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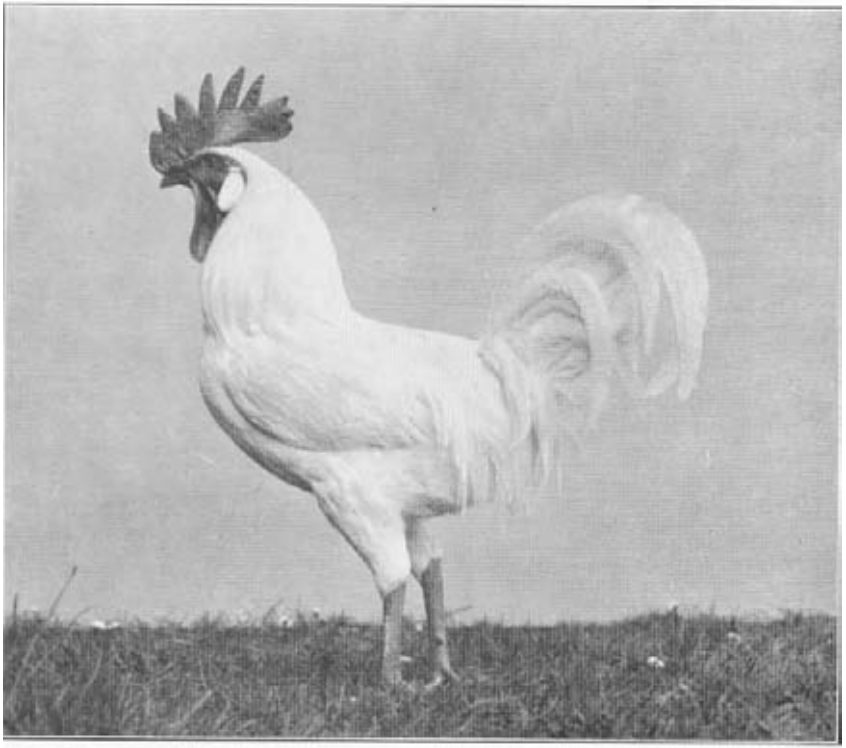
1.—*Leptophyes punctatissima*: panchromatic photograph, showing harmony in tone between the grasshopper and the leaf on which it is resting.

2.—The same: infra-red photograph, showing differentiation between the insect and its surroundings.

Camouflage in nature and war - 1&2



3.—White cock seen against a white background, showing conspicuousness due to relief.

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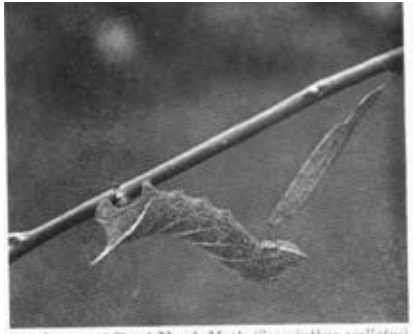

4.—Larva of Eyed Hawk Moth (*Smerinthus ocellatus*) showing obliterative effect of countershading in the normal attitude of rest.

5.—The same, inverted.

6.—The same, seen in natural surroundings, showing the flattening effect of obliterative shading.

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8.—Young Woodcock. When seen against the irregular patchwork of fallen leaves and deep shadows of their natural environment, the young of this species provide a puzzle for the sharpest eyes. Their concealment is due to the effect of a disruptive pattern of bold contrasts, which catches the observer's eye, and distracts his attention from the form upon which it is superimposed.

[*Frontispiece.*]

CAMOUFLAGE IN NATURE AND IN WAR.

A Lecture delivered at the S.M.E., Chatham, on October 20th, 1938, by
DR. H. B. COTT, M.A., D.SC., F.R.P.S.
Lecturer in Zoology, Cambridge University.

I.—INTRODUCTION.

I FEEL it a great compliment to have been invited to address you this evening on a subject which has been a special interest to me for many years. It is my intention to describe the optical principles upon which concealment depends: to indicate the methods by which this end has been achieved in nature: and to refer to the bearing of these principles and devices upon the important problem of applied camouflage.

My reasons for bringing in the case of animals at all are twofold. In the first place, while the general scientific principles to be discussed apply to all objects under natural daylight illumination, the case of animal coloration is particularly well calculated to drive home the principles into the minds of those who, like so many of our officers, happen themselves to be keen and observant sportsmen.

In the second place, there is a close analogy between the need for concealment in nature and in war. But in this sphere of visual concealment different wild animals have attained a degree of perfection far beyond the comparatively clumsy attempts at camouflage with which we are too easily satisfied. For this reason we may learn from the study of Nature many valuable lessons which otherwise might scarcely be apprehended.

May I begin, therefore, with a few words upon the part played by concealment in the lives of animals. One of the fundamental facts affecting living creatures is the interspecific warfare known to biology as the struggle for existence. The problem of self-preservation

in the field is very real, very urgent, and often difficult enough to solve. But it is one with which all forms of animal life are faced.

Taking a broad view of the subject, individual survival depends upon the satisfaction of two primary needs—food and safety. It is the old question of the relation between the aggressor and the victim of aggression; between predator and prey; between hunter and hunted.

The urgent nature of this central biological problem of self-preservation is reflected in the variety and specialization of Nature's adaptive experiments in offence and defence. For instance, we see evidence for this in the evolution of speed, on land, in the air, and under water, by pursuer and pursued; in the use of stealth and surprise, of deception and ambush; in the display of warning signals, or of alluring baits; in the elaboration of smoke screens, traps, nets and parachutes; in retreat obtained by burrowing underground, or by the adoption of nocturnal habits; in the development of poison, and of deadly apparatus in the form of fangs or stings for its injection into the bodies of enemies or prey; in protection afforded by plated or spiny armour; and in the use of chemical warfare which is practised, for instance, by certain insects; and of poison gas, by creatures like the skunk.

Of all these various adaptations—which it will be noted each have their parallel in the paraphernalia of modern warfare—perhaps none is so important, so widely distributed, or so perfect as that which renders animals inconspicuous, and often well-nigh invisible, in their natural surroundings. It is not too much to say that concealment appears to have been one of the main ends attained in the evolution of animals. And although in most spheres of modern warfare man has now (though in some cases only recently) advanced far ahead of the animal creation in his equipment for protection and aggression—in regard, for instance, to the development of armour and mobility, to the use of projectiles and of devices such as the balloon barrage (which in principle is a gigantic spider's web), smoke screens (which are used with effect by cuttle-fishes who dart for safety behind a dense cloud of sepia), and of instruments such as range-finders and sound-detectors and the like—the case of camouflage is an exceptional one.

