29 miles.

Rain fell during the night and a ground mist lay over the plain of the Lys in the early morning of the 10th April when the Sixth Army resumed its advance south of Armentières, and the Fourth Army launched its attack between Warneton on the Lys and the Ypres–Comines Canal against the Messines–Wytschaete ridge and the southern end of the main Ypres ridge held by the IX Corps of the British Second Army. Although the former succeeded in enlarging the Bac St. Maur bridgehead and captured other crossings of the Lawe and Lys and the Fourth Army occupied the site of Messines, the latter was unable to capture Wytschaete, and the Germans as a whole were prevented from making any great progress. Their advance, however,

caused orders to be given for the evacuation of Armentières during the afternoon, and this was carried during the night of the 10th/11th April.

As a result of the fighting on the following day (11th April) the German front formed a salient with its apex almost reaching the eastern edge of the Forêt de Nieppe, nine miles west of the front line on 9th April, with its faces extended back to Givenchy in the south and Hollebeke in the north.

The situation was critical, for if the enemy pressed much further he might not only reach Hazebrouck but separate the British First and Second Armies, and then cut off the latter. It was estimated at G.H.Q. that the Germans still had 29 divisions in reserve on the Western Front, of which 14 were opposite the British in Flanders.

General Plumer had, since the 22nd March, denuded his army and sent as many reinforcements as he possibly could to the Third and First Armies. As an instance of his confidence as to the situation on his own front he temporarily relieved the 37th Division on 25th/26th March by a single dismounted Yeomanry Regiment, with some extra machine-guns, to hold what was normally a two-brigade front astride and north of the Gheluvelt road, S.E. of Ypres. It was now a matter of sending assistance to him, and Sir Douglas Haig again appealed to General Foch.

At 10 p.m. on 10th April at British G.H.Q., General Foch said that "after full consideration, he now agreed that the enemy's objective was the British Army, and that the main effort would be made between the Somme and Arras: a relief would involve a delay unpermissible in the circumstances: he had therefore decided to move up a large force of French troops ready to intervene, if necessary, on the Arras front." It might be inferred that General Foch intended to keep this mass ready to counter-attack in the direction of the base of the German salient in Flanders and across the communications of the troops who had penetrated the First Army front, while at the same time covering Amiens and Paris. But whatever General Foch had in mind, Sir Douglas Haig accepted the decision, and gave orders at once to clear the zone required by the French Army by sending the British troops occupying to the north. The French did not, however, evince any hurry to occupy it, and when they did move up behind Amiens, Sir Douglas realized that they were more an inconvenience than a help there, and he wrote to General Foch again, pointing out the shortage of reserves on the Northern battle front. He asked him to *concentrate* at least four divisions between St. Omer and Dunkirk in readiness to support the Second Army. The only reply Sir Douglas received was, "The British forces must hold on where they stood." Foch was adamant in his refusal to take over any of the British line or to provide troops for the construction of a reserve line which he indicated should be prepared from Hinges Wood on the right—edge of Forêt de Nieppe—Bailleul—to Kemmel. In conversation General Foch always alluded to the Lys attack as "*la bataille du Nord*," seeming to hint that it was entirely a British affair, and G.H.Q. had better recognize it as such. When eventually he did move up French divisions *progressively* behind the British front, it caused congestion of the back areas and detriment of the railway and other communications. When this was pointed out to him he replied that "their presence had a moral value." This seemed to G.H.Q. to indicate that they were only there for show. One wonders whom he thought their appearance would impress! Possibly it was to reassure the French inhabitants in the back areas.

General Foch, however, knew his troops and was aware that they could not yet be relied on for any major operations, such as entry into a defensive battle in which the defenders were being daily forced to give ground. That he was right up to a point was to be proved by the failure of their counter-attacks, after they entered the line on 13th April, to retake Meteren and Wytschaete and the subsequent loss of Mont Kemmel. Sir James Edmonds remarks: "In any case the two factors in General Foch's mind, that the British could very well look after themselves, and that the French required careful nursing, must be borne in mind in weighing his conduct during the Lys battle."

It was on this day, the 11th April, that the British Commander-in-Chief issued his special "Order of the Day," which became popularly known as "the backs to the wall" message. It aroused throughout the fighting troops a strong wave of determination not to be beaten, and they responded by giving of their best. It also had a good effect at home in England, and amongst the reinforcements which were daily arriving in France.

The following order issued by a subaltern of the 1st Australian Division after its arrival at Hazebrouck on 12th April, was subsequently picked up in the trenches by a First Army liaison officer:—

"*Special Orders to No. . . . Section.*

(1) This position will be held, and the Section will remain here till relieved.
(2) The enemy cannot be allowed to interfere with this programme.
(3) If the Section cannot remain here alive, it will remain here dead, but in any case it will remain here.
(4) Should any man through shellshock or any other cause attempt to surrender, he will remain here dead.
(5) Should all guns be blown out, the Section will use Mills' grenades and other novelties.
(6) Finally, the position, as stated, will be held."

The 12th April, writes Sir James Edmonds, was a very critical day. In general, though the British centre near Vierhouk, where the 4th Guards Brigade was fighting, stood fast, there were advances on both flanks and the apex of the salient was gradually flattened out. Divisional staffs were unable to exercise much control over the action: the actual fighting remained a brigadiers' and soldiers' battle, and orders from the higher staffs, as a rule, merely gave approval to what had already been arranged. It must be remembered, writes Sir J. Edmonds, that few of the divisions were supported by their own artillery, owing to the infantry reinforcements having been rushed up by train, bus and lorry, the guns following by road.

No British tanks were yet available in Flanders, owing to the heavy losses in March. The Germans showed a few but they effected nothing except in the attack on Kemmel.

It was on this day (12th April) that the 1st Australian Division commenced to arrive at Hazebrouck. It had been delayed by bombing attacks on St. Pol railway station and long-range shelling of Hazebrouck itself, and it was not till dawn on the 13th April that four battalions and a machine-gun company was in position, covering a front of 12,000 yards east of Hazebrouck, half a mile to a mile behind the Fifth Division.

Throughout the day the advancing enemy were subjected to relentless attacks by the British air squadrons. "More hours were flown, more bombs dropped and more photographs taken than on any other day since the war began." Air fighting was continuous, but German low-flying aircraft were less active than on the first three days of the battle.

The movements for shortening the line of the British Second Army were commenced on this day. Orders were given to continue to hold the Forward Zone and to make no change that would give the enemy any indication of weakness or provoke attack, but reserves were to be disposed and employed so as to allow the Battle Zone to be strongly held. All the movements were carried out without interference from the enemy by 10 a.m. on 13th April. It is recorded that on the 14th the Germans were still unaware that any changes had been made.

M. Clemenceau visited Sir Douglas Haig on this day. He, too, was deaf to appeals for help. He knew that assistance had been refused and told Sir Douglas that matters must be settled by the "normal hierarchy, that is General Foch." In justification of General Foch it is only fair to record that in his diary Crown Prince Rupprecht wrote, after a visit of his Chief of Staff (General von Kuhl) to O.H.L.—

" Ludendorff attaches importance to our getting as close to Amiens as possible. . . . Preparations are to be made for another attack later by the right flank of (the German) Second Army and the left flank of the Eighteenth Army. . . . Ludendorff is apparently meditating an offensive north of the Somme if that of the Fourth and Sixth Armies does not result in any great success." He also remarks, after recording a conversation with Lieut.-Colonel Wetzell: " Ludendorff is certainly a wonderful organizer, but not a great strategist." This was in reference to his showing a preference for a succession of small attacks instead of conserving all his available forces for a fresh blow on a large scale against the British opposite the Seventeenth Army front, which was where General Foch, as already stated, expected it.

On the 13th April the German infantry, Sir J. Edmonds writes, suffered more heavily than on any of the previous days of the battle. He attributes this in part to the good marksmanship of the 5th Division, which, under its Commander, Major-General Stephens (Rifle Brigade), had been strenuously exercised in musketry during a quiet time on the Italian front, whence it had just returned. There was also more artillery support: the young reinforcements, notably in the 61st Division, had been well trained; and the Air Squadrons did magnificent work. It was on this day that the German Alpine Corps for the first time failed to achieve the success to which it was accustomed, " in attaining our objective everywhere, in Serbia, in front of Verdun, in Rumania and Italy. I may say," continues the writer, " that the defenders on the British front in April, 1918, were the best troops of the many with whom we crossed swords in the course of four and a quarter years."

The crisis of the battle was approaching if it had not already been reached. General Foch is reported to have said that the Battle of Hazebrouck ended on the 15th April. The saving of Hazebrouck was probably the moment.

On the 14th April General Plumer issued orders for the withdrawal of the troops in the Ypres Salient to the main position from Kemmel—through Vourmezeele—past the White Château (one mile east of Ypres)—on to the Pilkem ridge: the Belgians, conforming and eventually relieving the 30th Division on the left of the Second Army. On the 15th Bailleul was evacuated. On the 16th Meteren and Wytschaete were captured by the Germans. On the 17th the Germans attacked Mont Kemmel and were driven off with heavy loss, and that evening General Plumer issued orders that the French 28th Division would assume the responsibility for its defence from midday on the 18th April. It was on the 17th that the German Fourth Army, on discovering that the British had withdrawn on the Ypres Salient, delivered its attack from Houthulst Forest (originally planned for the 20th) against the Belgians: it failed completely. South of the Salient the results of the fighting were equally disappointing. There the combined efforts of the Fourth and Sixth Armies to capture the line Mont Kemmel–Mont Rouge and Mont Noir made little progress. Crown Prince Rupprecht recorded in his diary: " The Headquarters of both armies report that the attack cannot be continued."

The 18th April was another day of successful defence—the Sixth Army failing against Givenchy and Festubert, and the Fourth Army making no progress beyond the Steenbeek stream.

From the 19th to the 24th April there was a pause in the fighting. On the night of the 22nd/23rd April the blocking raid on Zeebrugge and Ostend took place, but though it caused considerable consternation at Crown Prince Rupprecht's headquarters, it did not affect the military operations. According to his diary Ostend remained available for U-boats, but he writes: " It was otherwise at Zeebrugge . . . who knows how long the exit of our U-boats from Zeebrugge is blocked? "

On the 24th April the German Second Army attacked south of the Somme in order to round off the salient facing Amiens by the capture of Villers Bretonneux and the small plateau on which it stands, and at the same time to create a diversion to assist the battle in progress near Kemmel. Villers Bretonneux fell to the enemy's hands, and local counter-attacks to recover it failed on that and the following day.

By the morning of the 26th the enemy had been cleared out of the village although the original British front had not been quite recovered. The enemy had been foiled in his object of diverting attention before the German attack on Kemmel took place, and of getting near Amiens.

From the 27th both sides in front of Amiens settled down to a period of comparative quiet. Sir Douglas Haig himself was of opinion that had the French persisted between the 5th and 23rd April and retaken the high ground south of Hangaard in the angle between the Avre and the Luce, marked by Moreiul—Thennes—Demium, and had thus straightened out the line, the attack on Villers Bretonneux would not have taken place, for it was the loss of this ground which had uncovered the right flank of the Villers Bretonneux position.