Camouflage, as we now know it, was born in the Great War. It is only in comparatively recent times that its scope, its possibilities, and its importance have been fully appreciated. In view of recent developments in aerial warfare, and the ever-increasing part played by aircraft in military and naval operations of all kinds—including reconnaissance, photography and bombing—concealment has assumed to-day a new and most vital function, whose significance can hardly be overstated. But we have lagged behind, and have much

leeway to make up before we can approach the efficiency attained by different forms of wild life in the field.

In the time at my disposal I can do no more than touch the fringe of a great subject. Before considering the methods by which an animal or any other object can be rendered inconspicuous and difficult to recognize, we must be quite clear as to the optical principles upon which recognition depends. When we look at any opaque body, it appears in the field of vision as a patch of colour, more or less differentiated from the surrounding objects which form its background, and from which it may differ in various respects—notably in *colour and brightness*, in *light and shade*, in *shape and contour*, and in the form of its *shadow*. It cannot be too strongly emphasized that visible form can only be distinguished when it is exhibited by differences of colour or tone, or of light and shade. With the reduction of such differences an animal or any other object becomes more and more difficult to recognize: in their absence it becomes unrecognizable.

It follows from these considerations that four fundamental steps towards effective camouflage must lie in the direction (1) of *colour resemblance—i.e.*, the agreement in colour between an object and the background against which it is seen; (2) of *obliterative shading—i.e.*, counter-lightening and darkening which abolishes the appearance of roundness or relief due to the effects of light and shade; and (3) of *disruptive coloration—i.e.*, a superimposed pattern of contrasted colours and tones serving to break up the surface and to blur the outline; and (4) of *shadow elimination—i.e.*, the screening or effacement of cast shadows by orientation, or structural adaptations.

Now it is a very remarkable fact, and one of much significance, that these theoretical principles of colour resemblance, obliterative shading, disruptive coloration and shadow elimination, together with various additional devices and instincts, are those actually found to operate in Nature, whereby different animals—belonging to the most diverse groups and living in the most dissimilar surroundings—are rendered so extraordinarily difficult to recognize when encountered in the field: and they are those in the light of which every scheme of camouflage must be based.

A further point must be emphasized at the outset, namely, that it is only when animals—whether toads or tree frogs, fishes or wild fowl, mammals or insects—are studied in the wild state that it is possible to appreciate the significance of the colours and patterns which they wear, and then only in the living creature—when these can be considered in relation to particular postures and habits, and to the habits of enemies and prey. Of the utmost importance in this connection is the habit possessed by most cryptically-coloured forms of remaining motionless when in danger, and thus escaping detection

in circumstances where the least movement would be likely to betray their presence.

2.—General Colour Resemblance.

The first optical principle upon which concealment depends is that of colour resemblance. We have seen that every object appears in the field of vision as a patch of colour, differing more or less markedly both in *hue* and *brightness* from its immediate background. The general resemblance borne by various animals to the different surroundings in which they live is a theme more or less familiar to everyone. Every major environment with a dominant type of coloration furnishes innumerable examples of the principle—different members of the fauna wearing a cryptic dress or uniform—immaculately white in the snowlands; ochre, buff or sandy-grey in the desert; green among the evergreen foliage of tropical rain forests; dull and dappled beneath the trees; striped among grass and reeds; blue, or transparent, in the surface waters of the sea. Such methods have an obvious bearing upon the colour of uniform worn by forces operating in different fields.

It is interesting to notice in passing that in a given environment similar cryptic colours have been developed independently in the most distantly related groups of animals; and in the most widely separated geographical areas; while the coloration is itself due to a variety of causes—chemical, physical and physiological. For instance, among foliage dwellers, green coloration has been adopted as a uniform by many families of snakes and lizards, tree frogs and birds, as well as by innumerable caterpillars, grasshoppers, cockroaches, moths, mantids, beetles, bugs and other insects. It is found in similar environments in South America and Australia; in tropical Asia and tropical Africa. It is produced in some cases by green pigment; in others as a structural colour; in others by a combination of both effects; in others again by the colour of the green food showing through a transparent body-wall; or by green algæ living on the hairs of the body, as in the sloth.

A very interesting question bearing upon the nature and quality of light reflected from green animals is opened up by the comparatively new technique of infra-red photography. It is well known that the chlorophyll of leaves reflects light in the infra-red region of the spectrum, and that as a consequence grass or foliage appears snow-white in the infra-red photograph. But different green animals, which to the eye appear similar in tone and colour both to one another and to their surroundings, differ greatly in their absorption of the infra-red light. It follows that when twin photographs are taken respectively on pan-chromatic and on infra-red plates, the results in certain cases are most illuminating—those forms which absorb infra-red rays becoming in the latter strongly differentiated

from the environment, and appearing as dark objects standing out conspicuously from their light surroundings. (See figures 1 and 2.)

There is an aspect of this subject of practical importance. During the Great War the development of aerial photography and reconnaissance rendered the concealment of ammunition dumps, battery positions, headquarters and other objectives a matter of basic importance. To this end various devices were used, such as the construction of dummy positions, and the erection of overhead cover painted a suitable colour and texture, and disposed so as to eliminate shadows, approaches, spoil, blast-marks and so forth. Because such screens are effective against direct observation and ordinary (panchromatic) photography, by no means does it follow that they will be hidden in the infra-red photograph. Comparison of aerial photographs taken simultaneously on pan-chromatic and infra-red plates will reveal much that before the advent of this new technique would have been adequately camouflaged, and a new difficulty has thus been added to the difficult problem of concealment by deception. The problem is mainly one for the chemist. What we need especially is a green pigment which reflects both green light and infra-red light; and the discovery of a paint with these properties will be of considerable value.

Now, when we return to the problem in its bearing upon animals, it is found that this difficulty is one which can be, and has been solved in nature—as happens, for instance, in the case of the green tree frog *Hyla coerulia*. For here the skin, whose green colour is due to a combination of chemical and structural effects, behaves in the infra-red photograph like the chlorophyll of its surroundings with which it has no chemical or physical relations whatever. Thus the harmony of tone upon which inconspicuousness depends is retained, the frog appearing in waxy-white pallor amidst the snow-white foliage.

3.—Obliterative Shading.

The second optical principle upon which concealing coloration depends is that of countershading. Owing to the effect of unequal illumination falling upon its different surfaces, a solid object of uniform colour presents to the eye the well-known appearance of light and shade, or *relief*, to which is due its appearance of solidity. By this means alone an object can be distinguished as a solid form *—even when it is placed before a background whose colour and texture exactly matches its own.* (See figure 3.)

When an animal or any other solid body is observed out of doors in the open, it will be seen that its upper surface is more brightly illuminated than its under parts, owing to the direction of incident light from the sky. The effect of this top lighting is to lighten the

tone of the upper parts, while the lower surfaces which are in shade appear to be darkened.

By countershading the upper surfaces, and counterlightening those beneath, using properly *graded* tones, it is possible to counteract the effects of light and shade, and thus to render a rounded body *apparently flat*. If properly carried out, this treatment by countershading absolutely obliterates relief, and renders the object completely invisible from a short distance, provided it rests before a suitable background.

It will be noted that such a result is brought about by the use of tones which are *darkest above*, becoming *gradually* lighter on the sides, and *lightest beneath*. The theory of concealment by countershading will always be associated with the name of Abbot H. Thayer, the American artist, who first fully grasped this important optical principle which operates so widely in the cryptic coloration of different animals.

Countershading has been used with remarkable effect for the concealment of many creatures: the brush of Nature has laid down in skin and scale, in fur and feather, darker pigments on the back, grading into paler pigments on the belly, as seen in the coloration of many marine and river fishes such as Tunny and Trout, and of the majority of land animals and birds, and of innumerable insects. (See figures 4, 5 and 6.)

It will be noted that in countershading we have a system of coloration the exact opposite of that upon which an artist depends when painting a picture. The artist, by the skilful use of light and shade, *creates upon a flat surface the illusionary appearance of solidity*: Nature, on the other hand, by the precise use of countershading, *creates upon a rounded surface the illusionary appearance of flatness*. The one makes something unreal recognizable: the other makes something real unrecognizable.

Well, what is the bearing of all this on our present purpose? The conditions of light which affect the appearance of a caterpillar or a snake are the same as those which cause a gun or torpedo tube to stand out conspicuously *even against a background covered with exactly the same paint*. It is important that such round objects be treated with paint properly applied so as to counteract the effects of relief. I stress this point now, because I see failure to appreciate this principle in certain attempts at camouflage at present in use—namely, the use of paint on big coastal defence guns. The point will be made clear by the accompanying diagram. (See fig. 7.) The same remarks apply to uniforms. During the Great War, while attempts were made to camouflage our big guns with obliterative paint, our men were at first sent into action with a cap which seems especially designed by the reversal of this principle, to

8.—*Phalangium opilio*, illustrating the effect of such a pattern in nature; note the juxtaposition of the lightest and darkest tones, whose effect on the eye is to break up the continuity of the animal's surface.

12.—*Megalixalus fornasinii*, an East African tree frog, with a coincident disruptive stripe extending from the back on to the leg when the frog is in its natural attitude of rest.

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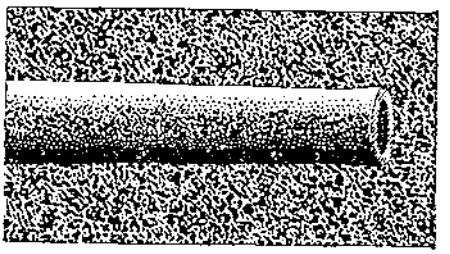
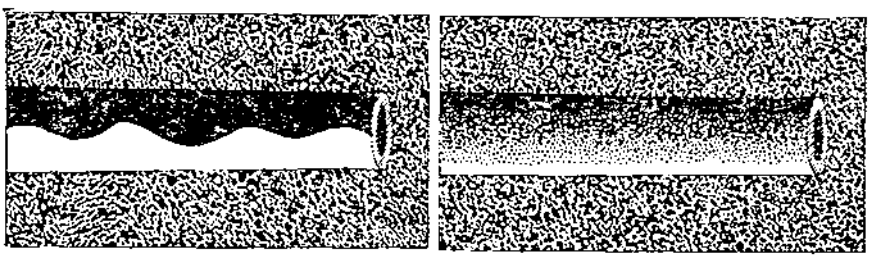
furnish the enemy with a conspicuous target, the sight of which no doubt caused the loss of innumerable lives.

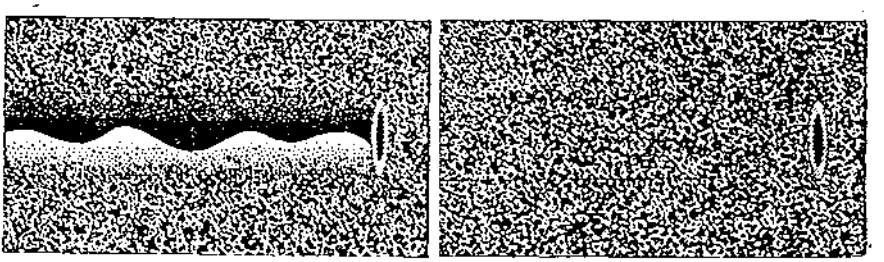


(i) The appearance due to lighting from above.



(ii) (iii)

(ii) and (iii) the appearance due to obliterative paint.



(iv) (v)

(iv) and (v) the appearance due to a combination of top-lighting and obliterative paint.

7.—The principle of countershading as applied to guns.

Note.—(ii) and (iv) show incorrect method of applying paint; (iii) and (v) the correct method.

The case of aeroplanes is in some respects analogous to that of surface-swimming fishes such as the tunny. These creatures, being coloured dark above, and silvery-white beneath, are relatively difficult to detect whether viewed against a background of water from above, or of sky from beneath. Day-flying aircraft should be similarly coloured, *i.e.*, the most brilliant white underneath—the

colour which most nearly approaches the bright background of sky; and some darker tone above, calculated to harmonize with the ground when viewed from overhead. For special duty at night, aeroplanes should be painted as suggested by Professor Graham Kerr during the war, with an absolutely matt black pigment, or with one providing the nearest possible approach to absolute blackness. On a clear night a machine so painted would be absolutely invisible from the ground. The purer the black used, the less chance there will be of any rays of the searchlight being deflected downwards.

4.—DISRUPTIVE COLORATION.

We now come to what is perhaps the most interesting, and certainly the most important set of principles relating to concealment —namely, the type of camouflage familiar from its wartime uses under the somewhat inappropriate term "dazzle," properly known as Disruptive Coloration.

It will be clear from what has already been said that under ideal conditions, obliteration of differences in colour and brightness, and in light and shade, between an object and its background, is sufficient to render the object quite unrecognizable, even from a short distance. But in nature, as in war, conditions never remain ideal—for they change. Most animals are active, and their movements bring them before a constantly varying background, which is itself rarely uniform in colour and texture. Moreover, the light which falls upon them itself varies widely in quality, intensity and incidence.