The 25th April was marked by the renewal of the German offensive on the Bailleul–Ypres area and the capture of Mont Kemmel, but it also saw the defeat of the German plan to push through to Poperinghe and cut off all the Allied troops in and north of Ypres.

The German assault on Mont Kemmel, although the men who made it in addition to their usual equipment were carrying four days' rations, overran the French front in the first rush, and the Leib Regiment of the Alpine Corps had reached the summit before the French supports had emerged from the tunnelled dugouts. The finest observation station on the Flanders front had been lost in little more than an hour. A French writer, General Palat, records that "the support and counter-attack troops were not brought into action either by the battalion or regimental commanders. They remained passive and inert whilst the units of the first line were submerged, and when the enemy reached them they suffered the same fate." The Germans failed to follow up their success, obsessed, so it seems, by the fear of counter-attacks before their own artillery could move forward to support them. During the night of the 25th/26th April heavy rain fell and a thick mist formed in the morning, a terrible handicap to any improvised advance. A counter-attack at 3 a.m. by troops of the 25th Division and the 74th Brigade gained all the advantages of surprise, but they were soon lost, although the British reached Kemmel village and actually pushed back the enemy beyond it: but owing to the French failing to appear on their right they were eventually withdrawn. Farther north the Germans had at heavy cost captured a small part of the Second Army outpost line between Vourmezeele and The Bluff, which caused General Plumer to order the occupation of several rear lines of defence to block further progress. The French Higher Command was now thoroughly nervous and General Foch was driven at last to take measures to increase the Allied reserves in Flanders.

During the 27th and 28th April the Germans were forced to pause in order to relieve exhausted divisions and replace ammunition for a final effort. This materialized on the 29th April when seven German divisions supported by four more in second line attacked the Allied line on a 10-mile front between the Douve and Zillebeke Lake. Only slight success was attained on the extreme flanks, against the French near the Scherpenberg and the British outpost line near Vourmezeele. The Alpine Corps, whose task it was to capture the Scherpenberg, got as far as the col (Hyde Park) between Mont Rouge and the Scherpenberg and captured Locre. There they were counter-attacked by the French and driven back with heavy losses.

On the evening of 29th April General von Lossberg, Chief of Staff of the Fourth Army, advised Ludendorff to suspend the offensive, and on the 30th definite orders were issued to that effect. Quoting from Schwarte, Vol. III, Sir J. Edmonds records: "The whole 'Georgette' operation was finished, the Fourth and Sixth Armies had exhausted their powers of attack. . . . The second great offensive had not brought about the hoped-for decision."

O.H.L., on 29th April, considered that more than half the available French divisions were now between Amiens and the coast. Therefore the French front must be attacked. But this attack was only to be a diversion, the British front was,

as heretofore, to remain the chief objective. The diversion (Chemin des Dames offensive) was settled for the 20th May and the main attack against the British for the middle of June.

We now come to the last chapter—"Reflections." This cannot be summarized, and must be read. One of the most important subjects is the need of training in the tactics of retreat, on which Sir J. Edmonds says there is no manual nor any doctrine.

One of the features brought out in studying the conduct of the defence of the Second Army is the fact that General Plumer utilized the experience gained during the March offensive: another that he made a practice of visiting Corps and often Divisional Commanders himself and discussed their plans and difficulties with them. The result was that the subordinate commanders were able to issue their orders without waiting for Army Orders. These often only confirmed what had already been arranged by General Plumer or his M.G.G.S. on the spot.

The volume ends with a Note on "Casualties," and includes a number, not excessive, of appendixes giving Orders of Battle, Operation Orders and a useful memorandum on artillery organization.

H.B-W.

THE EAST INDIA COMPANY'S ARSENALS AND MANUFACTORIES.

By BRIGADIER-GENERAL H. A. YOUNG, C.I.E., C.B.E.

(The Clarendon Press, Oxford, 12s. 6d.)

To say that General Young has done for the Ordnance Services in India what Colonel Sandes has done for the Military Engineer is high praise indeed. Both authors have produced from immense quantities of dead records, a living and extremely interesting narrative.

The book treats of the beginnings, often lost in the mists of antiquity, and subsequent growth, of the Ordnance departments in India up to the end of the Company's regime, and of the manufacture of warlike stores, such as gunpowder, guns, small arms and ammunition, during the same period, in factories and depots, many of which, such as those at Cossipore and Dum Dum, have lasted till the present day.

It is interesting to note that many engineers have functioned as "Commissaries of Stores," for the most part in charge of manufactories. Thus, Capt. G. Hutchinson, Bengal Engineers, was the first Superintendent of the Company's Gun Foundry at Fort William, Col. Montieth, Madras Engineers, erected a blast furnace for casting round shot, while Capt. Tremenheere, in 1840, held the post of Conservator at Tenasserim for the supply of teak for gun-carriages and other Ordnance stores. It is to be noted also, that medical officers were frequently entrusted with the manufacture of gun-powder.

Little is said of the erection of buildings in the various depots, in which Engineers must have played a prominent part. We may notice, however, that the Cossipore Gun Foundry had, in 1844, and may still have, "a chaste and simple façade of the Tuscan order" 178 feet in length, probably not permissible under the *Barrack Synopsis* of the present day.

It is curious to read that a good deal of the accounting in those days was carried out by vouchers, on which officers stated on their honour that their expenses were as shown. But in spite of this, there was a lamentable amount of graft. Salaries were low, and "perquisites" were recognized as legitimate adjuncts to emoluments. Thus Capt. Martin, B.E., reported in 1763, that the commissions attached to his post as Superintendent of the Brick Manufactory at Calcutta, were twice his salary as Chief Engineer. The dividing line between licit and illicit perquisites must have been ill-defined, and we read of one Brohier, also of the B.E., who escaped to Ceylon owing Government Rs. 76,000.

The difficulties under which these early Ordnance Officers laboured were immense; climate, unskilled labour and insanitary conditions were all against efficiency, and that they carried on at all is praiseworthy. What are we to think of the powers of endurance against heat displayed by the British Overseers of the Gun Foundry who had to wear at all times a uniform "green, with red facings and white lace"?

A general map of India would have been a useful addition, while early plans of some of the depots would have added to the interest.

The story stops at the close of the Company's tenure, in 1858, but amusing anecdotes, often from the author's own recollections, are given of later times. Thus we read of a story, which sounds most probable, of a Standing Barrack Committee, which met to decide on a site for a cook-house which had already been built. We read too "what are we to think of those who erected the buildings for the new arsenal at Kirkee and of those who flooded the place with stores before a proper system of connecting roadways had been constructed and before the old internal tramway had been made usable? Such was the position of the New Kirkee Arsenal at the beginning of 1909." Were we responsible?

May we express a hope that Brig.-General Young will one day carry the story on to the present time?

F.C.M.

WILLIAM BLIGH OF THE "BOUNTY."

In Fact and in Fable. By H. S. Montgomerie.

(Williams & Norgate Ltd. Price 15s.)

A good deal of attention has been drawn to the incident of the mutiny on H.M.S. *Bounty*, Captain William Bligh, in 1789. Books on the subject have appeared from time to time usually from the pen of those who for one reason or another wished to justify the mutineers. The recent film on the subject was based largely on these books and very naturally was biased by its attempt to present a story which would have an appeal to the public. In *William Bligh of the Bounty, in Fact and in Fable*, Mr. H. S. Montgomerie has attempted to put forward all the relevant facts in an unbiased manner, with the result that his book amounts to a defence of Captain Bligh against his detractors.

The book is very readable and contains much information of which most people are ignorant. It becomes clear that the expedition of the *Bounty* was ill-found and undermanned and that Bligh had no subordinates whom he could trust, or who were sufficiently responsible to be consulted. He had, therefore, to rely on his own initiative and drive in his attempt to carry out a very difficult task. After the first attempt had failed owing to the mutiny, Bligh was selected again to take charge of the second attempt, but this time with two ships and adequate personnel, and he carried out the task with complete success. Later, after a distinguished naval career, he was sent as Governor of the young colony and convict settlement of New South Wales and again was the victim of a mutiny caused by his attempt to put down the illicit traffic in liquor.

It is easy to condemn a man against whom there has twice been mutiny and to draw the conclusion that he must have been harsh and cruel, but it must be remembered that the close of the eighteenth century was a time when revolution and mutiny were rife. The French Revolution was in full swing and there were very serious mutinies on a large scale at Spithead and the Nore. Defiance of authority was in the air, much as it has tended to be in the years succeeding the Great War. The facts show that Bligh was a man of untiring pertinacity and zeal and highly efficient as a naval officer. This was partly his undoing as he failed to understand that his subordinates were lacking in his own good qualities. The failure in the *Bounty* can be attributed

largely to his bad choice of subordinates and to his failure to appreciate their failings and their potentialities. Fletcher Christian, his chief executive officer and the leader of the mutiny, proved himself both before and after the incident to be completely lacking in balance, and Mr. Montgomerie claims that, had Captain Bligh kept his cabin door locked and a couple of pistols at hand, there would probably have been no trouble. In New South Wales Bligh tried to go against strong vested interests with insufficient backing, thus again displaying lack of appreciation of the situation. Doubtless like many of his type he was autocratic and did not suffer fools gladly and possibly, when tired and over-strained, was given to outbursts of anger. But his punishments were not unduly severe considering those which were general at the time. Many captains on H.M. ships were far more brutal than Bligh in their methods.

Records show that in the *Bounty* he worked hard to maintain the good health and happiness of his crew, going so far as to ship a fiddler as an A.B., and it should be noted that several of his officers and men had served with him before the *Bounty* venture and some of them sailed with him again afterwards of their own choice. Even after his experience in New South Wales, those in authority at Home remained unshaken in their confidence in him and he was promoted to Vice-Admiral of the Blue. Sir Joseph Banks, the then Secretary of the Admiralty, continued his support and he was highly spoken of and selected for duty by such men as Nelson, Duncan and Cook, men who would not have been likely to choose a bully as a trusted subordinate. There can be no doubt of his tenacity and his skill at his work, which are so well brought to light by his remarkable voyage of over 3,600 miles in an open ship's-boat only twenty-three feet long across the Pacific with inadequate supplies, an insufficient and disgruntled crew and very meagre facilities for navigation.