Even allowing, therefore, for the most efficient colour harmony and countershading, we still have to reckon with the fact that a uniformly coloured animal presents to the eye a continuous patch or area in the visual field, standing out more or less conspicuously against lighter, or darker, or differently coloured surrounding objects —and recognizable as an animal by its characteristic shape. It is this *continuity of surface, bounded by a specific contour*, which chiefly enables us to recognize any object with whose shape we are familiar. Thus, for effective concealment, *it is essential that the tell-tale appearance of form should be destroyed.*

The difficulty of doing this is met, often with extraordinary success, by the application of optical principles involving the use of patterns. When a pickpocket intends to rob you of your watch or wallet, he, or his confederate, takes care to distract your attention from what he intends to do by creating a diversion. He draws your eyes from what is really happening to what seems to be happening. Now the patterns worn by many animals, such as boa-constrictors, bitterns, pipits, plovers, and various grass frogs and grasshoppers, moths and mantids, operate in a somewhat analogous way. Distributed over

the body are irregular patches of contrasted colours and tones. *These patches tend to catch the eye of the observer and to draw his attention away from the underlying form of the animal which exhibits them.* The patterns themselves may be conspicuous enough, but since they contradict the form of the animal on which they are superimposed, they pass for part of the background, in the same way that the pickpocket's tactics of bluff pass for a commonplace incident. (See fig. 8, frontispiece.)

5.—Differential Blending.

The function of a disruptive pattern is to prevent, or to delay as long as possible, the first recognition of an object by sight. Its success in the field depends upon a number of optical principles which we must now examine more closely. Provided an animal is seen against a broken background, it is probably true to say that any pattern of darker or lighter colours and tones will tend to hinder recognition by destroying to a greater or less degree its apparent surface configuration and contour. But in order to achieve effective results, the colours, tonal contrasts, and patterns used must conform to definite optical principles; and it is a fact of the greatest interest and significance that the particular devices which on theoretical grounds appear best for this purpose, are those which occur on the bodies of innumerable animals, which rely for safety, or for hunting, upon remaining incognito.

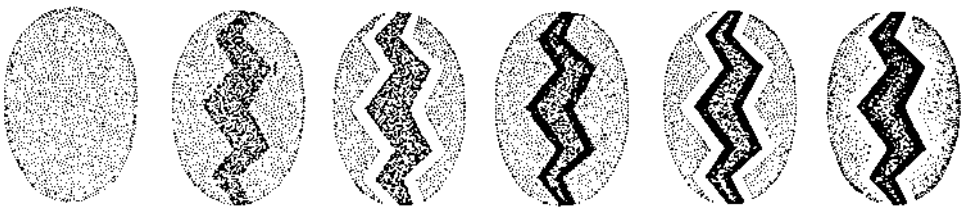
In the first place, the effect of a disruptive pattern is greatly strengthened when some of its components closely match the background, while others strongly differ from it. Under these conditions, *by the contrast of some tones and the blending of others, some portions of the object fade out completely while others stand out emphatically.* And it is to be noted that the shape of the latter—which alone can be distinguished—is such that their real identity can only with difficulty be determined.

The principle is illustrated by the simple diagrams in figure 9, where a series of forms—a fish, an egg, and a moth—are represented against different backgrounds. Seen as self-coloured objects without any pattern, as in the left-hand figure of each series, these forms are easily recognizable. If dressed in a disruptive pattern they become less distinguishable, even when seen, as in the second figure of each series, upon a background against which they stand out clearly. But when, as in the third and fourth, the background matches and absorbs one element of the colour scheme, the difficulty is much increased, and the effect on the eye of an observer is such as greatly to delay, or even altogether to prevent, recognition.

excessive brightness in contrast to the relatively dark room-interior prevents him from noticing what lies beyond it.

That the curtain acts in this way—merely dazzling or distracting the eye, and not, like an opaque screen, by actually intercepting vision—can easily be proved by dyeing the curtain black, when it at once becomes almost useless as an optical barrier against an observer outside. Inspection of diagrams such as those exhibited prove better than any verbal description the concealing value of such strongly contrasted markings when applied to the bodies of animals.

The principle of disguise by patterns is further intensified when the *tones of greatest contrast*—that is to say, those representing the highest lights and the deepest shades—*occur adjacent to one another;* when, in other words, the transition from one to the other is abrupt, *without*



10.—Stages in the construction of a contrasted pattern.

intermediate gradations or half-tones which would tend to detract from the illusionary discontinuity of surface. Stages in the building up of such a configuration are illustrated in figure 10. In Nature this arrangement of the elements in a pattern is applied with remarkable effect in the coloration of many snakes, such as the Puff Adder and Gaboon Viper, of birds, such as the young of Ringed Plover (see figure 14), of many reef-dwelling fishes, and of insects and other animals. A beautiful example of this optical device is seen in the case of the phalangid *Phalangium opilio*—of which an illustration is reproduced (see figure 11, facing p. 507).

The principles I have put before you, gentlemen, have a special application in any attempt to reduce the visibility of large objects of all kinds, such as ships, tanks, buildings, and aerodromes. In reference to the former, Professor Graham Kerr originally suggested this method of diminishing visibility in a letter sent to the Admiralty in September, 1914, which was subsequently communicated in a General Order to the Fleet. It was, however, not until 1917 that the method came into general use, under the direction of Mr. Norman Wilkinson.

The essential function of dazzle painting is to break up the continuity of surface by violently contrasting tones of colour, applied under the direction of someone with a real grasp of the optical principles involved. The work must be done with courage and

confidence, for at close range objects so coloured will appear glaringly conspicuous. But they are not painted for deception at close range, but at ranges at which big gun actions, and bombing raids are likely to be attempted. At such distances actual tint becomes less important than depth of tone, and to produce effective results *great contrasts of tone are essential*—a point which seems scarcely to have been realized by those directing the paint and pattern applied at present to such instruments as tanks and armoured cars.

7.—Coincident Disruptive Patterns.

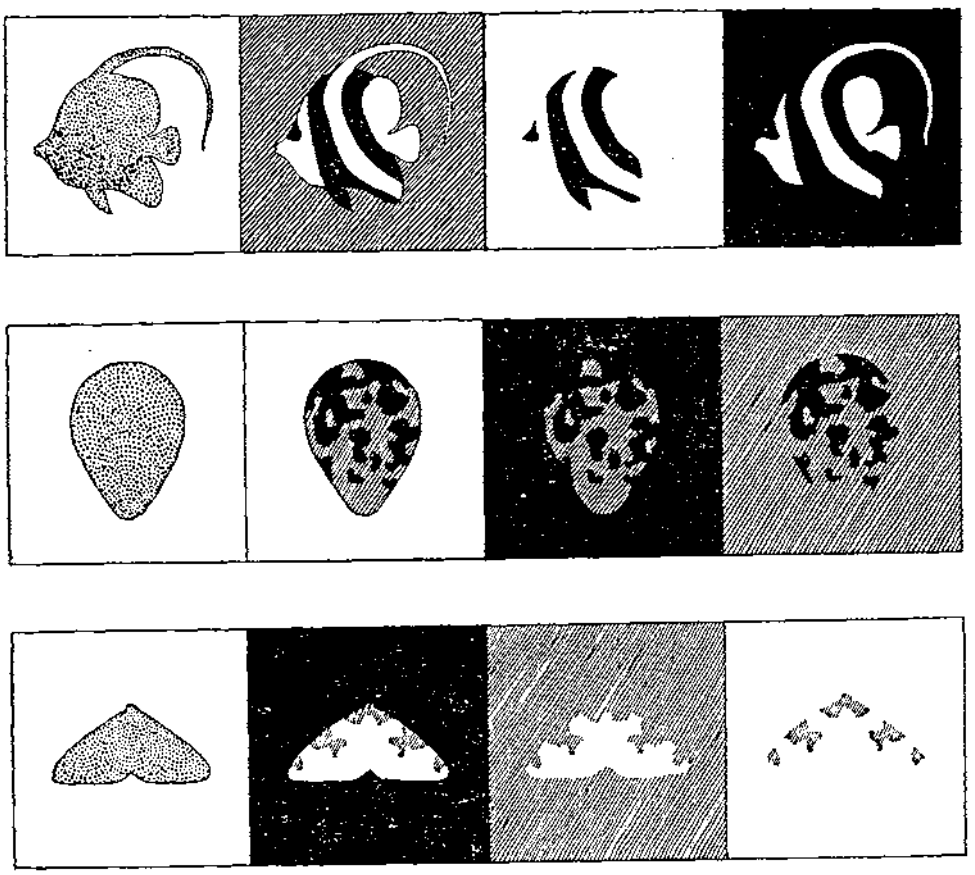
We have now to examine a further expression of the disruptive principle which is of the greatest interest. Such patterns as we have so far considered are successful because they appear *to break up the continuous surface of the body*. Now this optical principle is carried even further in the case of many animals where the pattern appears *to join together separate parts of the body*. If this can be done—and as we shall see, it has been accomplished in a wide range of totally unrelated animals—the chances of recognition must obviously be further reduced.

One of the main factors leading to recognition, by the eye, of a particular object, such as an animal in nature, is the familiar appearance of structural features—for instance, legs, fins, eyes and so on. Such organs, if caught sight of, will tend to spoil and betray the whole colour scheme. If, however, *the parts of the pattern interfere optically with the parts of the body*, the latter are less likely to be noticed.

This principle is well illustrated in the colour scheme of a small East African tree frog *Megalixalus fornasinii*. This animal bears on its back a pair of broad, conspicuous, silvery-white stripes. Similar stripes occur on the hind limbs. Now these markings are disposed in such a way that in the normal resting attitude—when the limbs are closely applied to the sides of the body—the stripes on the back exactly coincide with, and become a continuation of, those on the legs. (See figure 12.)

This attitude and very striking colour scheme thus combine to produce an extraordinary effect, whose deceptive appearance depends upon the breaking up of the entire form into two strongly-contrasted areas of brown and white. Considered separately, neither part resembles part of a frog. Together, in nature, the white configuration alone is conspicuous. This stands out and distracts the observer's attention from the true form of the body and appendages upon which it is superimposed, and, like a veil obliterating the features of its wearer, tends to mask its identity.

Similar patterns occur widely in nature, and are used to span the spaces between the folded segments of the leg in many frogs ; between



9.

6.—MAXIMUM DISRUPTIVE CONTRAST.

The second of these principles has to do with the degree of tonal contrast between adjacent elements in the pattern. We have seen that the effect of a disruptive pattern is to break up what is really a continuous surface into what appears to be a number of discontinuous surfaces. These tend to be interpreted by the eye as separate objects —none of which suggests, but all of which contradict, the shape of the body on which they are superimposed.

Now this illusionary appearance—this contradiction of the true form—is greatly intensified by the use of *strongly contrasted tones.* In general, very light markings on a dark object, and very dark markings on a light object, will be most effective. The principle is similar to that which makes an open network curtain effective as a screen in preventing a casual passer-by from seeing into the interior of a room. His gaze falls upon, and is arrested by, the curtain, whose

14.—Young Ringed Plover. The coloration beautifully illustrates the value of a disruptive pattern when combined with countershading and in agreement with the configuration of the environment.

15.—A Malayan tree gecko (*Coelopleurus fasciatus*) showing the close adpression of the body to the bark, and the lateral flap-like expansions of the tail, which serve to reduce visibility due to shadows cast by the animal upon its surroundings.

Camouflage in nature and war 14 & 15

the wings and body in grasshoppers; or between the upper and lower jaws in lizards and snakes. In all such cases, the pattern cuts right across existing structures and thus creates an *illusion of continuity* where, in fact, none exists. In this sense, the principles of disruptive and of coincident disruptive coloration are quite opposed *—the first working by optical destruction of what is present; the second by optical construction of what is not present. For while disruptive patterns appear to break up what is really a continuous surface, coincident patterns seem to unite what are actually discontinuous surfaces.*

A special application of this principle is seen in the camouflage of the eye itself. Few natural objects possess greater inherent conspicuousness than the vertebrate eye. This characteristic is mainly due to the round pupil—strongly defined, densely black, and staringly conspicuous—which stands out like a target in the head. Here the method, employed by many fishes, frogs, snakes, birds and other animals, is to include the black pupil in a stripe, or band, or irregularly-shaped patch of black pigment, which serves to mask its shape by absorbing it within a differently-shaped element in the general colour scheme. Many applications of the same principle will occur to those interested in the camouflage of stationary objects seen against a constant background.