This voyage is described shortly in the book, but an appendix discusses Bligh's navigation. Having no chronometer he relied on dead reckoning for his longitude and constructed a log and trained his crew in its use for this purpose. For his latitude he was able to obtain occasional sights with a sextant and there was fortunately a Moore's *Practical Navigator* aboard which gave the sun's declination at various points in his neighbourhood. The appendix shows how with these means he was able to check his latitude fairly accurately from time to time and make more northing or southing as required to get back to the latitude he required. His general method was to follow the latitude which would give him a certain landfall as, for instance, when he aimed at the Eastern Australian coast some three degrees south of Endeavour Strait and again later aimed to hit Timor in the centre of its Eastern coast. Having made sure of his landfall he then coasted to his next point of departure. The latitudes of the various points were well known to him from his having sailed in command of one of Captain Cook's ships on his famous Pacific voyages. His most anxious times must have been those immediately preceding the making of landfalls, owing to his lack of accurate knowledge of his longitude, and also the periods following hard winds which forced him to keep his frail craft dead before the sea and away from his desired latitude. But he always succeeded in rectifying his general direction when the winds eased. Thus he made in succession " Bligh's Islands"; the northernmost of the New Hebrides, an island of great altitude and therefore visible from afar off; the eastern coast of Australia some three degrees south of its most northerly point; and finally the island of Timor. It should be realized that he had to keep well to sea most of the way in order to avoid the native war canoes and only approached land to check his position or when he was forced to obtain supplies.

There is no doubt that William Bligh has suffered much at the hands of his detractors. Mr. Montgomerie's book deserves to be widely read and should do much to dispel popular misconception and to reinstate Bligh's reputation to the place where it rightfully belongs.

G.L.W.

MODERN WAR.

By Lieutenant-Colonel B. C. Dening, M.C., R.E.

(North Hants Printing Co., Ltd., Fleet, Hampshire. Price 3s. 6d.)

Lieut.-Col. Dening has given us a reasoned study of modern war in a short book of 100 pages. He is to be congratulated on this courageous and valuable attempt to forecast the nature of war as it might take place to-day. It is not everyone, however, who will agree with the claims implied in the sub-title "Armies, not Air Forces, decide Wars," or with the chapters on "The Fallacy of the Air Menace," and "Objectives in War."

It is the author's object, as he tells us in the introduction, to discuss certain fallacies on which popular opinion on war is built up and if possible to redress their effects. In the first chapter he discusses some general conditions, and suggests that the British public must face up to the deterioration in the ethical tendencies in the world, particularly in certain countries. This deterioration means that the chances of war occurring are increased; and that war itself may be more ruthless than is expected.

The second chapter is entitled "The Fallacy of the Air Menace." The general effect likely to be produced on the reader by this chapter (even though it may be modified by the concluding sentence) is that the dangers of air attack have been very much exaggerated, and that the country is perhaps spending excessively on the air arm. On examining the chapter more closely, however, we find that the author is considering war in general between two enemies "in the abstract." We find also that he gives the defence credit for best possible achievements, and assumes that the defending nation has prepared its civil populations and has with foresight, spread over a number of years, so arranged its affairs that relatively little is offered to the opposing air force. Conclusions reached on such hypotheses are hardly applicable to ourselves at the present time.

The next chapter contains a series of convincing arguments on the subject of gas warfare. The conclusion is reached that, far from continuing our present attitude, we should accept gas as the most efficient method that exists of inflicting casualties and that it will certainly be used by an opponent if it has that efficiency.

The author then discusses the theories of military movement and concludes that there are three fallacies which should be discarded. The first fallacy is that the defensive is always so strong as to prevent movement; the second, that armoured formations have great prospects of success by themselves; and the third fallacy is that it is impracticable to carry field armies in mechanical transport.

The next fallacies considered are those prevailing on the question of man-power. The theory that only small armies will be needed for the next war is convincingly disproved. The author then goes on to say: "We seem, therefore, to be back to the pre-1914 idea of placing the whole available man-power in the field, with the most important restrictions that the numbers placed in the field must be both fully equipped and fully trained." With these views one can entirely agree. In the next chapter, in which the factors which make up the military power of a nation are discussed, we find the following sentence:—"for the non-continental nation, sea-power and air-power are absolute essentials if the race concerned is to develop its other sources of strength, man-power, industry, etc." The question that now arises, however, is this—if a continental power, unburdened with the necessity of maintaining a large navy, develops an air force of enormous size, will it be possible for Great Britain in case of war to maintain its air-power (as well, of course, as its sea-power) and in addition fully to equip large armies? Will not this overtax the technical resources of the nation? This is a question to which the author does not appear to give a solution. One can, however, fully subscribe to his conclusion, stated in the final chapter, that "limited participation must be a policy fraught with grave risk."

Let it be granted, however, that large armies are required if defeat is to be avoided The question then arises: Will it be armies which will gain the decision? That it will

be is one of the main contentions of the book. "The decision, in the case of a number of powers being forced into action against one another, will depend upon the action of the main land armies." This contention is argued in a chapter entitled "Objectives in War." But has the author forgotten that the submarine nearly brought about the defeat of the Allies in the Great War, 1914–1918; and the German claim that it was the Naval blockade rather than the Allied armies which decided the issue against the central powers? A favourite counter-argument, that owing to the power of the defence the land armies will be quite unable to move, is further dealt with in the following chapters: "The Tactical Conditions of War up to 1919"; "The Changes in Tactical Instruments, 1919–1936"; "The Resultant Conditions of War"; "The Use of Ground"; "Surprise"; "Permanent Fortifications"; and "Army Organization."

In the final chapter the author says:—"If we believe that we still are, as under Marlborough, Wellington and Haig in three successive centuries, bound to take our share in the settlement of future issues, we have, on the showings of this book, indeed far to go. We have to alter our outlook on a great many big points and we have a great deal of organization and training to undertake, knowing well that on the next occasion time will not be permitted for a Kitchener Army to be formed."

This is a book to be read both by the general public and also by members of the services, particularly the Army and Air Force.

LONDON.

By STEEN EILER RASMUSSEN.

(Jonathan Cape, 1937. Price 15s. 0d.)

This book is a history of the development of London from Roman times up to the present day. This statement would lead one to suppose that it must be a dull sequence of facts, but this is far from being the case. The facts are there, and infinite time and trouble must have gone to their research, but Mr. Rasmussen has not been content merely to transcribe from many sources into one chronicle. He has studied the English character and shows how London has developed in expression of that character; from the standpoint of a foreigner he compares the English city produced by English methods with Paris, Copenhagen and other large cities in Europe.

He defines the two main problems of the large industrial town as traffic congestion and slums, and shows how continental cities have tried to solve them by piling up high blocks of flats so that more people may live near the works. But the Englishman's house is his castle, and the ideal of one family in one house has led us to seek the opposite solution of dispersing the centres of work, as in Letchworth and Welwyn Garden City.

But whether we are interested in the science of town-planning, in styles of domestic architecture, in the views of the Northern European on the Englishman, in the mediæval history of London, or in beautiful photographs of the London we know, it is all here. No one of whatever age or inclination need put down this book disappointed, and if Mr. Rasmussen sometimes places his adverbs rather strangely, his English is more readable than that of many modern novels.

C.C.D.

PLANNING.

An Annual Notebook by E. & O. E.

(*The Architect and Building News*. Price 5s. 9d. post free.)

This book of which the first edition has just been published, is intended to be brought up to date and republished annually.

It contains a mass of information on the subject of planning and should be particularly useful to an R.E. officer who may be called upon to design some structure about which no very precise rules are laid down in Army regulations. Information on such varying subjects as the design of schools, flats, swimming-baths and dog-kennels, to take a few subjects at random, is included.

Indeed, it is a book to which reference may well be made before attempting any design, however small. For instance, how often one finds a cupboard of just the wrong size to take the article it is intended to contain; a reference to this book will tell the designer the proper size of a cupboard to take a coat, a slop pail or a carpet sweeper.

Comprehensive as the scope of this book may be, by their choice of a *nom-de-plume* the authors seem to hope to disarm any criticism of the book's shortcomings.

R.G.V.W.

GEODETIC REPORT 1936, SURVEY OF INDIA.

(Published under the direction of BRIGADIER Sir HAROLD. J. COUCHMAN, *Kt.*, D.S.O., M.C. Surveyor General of India.)

Geodetic triangulation to effect a connection between the Assam longitudinal series and the Upper Irrawaddy series was carried on in the unadministered Naga territory, requiring a large escort of the Assam Rifles. It was necessary to build perimeter camps for the survey detachments, and guards had to be provided at hill stations. However, with these precautions, everything seems to have gone off peacefully. The highest station on the Patkai Range, the watershed which separates Assam from Burma, was Tonyong, 9,120 feet above mean sea-level. Many points on this range exceed 8,000 feet. The main difficulties of the season lay in transport and supplies, to which were added language difficulties. For the former, coolies had to be employed, being the only form of transport on steep forest-clad hills. "It would be hard to say how many entirely different languages were met with: certainly a new one for each hill station would be no exaggeration, and a chain of two interpreters was often necessary. At some stations, work was delayed by snow, rain and cloud. This seems to be one of the few regions of the earth left where the explorer might find adventure.

The lengths of rays seem to have varied from about 16 miles to a little over 30 miles. The Wild theodolite was used. It was necessary to modify the stand supplied by the makers in order to use it on the normal survey pillar, 38 inches in diameter. The lamp squads were for the first time provided with small clocks enabling them to shut off their lamps punctually at 23.00 hours, instead of keeping them burning all night. To regulate the clocks, each lampman had a list of times of sunset and sunrise. The observer used a powerful electric torch to signal the end of a night's observations. In this way, a good deal of oil was saved and much weary night work for the lampmen. Observations were made on at least 12 and more usually 15 zeros, giving a total of 36 to 45 measures per angle. The position of the footscrews on the stand was changed 120 degrees after each third of the zeros had been observed. From certain experiments in readings taken on one particular zero at different times of the day and night, instrumental conditions remaining the same, it was concluded "that for primary triangulation, observations at each station must be taken at as many different times of day and night as possible, and the best results cannot be obtained during a flying visit of a few hours."

The geodetic levelling to connect the bench marks in the Bihar earthquake area with those on the more stable central plateau of India was completed; this comparison did not reveal any serious change in the configuration of the western end of North Bihar. It would seem that an earthquake can do great damage with hardly any permanent disturbance of the level of the country.

An interesting question is discussed in Chapter IV by Lieut.-Col. E. A. Glennie, R.E. It is well known that, geologically, the Gangetic plain is a gigantic trough, or geocynclinal,which has been filled to a great depth, as yet unfathomed, by material which has been brought down by the great rivers from the Himalayan Mountains, forming one of the most fertile and densely inhabited areas in India. It has been supposed that this transference of material from the mountains to the plains, so upsets the general equilibrium of the earth's crust as to set up strains, which, becoming excessive at times, cause earthquakes, when adjustments take place and equilibrium is restored. Colonel Glennie's view is just the opposite. It is worth quoting:—" This, however, is precisely what is not happening in Northern India. The Gangetic plain is an area which is greatly underloaded; the outer ranges flanking it are apparently overloaded, so the whole effect of the extensive denudation of the mountains which is going on is to restore equilibrium both in the mountain area and in the plains. Earthquakes in this area therefore cannot be ascribed to any superficial cause. Seismographic records are usually surprisingly clear, indicating a small focus at considerable depth. It is now known that some earthquakes originate at great depth, one hundred miles or more down. These are exceptional, nevertheless the normal depth of focus is between ten and thirty miles, that is well below the granitic layer, and either within or below the intermediate layer.