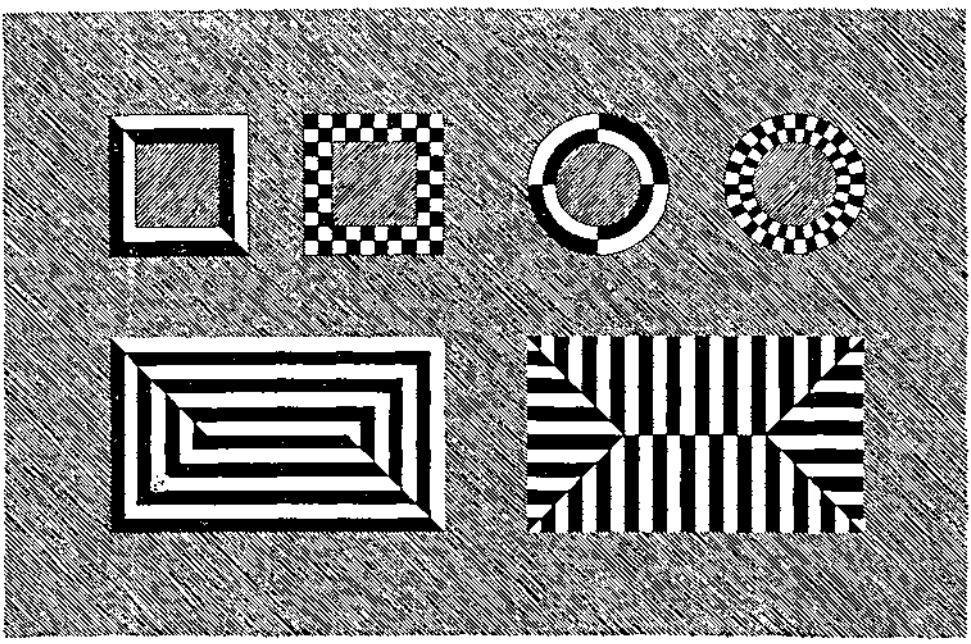
In reducing the visibility of parts of large objects such as ships, the essential point here is that elements in the pattern must be carried without interruption across adjacent surfaces, such as the hull and upper works, or in the case of buildings, from the roof to the ground topography. A good deal of what I have said has a very special bearing upon the concealment, from relatively great altitudes, of landing-grounds and aeroplane hangars. I have not the slightest doubt that if the work were put in the hands of an expert with the necessary scientific and artistic training, and with that keen interest in the subject which is essential to success, the concealment of our aerodromes from an observer at, say, 10,000 feet, could be made a practicable proposition. But there is a danger in relying upon rule-of-thumb methods. In order to obtain full advantage of the principles of concealment it is essential that every landing-ground should be considered as having an individuality of its own. Such work can only be done under the direction of someone with a clear grasp of the scientific principles involved.

8.—Contour Obliteration.

Disruptive patterns may be applied to the surfaces of solid bodies for two fundamental purposes—namely, for the *disguise of surface;* and for the *obliteration of contour.* Hitherto we have dealt with the first of these functions. We have now to consider the problem

presented by the contour, which is one of some importance, since a familiar contour is one of the main factors upon which recognition depends.

Outline obliteration is induced when contrasted elements in the pattern are interrupted at, or near, the margin. Conversely, the contour is accentuated when the pattern conforms to its border. The essential point is that for purposes of concealment the pattern must *cut across*, rather than *run along*, the contour. The principle



13.

involved can at once be appreciated by comparing similar bodies bearing the two types of pattern. (See figure 13.)

When such bodies are examined from successively increasing distances, it will be found that the point where the contour blends into the background is further away for those in which the lines of the pattern conform to the margin: and nearer for those in which the pattern runs across, and is interrupted at, the margin.

In nature, interrupted patterns of the kind occur in many classes of animals, such as the zebra and giraffe, and many fishes, butterflies and moths, and play an important part in the problem of concealment. The same principle has, of course, a wide wartime application in the disruptive painting of ships, tanks, factory buildings, hangars, and other objectives.

I now come to a second method of disguising the contour. There

are certain inherent characteristics of the outline of animals which greatly facilitate recognition by sight—namely, *regularity of form*, *repetition of detail*, and *symmetry*. It follows that any device which destroys or subdues these qualities will increase the difficulty of detection. This problem may be met by the modification of the contour itself—a method actually seen in many of the most perfectly camouflaged animals. In the cases dealt with hitherto, the outline is obscured by an *interrupted marginal pattern*; in those under consideration, it is effaced by an *irregular marginal form*. The first method depends mainly upon *optical illusion*; the second upon *structural modification*.

The device is beautifully illustrated by the Comma butterfly, whose outer wing-margins are highly irregular in form, and give the insect a very cryptic appearance in nature. Similarly, various fishes and tree geckos have the outline wonderfully disguised by weedlike or barklike outgrowths from the sides of the body.

9.—Background Picturing.

We now come to another aspect of disruptive coloration particularly applicable to animals which habitually rest upon fairly constant surroundings. Patterns hitherto considered break up an animal's form into a number of more or less contrasted patches of colour, whose shapes are arbitrary. While they fail to suggest the form of the body displaying them, they do not necessarily suggest anything else in particular. A further step towards invisibility is taken when the disruptive design more or less closely resembles the background against which it is seen—as happens, for instance, in the case of many cryptic moths, birds and fishes. Such animals reproduce on their bodies detailed picturing of their normal habitat—of bark or lichen, of grass or heather, of coral or seaweed—and thus, when motionless, become extremely difficult to detect.

In camouflage painting, such methods are especially applicable to fixed objects, or to those likely to be seen against a typical background, such as observation posts. Such colour schemes differ from the disruptive type in being *realistic*, or scenic, rather than *abstract*, or arbitrary. By their use it is possible, not merely to disguise an object's form, but *to obliterate the break which it causes in its background*, and so to render it invisible.

10.—Shadow Elimination.

In the patchwork configuration which the eye sees in nature, shadows take a prominent place. Under conditions of intense illumination, the shadows cast by different objects may be both conspicuous in tone and characteristic in form. Indeed, in the case

of cryptic animals, the shadow will in general be more conspicuous than the animal which casts it. In the interpretation of aerial photographs, shadow forms play a vital part.