"The normal earthquake, therefore, appears to indicate movement in or below the intermediate layer and is in fact part of the process of crustal warping. The thrusting, folding and fracturing of surface rocks is only a secondary effect dependent on local geological conditions." This is interesting, as is everything tending to elucidate the causes of earthquakes.

Another subject we may mention is the investigations, by gravitational methods, of the existence of a buried ridge running from near Delhi to Shahpur in the Sargodha District in the Punjab. This ridge is supposed to have considerable influence in holding up the subsoil water and is of interest to the irrigation authorities in connection with problems of waterlogging. It is an example of how methods, originally employed for scientific investigations, have been turned to important practical use.

H.L.C.

MAGAZINES.

RIVISTA DI ARTIGLIERIA E GENIO.

(*April—May*, 1937.)—This number is practically confined to artillery subjects.

1. *Fuoco e movimento nella divisione di fanteria.*

General Ago expresses his views on the organization and regulation of fire in an infantry division. He deals especially with artillery fire, and shows how it can best support the infantry advance with maximum efficiency and continuity.

2. *Le opposte artiglierie nella battaglia del Piave.*

Lieut.-Colonel Frongia describes, at some length, the strength and distribution of the Austrian and Italian artillery, respectively, at the battle of the Piave in June, 1918. The Austrians copied the methods of the Germans on the western front, but failed to make sufficient allowance for the difference in conditions. The Italians received information of the hour of the Austrian attack (3 a.m. on the 15th June), but they were not certain of the accuracy of their information. The Italian artillery had a preponderance of long-range guns of medium calibre, and their effect made itself felt early in the battle. The Austrian artillery failed to support the infantry attack sufficiently. After a five-days battle, the fire of the Italian artillery succeeded

in isolating the Austrian troops who had crossed the river, and compelled the main force to retire.

3. *L'artiglieria alla battaglia dell'Asciangi.* By Dr. Cappa.

An interesting account of the battle of Ashangi, the decisive battle of the Italo-Abyssinian war, fought on the 31st March–5th April, 1936. The article is illustrated by two panoramic sketches and two contoured maps.

The advance guard of the Italian force arrived on the Dubbar Pass on the 17th March, and began to entrench itself in a naturally strong position, until the arrival of the main body. The Abyssinian army, under the Emperor, arrived on the scene on the 21st, the Mecan plain separating the two forces. The Italian position faced south and west; two Erythrean divisions facing south, and an Alpine division west.

The Abyssinians missed their opportunity. Had they attacked at once, before the Italians had had time to strengthen their defences and bring up their guns and ammunition, the chances would have been in the favour of the Abyssinians. But the Negus put off attacking until dawn on the 31st, having decided on a frontal attack against the southern face of the Italian position.

The Italians held their own against repeated onslaughts, and made a counter-attack at 11.30 a.m. The battle continued on the Mecan plain, and, towards evening, the Abyssinians began to retire. Fighting continued during the next two or three days, during which the Italians brought up their guns in pursuit of the enemy rear-guard.

By the 5th April, the Abyssinians had been completely routed, and the road to Addis Ababa was open.

4. *Condiderazioni sulla dispersione del tiro.* (S.T.A.M.)

5. *Pratica artiglieresca. L'artiglieria divisionale nella sosta difensiva.* By Lieut.-Colonel Camera.

6. *Il problema del tiro navale. Concetti e principi informativi.* Lieut.-Colonel Isidori.

7. *Il gassogeno e le sue possibilità pratiche.*

Lieut.-Colonel Cavalli discusses the practical possibilities of the gas engine for the propulsion of motor vehicles. Comparing the gas engine with the petrol engine, the latter has the advantage in almost every respect.

The general conclusions that the author arrives at are:—

(1) From a thermo-dynamic point of view, the gas engine has serious disadvantages, but most of these can be overcome by special construction.

(2) The efficiency of a gas-driven vehicle is reduced owing to the increase in weight and size of the engine, but in inverse proportion to the total weight of the vehicle.

(3) Inconvenience to the person using the vehicle, viz., difficulty about re-fuelling, delays in starting and re-starting, trouble in maintenance and cleaning.

(4) There is no economic advantage; but the disadvantages can be minimized by suitable fiscal arrangements.

At the best, the gas-engine is a poor substitute for the petrol engine. It could be made practical use of in agricultural engines, in heavy lorries, and in motor-buses running in a regular service between fixed points. It is not a practical proposition to use it in ordinary motor-cars with small cylinders.

But in a country like Italy, which is entirely dependent upon imports for its petrol supply, it is worth while investigating the possibilities of the gas-engine and trying to improve its efficiency.

8. *Preparazione topografica del tiro con i cannoni a grandissima gittata.* By Major Lerz.

9. *Uno studio recente sul secondo problema balistico.* By Professor Burzio.

10. *Traiettoria e odografa balistica.* By Professor Jachino.

11. *Calcolo degli sforzi di strappamento e di compressione negli affusti a piedistallo a piattaforma.* By G. Gentini.

A.S.H.

REVUE DU GENIE MILITAIRE.

(May–April, 1937.)—Le Siège de Sébastopol. (Extraits des souvenirs du général Segretain.) From the memoirs of Alexander Segretain (1826–1901), a celebrated Engineer officer, who took part in the Crimean War as orderly officer to General Frossard.

Cent ans de fortification allemande (1815–1914). By Lt.-Col. Montigny. The first instalment of a long article dealing with the origins of German fortification up to 1860, the influence of rifled artillery (1860–1871), the development of fortification from 1871 to 1886, and the introduction of the high explosive shell (1886). The author gives us the German developments and compares the corresponding response on the French side. He has written recently on the same subject in the *Revue Militaire Générale* (Feb., 1937), but he is now giving us the essence of two works dealing with German fortifications written by Germans. These works are those on which the present senior officers of the German Engineers were brought up.

Travaux souterrains exécutés dans les Alpes. By Lieut. Serin. A short account of galleries constructed by military labour. The author does not say where these are situated, but it is presumed that they are connected with works of fortification. Illustrations in the text show different methods of timbering.

W.H.K.

REVUE MILITAIRE GÉNÉRALE.

(May, 1937.)—La Guerre Civile Espagnole. By General Paul Azan. A short appeal by the editor of the *Revue* for contributions and comments on the civil war in Spain, in view of the importance of studying the effect of modern arms and equipment in action.

Le Commandement en Chef et les Armées de l'Air. By General Armengaud. The problem of the Supreme Command of modern forces has not yet been satisfactorily solved in any country. In France, the subject has been discussed in the Chamber, but without result. A Ministry of Defence does not solve the problem of the single command. The development of Air Forces has made it necessary to provide for a supreme command of the three arms, since the air arm, in a sense, combines the offensive powers of both army and navy.

La Stratégie et son Étude. By General Camon. This well-known author writes on his favourite subject, and gives a full article urging the importance of the study of strategy by every officer who aspires to the command of armies. We would go further, and omit the limited distinction. General Camon proposes the establishment of an institution for the higher study of war, with a view to the development of expert strategists.

Le Matériel commande la Tactique (aviation). By M. Courquin. A short article emphasizing the importance of having only the best and most up-to-date machines for the air service.

L'Appui de l'infanterie par l'artillerie dans l'offensive, sans intervention de chars. By General Brossé. A lengthy article on the artillery support likely to be available for infantry in future battles on a large scale, especially where tanks are not used. The unlimited supplies of ammunition which were at hand for the mechanical barrages of the Great War will not be available, at any rate in the opening battles, in a future campaign, so long as the front remains unfixed.

La défense contre une attaque allemande par surprise. By Colonel Épailly. The author bases his article on a surprise attack by Germany which is delivered without any warning whatever, and might be carried out by a force of as many as twenty divisions. The frontier fortresses might be isolated, and raiding troops might be landed from the air in rear of them, to hamper the mobilization and transport of the main armies. A pocket would then be created, which it would be necessary to counter-

attack at once in order to restore the fortress-line before the main battle. The troops to do this must consist of the active elements of the fortified region, without waiting for the reservists, who require time to re-adapt themselves to modern equipment, etc. A very supple organization is required to make this emergency force ready for such an eventuality.

(*June*, 1937.)—*Le danger aérien et la protection des populations.* By Gen. Niessel. The importance of educating the civil population in combating the dangers of air raids is emphasized, and the author urges a greater co-operation on the part of local authorities. The French are fully alive to the dangers, which are a very close contingency for them. Measures for meeting them are on much the same lines as those with which we are now becoming familiar.

L'Appui de l'infanterie par les chars rapides et l'artillerie. By General Brossé. A lengthy article on a subject which is perhaps the most widely discussed of all in the military literature of to-day. The method of use of modern tanks is largely theoretical, since the development of these weapons in the last eighteen years has completely changed the conceptions of their uses. The tactics of anti-tank methods have equally changed, and the outcome is now uncertain.

The author epitomizes the uses of tanks in the attack, and is careful to point out their limitations. Important rivers, the bridges over which are destroyed or swept by artillery fire, are complete obstacles to tanks, as are also villages, if the entrances are sufficiently barricaded. The experience of the Spanish civil war appears to show that tanks cannot be used in street fighting.

Infantry cannot hope to assail with success any properly organized position from which all the weapons of the defence may be brought to bear against their unprotected waves, unless they are supported by an enormous quantity of material. But if the enemy can be caught in the act of manœuvring or in a state of disorder, then infantry, in close co-operation with rapid tanks, may achieve speedy conquest of the battle-field.

Le tour de Babel. By General de Cugnac. This article deals with the confusion of thought which is prevalent, on account of the absence of a single command for all three forces. The same question exercises the French authorities as that which faces us: how shall the three national forces be controlled, in peace as well as in war? The author refers to the lack of a common doctrine. The Air Force had to learn navigation for itself, while the Navy had it all at its finger-tips and was prepared to pass it on. The three forces do not use the same language. The confusion which brought the Tower of Babel to ruin will endanger the whole system of national defence unless it be overcome by co-ordinated command, and it is now, in peace-time, that this should be established.

Le Commandement Unique. By General Maginel. This article suitably follows the last one, and is written chiefly from the point of view of the air force. The realization of the single command of land armies in the last war was only brought about by the stress of circumstances and the imminence of defeat. How much more necessary will be the co-ordination of the three forces under a single command in the next war, in which the air arm will play a predominant part? If a human being can be found capable of filling the rôle for his own country, it will require some superman to take charge of all the naval, military and air forces of a coalition. But it is not so much a question of the man, as of a trained staff to maintain the principles of unified command. Once the habit has been formed, the man for the post will be found.

Impérieuse nécessité du Commandement Unique. By Captain Tourte. The editor of the *Revue* means to press this subject on us thoroughly. This is a much shorter article, by one of the "juniors" to whom Marshal Pétain appealed in the opening number of the *R.M.G.* last January. The arguments are the same as before.