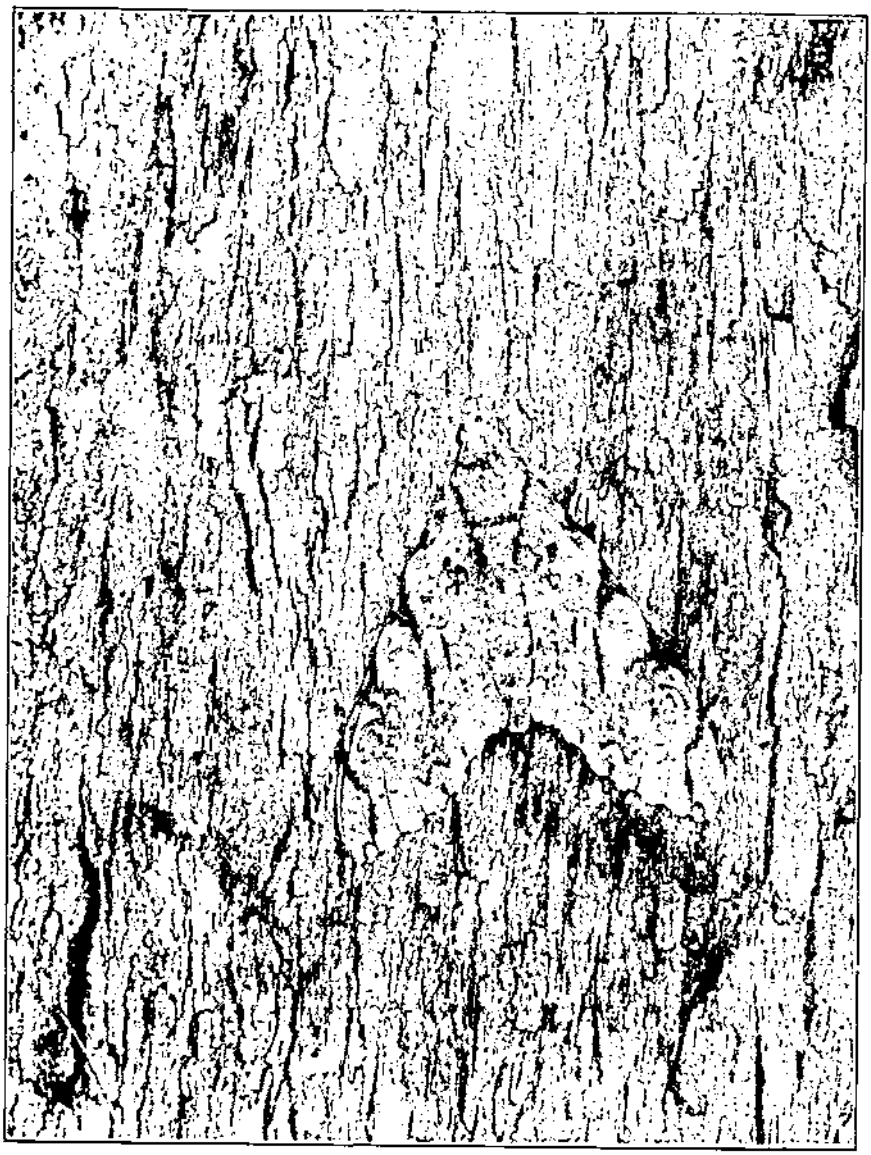
Many butterflies which habitually rest on the ground, with the wings closed over the back, orientate the body in relation to the sun on alighting, so that the shadow cast by the wings is reduced to a mere inconspicuous line. In this position the insects are extremely difficult to detect, for the exposed surfaces of the wings bear a disruptive design which harmonizes closely with the surroundings.

As a further adaptation tending to conceal the shadow, when seen from above, certain butterflies such as *Satyrus semele* and *Thecla rubi* exhibit the remarkable instinct of tilting the wings over to one side in a pronounced list. The effect of this habit is for the wings to cover and screen the shadow which they cast.

Various other animals meet the problem of shadow obliteration by crouching flat, with the body or wings closely applied to the surface on which they are resting. This arrangement is beautifully illustrated by different bark-dwelling moths such as the East African hawk moth, *Xanthopan morgani*, whose attitude is such that the shadow is entirely screened beneath the outspread wings, which themselves closely simulate, in colour, pattern and alignment, the surrounding bark. (See figure 16.)

A further development of the same principle is seen in certain tropical tree geckos, where the squatting habit is greatly enhanced by flap-like outgrowths which, extending from the sides of the body and tail, serve both to screen the shadow and to join the body to the bark, which it closely resembles, so that the animal appears to form part of the tree-trunk which is its normal resting-place. (See figure 15.) It is instructive to observe that this device is precisely that which was adopted in the Great War when the shadows cast by camouflaged buildings, or by overhead covering-camouflage on which were painted dummy roads, etc., were eliminated by the use of side screens sloping at a flat angle down to the ground, and themselves painted to simulate adjacent local details such as trees, hedges and fields.

Many years ago, Sir Edward Poulton pointed out that certain twig-like caterpillars, such as those of the Early Thorn Moth (*Selenia illunaria*) and Brimstone Moth (*Rumia cratægata*), appear to grow out of the twig in a natural manner. This effect depends upon the obliteration of the shadow between the insect and plant, and is due to a number of fleshy tubercles which, being light in colour, neutralize the shaded furrow which might otherwise betray the junction. Here again we may note an application of the principle—these screens having an analogous wartime use in the projecting overhead screens, *suitably thinned out towards their edges*, and painted so as to neutralize shadows cast by the camouflaged roofing or superstructure.



16.—An East African Hawk Moth (*Xanthopan morgani*) seen in its natural attitude of rest. This moth attains a wonderful degree of concealment through the pattern on its wings, which closely reproduces that of the tree on which it rests. It will be seen that the dark markings are correlated with the carriage of the wings, so that in the natural resting posture they form an approximately parallel series; that the moth instinctively alights with its body parallel to the tree trunk, so that the wing-pattern lies parallel to that of the bank which it simulates; and that the insect applies itself flat against the surface, thus eliminating tell-tale shadows.

II.—Special Deceptive Resemblances.

A number of inconspicuous animals carry on their bodies conspicuous patches of local colour, whose function is to deflect the attack of enemies from the more vital to the less vital parts. Frequently such markings take the form of dummy eyes, placed near the hind margins of the wings in butterflies, or of the bodies of fishes, the real eyes of such species being either hidden or camouflaged by disruptive patterns. In such cases, experimental and observational evidence tends to show that the fake eye-spots mislead enemies, and misdirect attack towards non-vital parts of the body, thus increasing the chances of escape by flight. The device has its parallel in the employment of dummy positions, made sufficiently conspicuous to deceive the enemy, and to draw his fire off the real positions which have been rendered unrecognizable by camouflage.

A further deceptive principle—with many obvious wartime applications—as, for instance, in the construction of observation posts—is based less upon concealment than upon disguise. Many insects and other animals are so profoundly modified in colour, structure and instincts, as to resemble some definite object in the environment—such as a twig, a leaf, a flower, or the dropping of a bird, and thus escape detection by their enemies, or their prey.

Observations on the habits of some of these creatures read almost like fairy tales—such, for instance, as the angler fish, *Lophius piscatorius*, with his line and lure; or the flowerlike mantis *Idolum diabolicum*, which allures to itself the insects on which it preys; or the American nightjar, *Nyctibius griseus*, which in an upright attitude incubates its single egg on top of the upright tree stump, of which its body forms an apparent continuation; or the masking crab, *Stenorhynchus*, which drapes its body with pieces of weed and other material torn from its surroundings.

Fantastic as they seem, such elaborate and perfect disguises, due to a combination of special structures, colours, attitudes and instincts, reflect the vital significance of concealment and deception, in nature, as an aid to the securing of food or of safety. And they read a lesson which may be widely applied in many different spheres of war—from the design of Q-ships to the construction of sniping suits—where surprise forms an essential factor in the discomfiture and defeat of the enemy.