Le Génie en Liaison avec les Autres Armes. By Lt.-Colonel Rousseau. In the French army, before the war, there was only one company of engineers in a division, and in tactical exercises it was invariably placed in rear of the leading battalion of the

advance guard. It was frequently employed as a fifth company by that battalion's commander; or, if it received a task from the divisional commander, it was as likely as not to act as artillery escort.

These experiences, so like those of our own units in pre-war days, followed on in the opening campaign of the Great War, and the author gives instances. The engineer units of the IX and XI Corps were kept so far back that both Corps lost more than a day in crossing the Marne. During the retreat of the 53rd Division on August 25th, on arriving at a road-junction, units were told "Men to right, vehicles to left," and nothing that the engineer captain could do to keep his tool carts with him would suffice; he was separated from his equipment for two days. Even where there was a divisional engineer commander, the companies would be distributed amongst the brigades, which in turn distributed sections amongst regiments. Gradually, co-operation between infantry and engineers became established on a sounder footing, but, to the very end of the war, mistaken ideas prevailed; and the author holds that they are not all eradicated from the present-day regulations, for in the 1936 edition of the French Field Service Regulations, dealing with tactical exercises, the participation of the engineers, even in the organization of a defensive position, is relegated to the background, as a secondary matter, after aviation, armoured cars, and signal communications. Too often the rôle of engineers in a tactical exercise is dismissed with a line "placed at the disposal of."

The difficulties, in times of peace, of executing any visible engineer works during manœuvres or exercises, are largely responsible for the failure on the part of other arms to realize the proper employment of engineers; and it is evident that other armies besides our own experience this difficulty.

In general, the article reveals a somewhat more backward state of liaison between engineers and the other arms than we have been accustomed to since the Great War, but the author touches on many weaknesses familiar to us all.

W.H.K.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*May*, 1937.)—*Opérations contre la colonne Wintgens-Naumann* (*Mai*, 1917). By X.X.X. An account of the operations of the Belgian columns directed by Colonel Huyghé in co-operation with the British forces in German East Africa, in May, 1917. An attempt was made to round up the remnants of the German force by a combined encircling movement, but the vast area of the country prevented complete encirclement. A Belgian patrol came upon a small caravan which was on its way to surrender to the British, carrying Captain Wintgens, who was seriously ill and sought medical treatment. The sketch map accompanying the article shows a very small proportion of the names contained in the text.

Pratique et enseignement de l'escrime et du combat à la baionnette. By Captain Darrien. A syllabus for recruit training.

Essai de topographie typologique du soldat belge. By Captain Govaerts. A medical view of the geographical distribution of various physical types.

Les gaz de combat et la protection. By Captain Féron. The author excuses the use of gas as a weapon of warfare as being no more barbarous than high explosives; but the barbarity lies in its use against open towns and women and children. The usual precautions to be taken are described.

Quelques réflexions au sujet de l'éducation morale de la troupe. By Major Schneider. The author has recently published a book on the formation of national character in youth, and this article is a resumé of his subject. The days of iron discipline are passed; in its place, we must have a discipline freely given, and inculcated by a combination of good humour and cordial understanding. The more intelligent the men, the higher must be the qualities of the officer.

Tables et graphiques permettant de déterminer les moments propices pour des opérations nocturnes. By Lieut. Arend. A compilation of tables and graphs to show the hours of daylight and darkness, the degrees of illumination by the moon, etc. It is somewhat too theoretical for the commander in the field, who is more concerned with meteorological prospects, and how to get his troops into their starting positions in time to avail himself of the hours of darkness. The times of rising and setting of the sun and moon are now usually given in field almanacs issued by the staff.

(*June*, 1937.)—*Les combats de Termonde des 26 et 27 Septembre*, 1914. By Lieut.-Colonel Willems. Early in September, 1914, Termonde had been evacuated by the Belgians, but the Germans (IX Reserve Corps), instead of pressing on to occupy Ghent, were diverted towards the French frontier, and the opportunity was seized by the Belgians to attack with practically all their forces. Termonde was re-occupied on the 9th September, and used as a bridgehead over the Scheldt. While the Germans were being forced back from the Marne, their troops in Belgium resumed their operations against Antwerp. The article chiefly describes the operations of the Belgian 4th Division, under General Michel, while engaged in delaying von Boehn's advance.

Aide-Mémoire du fantassin. By Captain Leseul. A collection of precepts for every good infantryman.

Les missions dévolues á l'aviation et l'attaque des troupes au sol. By Captain de Caters. A lecture given to reserve officers. Describes the airman's methods of attacking ground troops. The ideal target is the column of troops. Low-flying aeroplanes did much execution during the last stages of the Great War, and, since then, the improvement in machines, their armament and their methods of attack, have rendered their menace much more formidable. An interesting article, giving considerable food for thought.

L'organisation et l'instruction des troupes du Service de Santé. By Colonel Leman. A review of the progress of medical arrangements in the field.

Le Musée Royal de l'Armée. By L. Leconte. A description of the Royal Military Museum at Brussels, by its founder and Chief Conservator. The establishment of this museum is of recent origin. In 1910, the military section of the Brussels Exhibition was developed into a permanent army museum, and the Great War naturally enlarged its scope beyond all anticipation. A description is given of the principal contents of each hall, and photographs accompany the article.

W.H.K.

MILITÄRWISSENSCHAFTLICHE MITTEILUNGEN.

(*April*, 1937.)—1. *Benedek and Benedek Legends.* By Colonel Heller.

Benedek, the unsuccessful Austrian commander in the battle of Koniggrätz in 1866, has, ever since that battle, been the object of criticism. By some he has been worshipped as a hero, who failed to receive the support of the aristocratic generals under his orders, by others he has been regarded as an incompetent and undecided commander.

Colonel Heller quotes from a number of books on Benedek and the campaign in Bohemia, but particularly from a book by a Viennese journalist, Alter, that appeared in 1912, and another book entitled: *I will render an Account*, by Count Lonyay, published in 1936. These two books, while claiming to settle the question finally, make, according to the writer, such unfair attacks on the commanders belonging to the Austrian nobility, that the statements they contain cannot be relied upon as true.

2. *Sea Power and Politics.* By Lieut. Handel-Mazzetti.

The writer shows how sea-power has influenced the policy of all nations. To all nations bordering on the sea-coast the sea is not a frontier, but a means of communication, and all nations that have a sea-board are neighbours.

In 1859 and 1860 it was the strength of the French and British fleets that helped to

secure the union and independence of Italy. Italy's membership of the triple alliance was only possible as long as Great Britain was not at war with the other members of the alliance. The British command of the sea made it imperative for Italy to abandon the triple alliance as soon as the World War broke out.

For many years, the maritime policy of France was directed mainly against Britain. But when it came to a test—that of Fashoda in 1898—France realized that her navy had been developed on the wrong lines, and she was obliged to give in. The result was a complete change of policy and the Entente Cordiale.

The writer devotes a good deal of space to the post-war policy of maritime powers. The imperialistic attitude of Italy and Japan has compelled Britain to modify her traditional attitude of friendship to both countries. Italy's ultimate object is to secure communication between her African possessions by the occupation of Egypt.

3. *Areas allotted to Units and their Boundaries in Mountainous Countries.*

Major Heydendorff stresses the importance of having suitable points of junction between areas allotted to units in a front line. Although they are convenient points to select on a map, mountain peaks and river lines are not the best boundaries, even if the word "included" is added when dividing up a line into sections.

Three instances are quoted from the Great War: the capture of the Krn peak in the Upper Isonzo by the Italians in 1915, the Austro-German break-through across the Isonzo at Tolmino in October, 1917, and the Italian attack on Mount Ortigara in Southern Tyrol in June, 1917.

4. *The Psychology of the Soldier.*

Captain Ambros explains how an officer, without being a psycho-analyst or nerve specialist, can study the psychology of his men, and so encourage a spirit of loyalty and devotion that will make them do all they can for him.

5. *The Civil War in Spain.*

General Wiesinger continues his account of the civil war in Spain, bringing it up to the state of affairs on the 15th March, 1937. The present situation finds 26 provinces in the hands of the Nationalists, 14 in those of the Government, while the possession of the remaining 7 provinces is being contested.

In the period under review the Nationalists have carried on a campaign round Malaga, the success of which has been counterbalanced by the failure of the operations round Madrid. The result of the Guadalajara offensive, which has for its object the completion of the encirclement of Madrid from the east, was still unknown. In Asturias the Government troops were making strenuous efforts to recover Oviedo.

(*May*, 1937).—1. *Benedek and Benedek Legends.*

Colonel Heller continues his study of the character of Benedek, and the criticism of books on that subject. In this instalment he deals mainly with the battle of Koniggrätz. Whatever his good points, Benedek cannot be considered a success as a general. He was a hero when given a clearly defined task. He failed completely when the responsibility for the whole operations devolved upon him.

He was popular with subaltern officers and with the rank and file, but could not get on with the senior officers under his command.

On the 1st July, 1866, just before the battle of Koniggrätz, Benedek recommended to the emperor an immediate conclusion of peace, failing which a catastrophe was unavoidable. And yet, two days later, with an army that he had described as incapable of resistance, he ventured on a decisive battle in a position where all the odds were against him.

2. *Colonel-General Count von Bothmer.* A brief memoir.

3. *The Reserve of Officers during seventy years in Austria.* Major-General Kainz traces the development of the reserve of officers in Austria from its early stages in 1866 to the present day.

4. *Supply and Replacement of Artillery Ammunition.* By Major Zuber.

5. *Building-up and Extent of Great Britain's Civil Air Defence.* By Nis Petersen.

The practical disappearance of the "blue streak" as a British line of defence

has had the effect of causing an immediate increase in the Royal Air Force from 2,400 to 4,100 aeroplanes, while the Home Defence Force is being increased from 500 to 1,500 machines.

Along with the increase in British air power, measures have been taken to create organizations to nullify the effects of enemy air attacks. Action for civil protection against air raids is to be taken on the following lines :—

(1) by the State, (2) by local authorities, (3) by employers in commerce and industry, (4) by private house owners.

What is needed above all, when a danger of this kind threatens, is an authoritative lead.

6. *Instruction in handling Cross-country Vehicles.* By Major Mahr.

It is not possible to train all motor-car drivers in handling cross-country vehicles, as there are not enough of these vehicles to go round, and the fuel consumption is heavy. But with the men selected a high standard should be aimed at. The training should be theoretical as well as practical. For the latter the classes should be limited to five or six men. The writer explains in detail how the instruction should be carried out.

A.S.H.

WEHRTECHNISCHE MONATSHEFTE.

(*April*, 1937.)—1. *The Conduct of War and Interior Economy.*

Colonel Thomas discusses the relationship between war and the interior economy of a country. Modern " total " war is not merely a fight between armies and fleets, but is a struggle for existence between populations.

The connection between war and interior economy dates back to the times of the ancient Greeks and Romans, but it came to special prominence in the World War, when the necessity for the control of manufacture and labour became apparent. In Germany, however, there is no intention of bringing private manufacture under Government control, or of hampering individual initiative.

2. *Connection between Conduct of War and Technics.*

General Ludwig dwells on the importance of keeping the conduct of war up to date with the progress of science. The elder Moltke was one of the first great commanders to realize the value of railways and to use them to the best advantage. It is possible that Count von Schlieffen would have altered his famous plan for the invasion of France if the 42 centimetre mortar had been invented in his lifetime, and the reduction of the French fortresses had been rendered feasible.

None of the combatant powers in the Great War at first realized the possibilities of the air arm, and they were slow in taking advantage of them. Germany underrated the value of the tank, and allowed the Allies to get in the first blow with this weapon.

While it is not possible for a general to be a technical specialist, he should, to achieve success, know how to collaborate with technicians.

3. *The four Types of Artillery Fuzes.* By Lieut.-General Marx.

4. *Commercial Background of the World's Oil Policy.* By W. H. Thurow.

The writer quotes statistics of the production and export of oil in different countries and then points out what steps some of the powers have taken to ensure a supply of oil in the event of war.

France, with no oil-fields in her own colonial possessions, has large stores of oil in all her harbours. Great Britain is encouraging the production of oil from coal, and is considering the establishment of underground oil reservoirs in suitable places. Russia is endeavouring to safeguard and increase her supplies. Japan is looking for substitutes for oil, so as to lessen her dependence on foreign imports.

5. *The latest Developments of Machine-Guns abroad.* By H. Narath.

A description of some of the latest American and Italian heavy machine-guns.

6. *The Regulation of Prices in the United States of America during the World War.* By Dr. Roemermann.

(*May*, 1937.)—1. *Investigation of the Causes of the unsatisfactory Flight of Shells fired from the* 30·5 *cm. Mortar.* By Major-General Edler von Vallone.

2. *France's Land Fortifications.*

Before the World War, France relied for her frontier defence on the troops stationed on the frontier, who were to fall back, in the event of an overwhelming attack, on the line of forts on the Meuse and the Moselle. Present-day conditions and the importance of holding the Alsace mining and manufacturing areas have made it imperative that not an inch of territory should be given away to a would-be aggressor.

This article describes the land fortifications of the eastern frontier of France from the Channel to the Mediterranean, but especially the portion bordering on Luxembourg and Germany, known as the Maginot line. This line was, originally, connected with the Belgian line of defence, but the recent change in Belgian policy, and the decision not to allow French troops to occupy Belgian fortresses in the event of war with Germany, have compelled France to continue her line of defence along the Belgian frontier up to the English Channel. It has also been continued southwards along the Swiss border to prevent the possibility of its being outflanked through a breach of Swiss neutrality.

The vast expenditure on her defences appears to the French to be justified by the saying: "Les millions dépensés en paix sont des milliards économisés en guerre."

3. *Ammunition for Light Guns.* By Lieut.-General Marx.

4. *Electric Power in Armament Works.* By Major Mende.

Decentralization is the correct policy for armament works. On the other hand, the economical supply of electric power is obtained by concentrating it in large powerful generating stations. Dr. Schacht has pointed out the danger of concentrating the sources of electric supply in highly vulnerable power stations. Sources other than steam and water-power should be investigated.

5. *Politics and Fuel for Ships in Britain.*

Captain Ruprecht discusses the policy followed in Britain with regard to fuel in the Navy. Three years ago, the struggle between oil and coal appeared to have been finally decided in favour of oil. But although Britain can command, financially, 70 per cent. of the world's oil supply, recent events have shown that, in case of war, the supply might be greatly endangered by Italian action in the Mediterranean, or by Arab risings in Palestine and Trans-Jordania.

The fact that the two new battleships: *King George V* and *Prince of Wales* are to be entirely coal-fired has made a profound impression abroad.

The writer considers that there are great possibilities for an invention that will drive both marine and locomotive engines by gas generated from coke or anthracite.

4. *The Production of Raw Material.* By Major Hedler.

The question of raw materials is an important one for all countries, but especially so for a country like Germany, that has no colonies of her own. It cropped up during the continental blockade in Napoleonic days, and that blockade was the cause of several industries being started or developed, e.g., beet sugar, soda, chicory and dyes. In more modern times, we have the manufacture of artificial silk, rubber, etc., and the hydrogenation of coal, also the recovery of raw materials from what were formerly regarded as waste products.

5. *Alloy Steels and the Arms Industry.*

Steels alloyed with the rarer metals are classed as "Edelstähle." The alloys in question are nickel, chromium, molybdenum, vanadium, wolfram, titanium, boron, beryllium, cobalt, and tantalum. Added to carbon-steel, they improve its texture and give it a higher strength and ductility. Alloy steels are now indispensable for arms and motor industries.

Manganese, vanadium, and some of the other alloys are obtainable in Germany, but almost all nickel and chrome ores have to be imported. Some countries, e.g., Germany, France, and Belgium, have a large nickel reserve in their coinage.

6. *Steel or Lead Accumulators in the Motor-Car.*

Dr. Hanft dwells on the advantages of the Edison steel storage battery over the lead battery. In the matter of cost, spread over the life of a vehicle, it is no more expensive. As a starting battery, it has many advantages.

(*June*, 1937.)—1. *Artillery Armament in the Japanese Army.*

Colonel Bluemner gives details of the artillery armament of the Japanese army in 1934, and of the increases effected since then, corresponding with the increase in the army from 17 to 25 divisions. The number of guns in the army at peace strength is estimated at 1,700, out of which 400 are heavy guns.

2. *Means of Communication and German Inventors.* By Colonel Dufais.

A description of the share taken by German inventors in the introduction and development of telegraphy, telephony, and wireless telegraphy, for which, in the writer's opinion, they have not been given sufficient credit.

3. *Portable Tank Traps.* By Major von Ahlfen.

In this article, entitled "Schnellsperren," the writer refers to mines that are fired automatically by tanks or armoured cars passing over them. Two small diagrams explain the principle on which they work. The trap consists of two similar sections, each 1·5 metres long, placed end to end, thus covering a 3-metre width of roadway. Each section contains, at each end, a suitable charge of explosive, which is fired by the pressure of the track or wheel passing over or near it. Between the charges, pressure is transmitted through an iron pipe resting on springs. On either side of the pipe is a wedge-shaped piece of wood which forms a ramp for the tank to go over; the pipe projecting slightly above the highest point of the wedges.

The idea is that the road should be kept open until the last moment for friendly dispatch riders and other traffic, and that the trap should be set at the last moment, for enemy tanks, by a party of men concealed under cover.

4. *The Electrification of Italian Railways.* By Dr. Sell.

The Italian railway system has a total length of 22,000 km. In 1922, 685 km. were electrified. By the end of 1936, the length had been increased to 3,400, and a programme is now being worked to by which 8,000 km., all told, will be electrified by 1944. The ultimate object is to have electric traction for all the railways in the country. The cost will be immense, but the Italian Government is determined to free itself from the necessity of having to import foreign coal.

In making this decision, it is taking a heavy risk, since the water power for providing the necessary electric output is concentrated in the north of Italy, near the frontier, where the power stations are exposed to danger from enemy action in time of war.

5. *Lead and Manufacture of War Material.* By C. Dampfer.

Formerly the only use for lead in the manufacture of war material was for ammunition. Nowadays there are many other purposes for which it is essential. German lead mines produce about 30 per cent. less lead ore than they did before the war, but the loss in production has been, more or less, counterbalanced by a lesser demand.

On the basis of the out-turn of 1933, Germany is about 30,000 tons short of the amount of lead required in war-time. The writer advocates the collection of a war reserve of 100,000 tons, and also the imposition of a duty on imported lead, to encourage the home mining industry.

6. *Concrete and Reinforced Concrete Shields against High Explosive Shells.* By Dr. Heidinger.

A study of the penetration of shells into concrete shields of varying thicknesses.

7. *The Penetration of Projectiles into Solid Bodies.* By Dr. Vieser.

A.S.H.

VIERTELJAHRESHEFTE FÜR PIONIERE.

(*May*, 1937.)—1. *Training of Engineers for Battle. Part II.*

Captain Meltzer continues the article begun in a previous number. The greater part is devoted to training with the rifle. After preliminary instruction, men should be

trained to make the best use of the ground, to select their target and firing points, adjust their sights correctly, control their fire, pay attention to their leader, etc. Then follows a series of instructions for scouts. Finally, instruction is given in the use of the light machine-gun.

2. *Portable Obstacles.* By Major von Ahlfen.

The main characteristics of portable obstacles (*Schnellsperren*) are :—

(1) They should hold up armoured cars of all kinds on roads and tracks.

(2) They must be easy to handle.

(3) They must be capable of easy erection.

(4) The gap that they cover must be easily opened or closed.

(5) They must be under fire.

The writer gives a series of examples to show how these obstacles can be used to the best advantage, sometimes in conjunction with anti-tank and machine-guns.

3. *The Employment of a motorized Engineer Battalion in erecting Obstacles in Divisional Operations.*

Captain Betz deals with the employment of Engineers in erecting obstacles under the following conditions :—

(1) In the course of an advance, (2) in attack, (3) in defence, (4) in fighting a delaying action, (5) on deciding to retire.

4. *Anti-tank Defence from a French point of view.*

In recent years, anti-tank defence played a very subordinate part in French official regulations. The Treaty of Versailles placed a ban on tanks in the German army. But the repudiation of that treaty by Germany has completely altered the position.

In June, 1936, an article appeared in *La France Militaire*, in which General Clément-Grandcourt drew attention to the necessity for preparation for defence against tank attacks. For an efficient defence :—

(1) infantry should be furnished with anti-tank equipment that it can itself handle,

(2) material should be held in readiness to be issued to engineer units for their own use in case of need,

(3) more elaborate devices should be employed by the engineers.

It is very important that ground unfavourable to tank action should be selected for defence. Advantage should be taken of rivers, swamps, woods, cliffs and rocks. As artificial obstacles the following may be used :—abatis, piles projecting about 50 cm. above the ground, barricades, ditches, and tank traps. More elaborate devices are :—mines, wide ditches, inundations, and obstacles consisting of rails driven into the ground.

5. *Armoured Engineers.*

Lieut.-Colonel Koller-Kraus uses the expression *Panzerpioniere* for engineers forming part of armoured units. He makes a brief reference to an article in the *R.E. Journal* and also shows that the question of the employment of armoured engineers has been considered in Italy and Poland.

It is not likely that armoured units will deliver an attack where a strong defence with anti-tank guns and obstacles is to be expected. But it may sometimes occur that an armoured brigade, acting independently, may have to deal with hastily laid mines and artificially strengthened natural obstacles. The advantage of a surprise will be lost if armoured sappers are not ready to hand to remove the obstacles as soon as they are met. It follows that armoured sappers will have to carry suitable equipment for removing mines and constructing bridges.

6. *Military Geology and Water-Supply along the Belgian Coast in* 1915.

Major Kranz describes the geological formation and the water-supplies available in the Belgian coastal regions occupied by the German armies during the war. The Germans suffered heavily from their failure to realize the effects of the North Sea tides, the flooded areas along the Yser, and the sluices at Nieuport, but their water-supplies along the Belgian coast were well regulated by the Marine Corps and the 4th Army.

The coastal tract is divided into three parts: the line of dunes along the sea coast, an area of marsh-land next to it, and a tertiary-diluvial plain still farther inland.

In the dune area water was, as a rule, scarce, often brackish. Knocke, on the Dutch border, had a good water-supply: Ostende had a very poor one. In the marsh-land the water was often polluted with decaying vegetation; in a few places only could deep wells be sunk furnishing good water.

The tertiary-diluvial plain provided a better water-supply. As a rule, tube wells were of little use, the flow of the water through the fine Ypres sand being too slow, and open wells of large diameter were needed.

The writer dwells on the importance of close co-operation between the medical service and army geologists, and attributes the satisfactory arrangements in the Marine Corps to the fact that an officer of high standing in the medical service was a geologist.

7. *Roads in the War Area.*

In this article, Major Strobl makes a comparison between American and Italian ideas on road construction at the front.

As regards vehicles, the Americans hold the view that no vehicle accompanying a cavalry or infantry division in the field should, when loaded, exceed 7½ tons in weight. This is the maximum load that pontoon bridges and modern second-class road bridges will carry. A large quantity of first-line transport consists of Ford or Chevrolet vans carrying a useful load of 1½ tons. These can travel wherever horse-drawn vehicles can go.

The Italian point of view is that the first échelon transport should consist of vehicles with caterpillar tracks and tractors, of considerable weight, but capable of travelling at speed over almost any ground.

With regard to the use of roads, the Americans consider that every available road must be fully utilized, that transport should be subjected to strict march discipline, and they bear in mind the possibility of having to suspend operations temporarily, if weather conditions make the roads impassable.

The Italians, on the other hand, while regarding a road system in the same light as a railway system as an aid to warfare, do not wish to hamper their strategy by sticking to roads. They are prepared to leave the roads at any moment, and transport their troops across country in caterpillar track vehicles. If tracks are needed for such vehicles, it will be the business of the engineers to construct them, with the assistance of other troops.

In connection with road construction, American divisional engineers are provided with road-building plant. An engineer regiment has 54 motor-driven tip-carts for the transport of stone, metal or gravel. Forward roads are given a light wearing coat and are consolidated under the traffic. Sometimes calcium chloride is added as a binder, or else a bituminous binding material is sprinkled over the surface. Corps and Army engineer parks keep a supply of steam rollers, stone crushers, and other heavy road plant.

The Italian idea is to construct "tactical roads." The object is to facilitate the advance of cross-country vehicles, and not to build roads suitable for peace-time traffic. The main idea is that these "tactical roads" should be built very quickly, and that, during construction, working parties, materials and plant, should be concealed from view. A minimum amount of levelling or filling is needed; in places the track need only be spit-locked. In mountains or swampy tracts, where it would take time to level or prepare the surface, a road is made by putting down steel trough-plates—packed underneath where necessary. These are taken up when no longer required, and used elsewhere. This system of tactical road construction was used in places in Abyssinia.

Comparing the methods adopted in the two countries, Major Strobl concludes by expressing the opinion that, the greater the variety of vehicles in an army—horse-drawn, light or heavy mechanical vehicles—the more complicated will the problem be

8. *A Prussian Engineer Officer as War Correspondent.*

An account of the career of Major Scheibert, born in 1830, who served as war correspondent during the campaign in Italy of 1859, and later with the Confederate forces during the American civil war.

9. *Securing the Dutch Frontier of Germany during the World War.* By Colonel Biermann.

The landing of the Franco-British force in Salonika in 1915 made the Germans anxious about the fate of Holland. A successful landing by a British force in the Scheldt, in rear of the 4th German army, combined with a general frontal attack along the whole line, would have caused a collapse of the whole German west front. Moreover, a force landed in Holland would not only reach the submarine bases at Zeebrugge and Ostende, but would make its way overland to the U-boat supporting stations in the Heligoland Bight. It was suggested that Holland might be bought over to the side of the Entente by a threat to her colonies.

This article describes the protective measures taken along the Dutch frontier to resist a landing force. All preparations were completed in the summer of 1917. According to the writer, they had the effect of preventing any attempt to land on the Dutch coast, and saved Holland from becoming a battlefield of the World War.

10. *The "Limes," the Roman Boundary Wall in Upper Germany and Rhaetia.* By Major Herrmann.

A description of the wall that formed the boundary of the Roman empire between Coblence on the Rhine and Regensburg on the Danube. In Rhaetia, it took the form of a stone wall, while in Upper Germany it consisted of a mound, ditch, and stockade. Major Herrmann describes the changes that took place during the various periods of the existence of the wall, viz., the reigns of Augustus, Vespasian, Domitian, Trajan, Hadrian and Antoninus. From Hadrian's time onwards, the Roman policy changed from an offensive one to a purely defensive one. Eventually the Romans had to give way to the advancing Germans, and the wall gradually fell into ruins.

11. *Construction of the Winske Bridge at Oppeln by the 8th Engineer Battalion.*

Captain Bernhardt describes the construction of a pile-bridge over the Winske, a branch of the Oder, at Oppeln, where an existing hump-back bridge required replacement. The town furnished the materials, the 8th Engineer Battalion provided the requisite labour.

The bridge had 7 spans of 7 metres each, and was designed to carry loads of 3·1 tons. Each pier consisted of five wooden piles of 28 cm. diameter. The central portion of the roadway consisted of six 32- by 36-cm. wooden longitudinals, two side beams of lighter section carried the foot-paths. The abutments and wing walls were of concrete.

The average number of men employed at a time was 39, working in two seven-hour shifts until the days shortened in the autumn, when only one shift became possible. The work took 40 days to carry out, and included dismantling of the old bridge, and erection of a temporary foot-bridge. Pumping was necessary for the abutment foundations. The bed of the stream was too hard for driving piles, and holes had first to be bored with special deep-boring apparatus. A pile-driver was set up on a floating raft. The work proved a useful experience for all ranks.

12. *Engineers secure Hamburg's Electric Light and Power Supply.*

In January, 1937, a combination of severe frost and east wind affected the flow of water at the estuary of the Elbe to such an extent that the electric power station, situated on the Neuhof ship canal, was deprived of its water-supply. The canal served the dual purpose of allowing coal barges to come alongside and of furnishing water for cooling the engines.

At 8 p.m. on the 25th January, two engineer battalions were called out to deal with the situation. The first idea was to deepen the canal, but the task was found to be impossible, as the men sank up to their waists in icy mud. It was eventually decided to build a dam across the canal to retain the water that flowed in at high-tide. The

dam was constructed of sandbags, filled, for want of anything better, with lumps of frozen clay. The work went on all night and was completed by 12.30 p.m., as the next tide came in.

A.S.H.

REVUE MILITAIRE SUISSE.

(*Jan.*, 1937.)—*La défense d'après la S. C.* 1927 . . . *en* 1937. By Lt.-Colonel Montfort. This somewhat cryptic title refers to the chapter on defence in the Swiss Regulations for Field Service, 1927 edition, and its application in 1937 is discussed in this article. A great deal of re-organization is going on in the Swiss army, and many of the articles now appearing in this *Revue* deal with the changes. The 1927 system of defence was based particularly on an infantry attack supported by artillery; and, the author remarks, paid very little regard to attacks by air and by tanks. These latter forms of attack, he considers, are the most dangerous. He goes on to discuss the measures to be taken against tanks. For the defence of a position he advocates a zone of strong points, well hidden, designed and equipped for powerful anti-tank defence. But it requires a very high degree of morale to thus decentralize the defence in little groups, relied upon to resist to the last, and to act on their own initiative, probably amidst dense clouds of smoke.

Anti-tank defence is certainly the pressing consideration for the defender.

Un exemple de liaison entre les opérations et les services de l'arrière. By Lt.-Colonel Anderegg. An interesting book has recently been published in Germany by Colonel Jochim, formerly quarter-master of von Kluck's Army—or, as we should say, D.A. and Q.M.G.—on the subject of the rearward services of the First Army, during the battle of the Marne; and this article gives a resumé of the French translation of the book.

The German system of supply in the field consisted of: the supply wagons marching with the troops; the regimental trains marching behind the divisions; and the munition columns and trains of the Army Corps divided into 1st and 2nd echelons. While the fighting troops of a German Corps, moving on one road, formed a column 21 miles long, its trains required 20 miles more. When, therefore, von Kluck's Army was first diverted south-eastwards, then checked by the menace of the French Sixth Army on its flank, and finally turned backwards to meet the danger on the Ourcq, the problem of swinging round its supply arrangements and disentangling the crossed lines of the Seven Corps' communications was one of the greatest complexity. That it did not lead to the complete disorder of the Army was a triumph for the "Q" services; and the study of the problem is therefore of exceptional interest.

La nouvelle section d'infanterie. By Capt. Nicolas. The Swiss infantry section has recently been completely re-cast. It now has three fusils mitrailleurs instead of two, and three identical groups instead of five. Its total strength is now 43 as against 47, but it has an increase of fire-power. The pre-war infantry section was a very simple unit, consisting of some 50 rifles directed by word of mouth, or of 50 bayonets rushing to assault, led by a subaltern with a sword. The first battles of August, 1914, showed the devastating effect of the machine-gun, and new tactics had to be improvised on the field of battle. The section became split into groups, each led by an N.C.O. The decentralization went even farther, the individuals of each group becoming gradually more widely spaced, until each man was practically acting by himself. This change imposed a re-cast of the method of training, and to-day the infantry soldier has to be a unit in himself. (*To be continued.*)

(*Feb.*, 1937.)—*Problèmes de motorisation militaire.* By General Altmayer. A long article based upon a lecture recently given by a distinguished French general (at present commanding the 5th Cavalry Brigade) to Swiss officers. The author sketches the whole subject of military mobility from ancient times to the development of

tanks, and in this instalment brings his readers up to the point of considering how these new means are to be employed.

Remarques sur le tir indirect et le tir lointain à la mitrailleuse. By Capt. Daniel. A short exhortation to officers in favour of indirect machine-gun fire, as distinct from long-range fire.

La nouvelle section d'infanterie. By Capt. Nicolas. Completes the article begun last month, discussing the employment of the reorganized infantry section.

Quelques opinions au sujet de la fourniture des chevaux dans notre armée. By Lt.-Colonel Muller. A census of horses and mules, fit for military service, throughout Switzerland was carried out in October, 1936; and the author, an inspector of remounts for the 2nd division, describes the results.

(*March*, 1937.)—*Notre nouvelle carte militaire.* By Colonel Schneider. An account by the Director of the Swiss Topographical Service of the new 1/50,000 military map of Switzerland now in preparation. A general revision of methods of map-production took place throughout the principal countries of Europe after the Great War; and military maps in particular are being universally overhauled. The Swiss Army is to have a map in several colours, with contours at 20 metres; and in editions with or without shaded relief. Enlargements on the scale of 1/25,000 are provided for the artillery, and for other special needs.

Problèmes de motorisation militaire. By General Altmayer. The conclusion of the article. The author gives his readers a very clear view of the probable development of events in future operations. He emphasizes the need for a greater intensity of training of the higher command, which will have to act with greater promptitude than ever, and make decisions with less notice than before, which in turn requires quicker information. In fact, the whole tempo has been quickened. Hard and fast tactical rules must be avoided. A quick clear intelligence must be trained on the widest possible experience.

Les infanteries comparées. By Capt. Nicolas. A short comparison of the composition of infantry sections in the Swiss, French, German, Italian, Austrian and Russian armies.

D'autres leçons de la guerre d'Espagne. By J. V. The theories of General Douhet, the Italian who predicted the complete demoralization of civil populations in the face of gigantic air raids, appear to have been upset by the stubborn resistance of Madrid to air bombardments. The civil populations of Spain have bravely faced the air attacks, and refuted the Douhet theory.

(*April*, 1937.)—*L'accompagnement des attaques d'infanterie.* By General Rouquerol. Superiority of fire remains the essential element of success in any infantry attack. The author deals with the various forms of close support by artillery arms, and with the different trench weapons designed for infantry use. He urges the permanent attachment of a battery of field artillery and a tank to each infantry regiment. The infantry, in fact, prefer light artillery weapons which can accompany them, and be, to all intents and purposes, infantry arms to detached bodies not under their control.

Quelques reflexions sur notre pays et sa défense. By Colonel Pfund. These were written by a veteran Engineer officer some two years ago, but were laid aside when the new official plan for reorganizing the Swiss defences was first mooted. Apparently, the author thinks that sufficient weight is not being given by the public to certain aspects of the problem and he has therefore brought his reflections to light, in support of the new impulse given to Swiss national defence. He touches on such questions as pontoon bridging, teleferage, and fortification, in a very general manner and sums up his counsel with the ancient proverb, "*si vis pacem, para bellum.*"

La bibliothèque de l'officier. By Lt.-Colonel Mayer. The author, a lifelong student of military literature, says that he has often been asked what books should compose an officer's library. It is rather a question of aptitude and aspiration; and no specific list of works is mentioned. The author enlarges on the influence which certain works—

notably von der Goltz's *Nation in Arms*, Montluc's *Commentaries*, Marmont's *Memoirs*—have had upon him, but he leaves his readers somewhat in doubt as to what books they should collect in these modern days.

(*May*, 1937.)—*À propos de telepheriques*. By Colonel Lecomte. Although the Swiss Army, thirty years ago, was furnished with mountain brigades, the subject of teleferage has been somewhat neglected. The limitations of this form of transport were appreciated, but the Great War provided a wide experience of rope-ways, especially on the Italo-Austrian front. The article describes a small installation recently tried out, with a length of 1,200 metres and a difference of altitude of 540 metres. Its uses are practically confined to static warfare.

L'avion contre le char de combat. By Lt.-Colonel Mayer. An article based on a recent book by M. Camille Rougeron, entitled *Air Bombardment*. The author enlarges upon the view expressed therein that anti-tank defence might be operated from the air by carrying a light gun capable of piercing the armour of tanks. By its speed and mobility, the aeroplane can attack the tank from behind or on a flank, and always from above. There seem to be many objections, however, and one of them is that a tank is a very small target for the airman. Moreover, to obtain a direct hit, the machine must fly low, and will therefore come within range of the enemy's anti-aircraft weapons.

La préparation militaire de la jeunesse en Suisse.—By Lt.-Colonel Junod. An historical account, from earliest times to the present day, of the military training of the Swiss youth, showing how far ahead of most nations the Swiss were in this respect, until recent years, when there has been a falling off. Training to-day is more in the direction of moral and physical improvement than in actual military preparation.

Excès de confiance. By Capt. Thilo. A short expostulation against too much freedom of discussion, in the Press and elsewhere, of military measures, particularly of any new developments resulting from the present reorganization and strengthening of the Swiss defences. The author protests against the facilities allowed for individuals of double nationality to gain information.

(*June*, 1937.)—*Le commandement unique*. By General Rouquerol. Another plea for the establishment of a unified command over land, sea and air forces. The failure of command by committee is again emphasized, and what is a group of three separate commanders-in-chief but a committee?

La mentalité de l'officier et sa mobilisation. By Lt.-Colonel Mayer. Based on an article written by a young artillery officer in the French *Revue d'Artillerie*. The change from trench to open warfare in 1918 had its repercussions on the mentality of the young soldier, who had just passed his examination for entrance into the École Polytechnique when the war broke out. The difference between the siege gunner and the field gunner is taken as the author's theme.

Répercussions possibles de notre nouvelle organisation militaire sur l'emploi de l'artillerie. By Major Gonard. The considerable changes in the composition of the new Swiss divisions have led the author to examine *ab initio* the question of the employment of the artillery. After some general opening remarks, he takes us methodically through the employment of artillery as he sees it in the future. The article is to be continued.

W.H.K.

THE INDIAN FORESTER.

(*April*, 1937.) The prevention and cure of erosion occupies an ever-increasing space in the magazine. In this number, it is the subject of the Editorial, of another article "Erosion Survey in the Uhl Valley," and, largely, of a long excerpt from a handbook of native woody plants in the United States. In the Uhl Valley, there is serious danger of uncontrolled floods damaging the headworks of Battye's hydro-electric scheme

(described in *The R.E. Journal* of March, 1936), which can only be averted by the re-planting of areas which have been stripped of their soil cover by torrential rains following on over-grazing and over-felling.

It is a moot point whether a forested area attracts rainfall. It certainly seems to be the case in a dry hill area near Ranchi, where *sal* has recently been planted and irrigated.

A scheme for timber seasoning emanates from Russia, where short-wave electrical rays are directed on to the log, in such a way that its moisture content is reduced uniformly, and the timber seasoned in a few hours. This compares very favourably with the most rapid kiln-drying method in existence, where at least several days are required.

(*May*, 1937). "The Rôle of Treated Timber," by Mr. Kamesam, is a plea for the greater use of timber by engineers, in place of concrete and steel. Timber treated with some of the more modern preservatives can be expected to have a very long life. There is more on the same subject in the report of the opening speech at the Forest Utilization Conference by Sir Gerald Trevor.

"Reclamation in the Pabbi Hills"—a low range lying to the east of the Jhelum athwart the N.W. Railway and the Grand Trunk Road—is the story of a long struggle against over-grazing and the consequent erosion of what was, not long ago, a well-wooded range. Fair success has attended the efforts already made, but there is still much to be done. There is nothing spectacular in the campaign; it is a tale of small doings such as the making of innumerable stone dams across *nullahs*, but it has to be carried on with meticulous attention to details and unceasing vigilance.

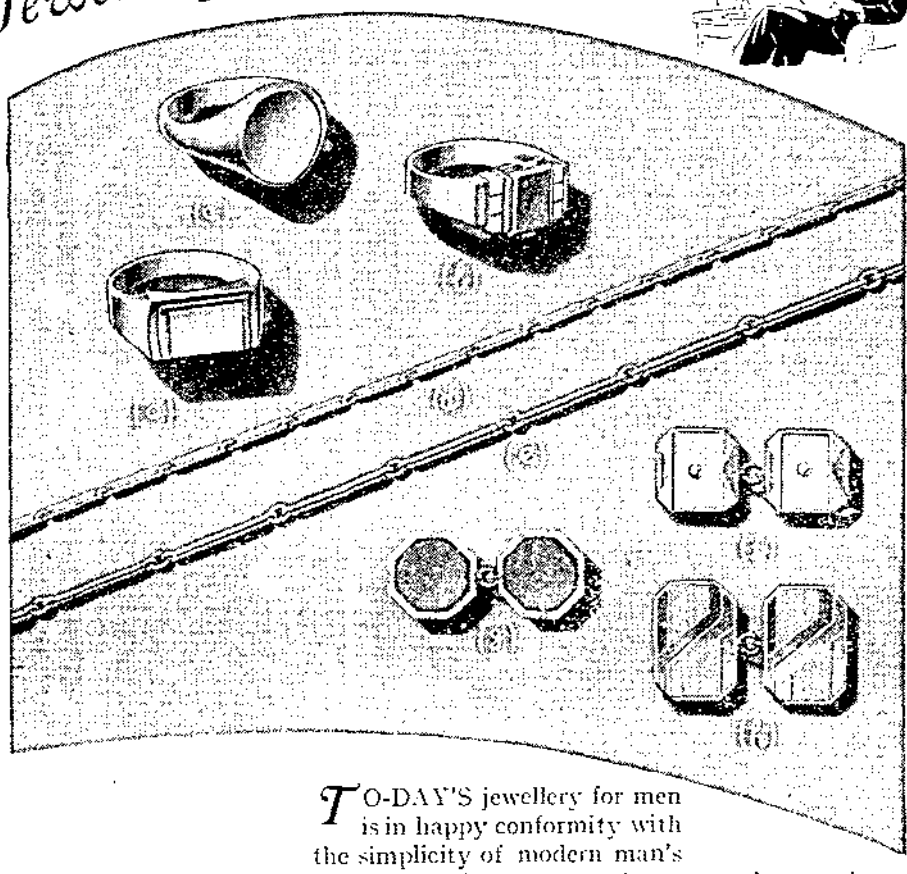
(*June*, 1937.) At Convocation Day of the recently reopened Forest College at Dehra Dun, Mr. Hall, the Director, gave an account of the work at the College, paying a tribute to the Commandant of the Bengal Sappers and Miners, for the valuable course of practical training given to the students at Roorkee, where they built a trestle bridge, a suspension bridge and a cantilever bridge. They also constructed a 20-foot derrick, and, amongst other things, had practical instruction in the handling and use of explosives. As regards the duties required of forest rangers, he added, "I would first like to mention forest engineering, a subject which to the Indian Forest Ranger is second only in importance to forestry itself. The Divisional Forest Officer is responsible for the plans, estimates, construction and maintenance of all forest buildings in his division. Too often he has to rely on a very poor class of contractor. It is thus all the more essential for the Forest Ranger to have a sound working knowledge of building materials and construction. . . . A forest officer is also responsible for the construction and maintenance of hundreds of miles of roads and instruction is given in road-making and bridge construction. Theoretical and practical training in survey is necessary and each student has finally to make a survey plate of a plot of ground."

Some of us may have commented on the high cost of game licences in Kashmir, the issuing of which is now a function of the Chief Conservator of Forests in that State. It is recorded that only a small profit is derived from this source, by far the greater part of the income being devoted to protection and improvement.

In the final extract, "The Organization of the International Timber Market," an account of the convention at Copenhagen between the principal timber-exporting countries in Europe, we are told the somewhat alarming fact that of the world consumption of 1,500,000,000 cubic metres of timber annually, as much as one third is obtained by drawing on forest capital.

F.C.M.

Jewellery for Men



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