In conclusion, gentlemen, I need not stress the importance of this whole question of concealment. If two powers are at war, and if one tackles this problem in a serious and scientific manner, while the other neglects to do so, she is bound to gain an enormous advantage—an advantage which under conditions of modern warfare may well make all the difference between disaster and victory.

THE MILITARY ENGINEER IN MODERN WARFARE.

A lecture delivered at the Royal United Service Institution on March 9th, 1938.

By MAJOR-GENERAL L. V. BOND, C.B.

LIEUTENANT-GENERAL SIR J. R. E. CHARLES, K.C.B., C.M.G., D.S.O., *in the chair.*

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MY excuse for taking up your time with what may seem a technical or a specialist subject, is that developments in the organization of armies and in methods of warfare since 1918 have, it seems to me, very materially affected the place of the military engineer in modern armies. I doubt whether the effect of, for example, the mechanization of armies on the strategical and tactical value of the engineer arm is being fully realized, even in my own Corps. I propose, therefore, to examine these developments and to consider the calls which should be made on us and the extent to which improvements in equipment and methods have allowed us to keep pace with these calls. I shall, of course, speak from the point of view of the British Army and of British problems. And I hope that I shall not be accused of speaking too much from the point of view of the Royal Engineers, or of overrating the importance of my own Corps.

In order not to make too large a call on your patience, I shall have to confine my remarks to mobile warfare and mainly to the role of Divisional, Corps and Army Engineers—that is to say, to engineer units particularly affected by the problems of mobile warfare.

As we are taking 1918 as our starting-point, I should like to begin by a reference to what I believe to be a misconception regarding the engineer establishments at the close of the war. You will remember that we had, not only in France, but on all fronts, an establishment in the division of three field companies R.E. and a pioneer battalion. In addition, under corps and army control, there was a large variety of engineer and labour units—Army Troops Companies, Tunnelling Companies, Road Construction Units, and so on. It is generally thought that these establishments, being the result of static warfare, were excessive for the requirements of mobile warfare. That view is comforting to the economist, but I believe it to be totally untrue. In Mesopotamia, as C.R.E. of a division during the final operations, I should have been glad of double these establishments. They were not found too great, I feel sure, in Palestine and Salonica. In

France, during the period of mobile warfare before the Armistice, the whole of the engineer resources were hardly sufficient to keep the army in motion.

As an example : in one Corps on a two-divisional front none of the twelve field companies and four pioneer battalions of the Corps, together with army troops and tunnelling companies, had a day's rest : while working parties of a brigade of infantry were required on a single road. In another division, advancing slowly on a single brigade frontage, the three field companies and one pioneer battalion and a most efficient Australian heavy battery were fully employed. Had speed been necessary, the C.R.E. tells me that double these numbers would have been required. On this divisional line of advance every bridge and culvert was systematically destroyed, and in ten days fifty to sixty had to be repaired.

As a further example of the difficulties of moving as opposed to static warfare, I may mention that during this period of moving warfare in October and November, 1918, over 300 heavy bridges were erected on the front of the B.E.F. in France, including as many stock spans as were erected during the whole four years up to August, 1918, and this in addition to the pontoon and other temporary bridges required for the initial crossings of the comparatively minor obstacles on our line of advance. On November 11th the Army was indeed about to be brought to a standstill by the delay in the repair of roads and railways. The experience of 1918 showed, in fact, that it is mobile warfare and not static warfare which imposes the maximum strain on the engineers of forward formations : that, contrary to the usual belief, establishments sufficient for static warfare will normally prove insufficient for mobile warfare.

You may object that these conclusions are based on a period of the war in France where our opponent had time to prepare demolitions on an extensive scale, and that, although continuously battered, he was not hustled. What I shall try to show is that recent developments in equipment and technique have made it possible to create similar obstacles at very short notice, and in consequence to impose similar delays.

Reduction of Manpower.

I would first ask you to note that although our own engineer establishments have, since 1918, by reason of mechanization and improved equipment considerably increased their efficiency in certain directions, our present establishments are in actual manpower considerably less than at the period of 1918 to which my examples refer. The working manpower of divisions as a whole has also been considerably reduced, while the number of vehicles in formations and their average weight tend vastly to increase. The general effect of these changes, as we shall see, is greatly to increase the efficiency of

our engineers in destruction without a corresponding increase in their powers of reconstruction.

On the other hand, engineer establishments in foreign armies are, in general, considerably greater than our own. In those armies which we have mainly to consider, divisional, corps and army engineers, like our own, are or will shortly be fully mechanized with personnel carried in lorries. Their equipment is in no way inferior to ours, and their opportunities of training are generally much superior to those which we in this country enjoy. We must not flatter ourselves, therefore, that the technique of our opponents will not be up to the highest modern standards. We know, in fact, that it is so, for in such armies the art of the field engineer is being intensively studied and widely applied.

In all armies the rapid execution of demolition schemes is receiving particular attention. As two examples of improvements in demolition technique, I may mention that a road crater which in 1918 might have taken 12 to 24 men 48 hours to prepare, could probably now be executed in one to two hours by six men. Again, with the pneumatic tools included in the equipment of all field units, more effective demolitions of bridge abutments and piers can be executed with far greater speed than by the old hand methods.*

Apart from these alterations in engineer organization and technique which, as I have said, favour the destructive engineer, rather than the constructive engineer, what general changes in organization and methods of fighting have taken place since 1918, and what is their effect ?

MECHANIZATION.

The first factor to be considered is *mechanization :* first, in the sense of the substitution of mechanical for horse transport and of the provision of troop-carrying vehicles ; second, in the sense of the increase in the employment of a mobile and armoured forces ; and third, in that of the lorry carriage of the engineer personnel of divisional, corps and army engineers. The effect of the partial mechanization of the infantry is to increase to some extent the general

* It may be objected that the widespread use of reinforced concrete for bridges may reduce the efficiency of the demolition technique of the military engineer. There are two answers to this objection, viz. :—

(*a*) The majority of reinforced concrete bridges on the Continent appear to be fitted with demolition chambers or boxes ; and it may reasonably be assumed that these are so located (in accordance with the disposition of the steel reinforcement) as to ensure demolition.

(*b*) The new equipment of field units very much increases our efficiency in the destruction of such bridges.

The difficulty in the destruction of reinforced concrete usually arises from the necessity of carrying out the demolition by successive stages, cutting separately the concrete casing and the steel reinforcement. Such bridges are therefore unsuitable for " final," *i.e.*, last-minute demolition, and where they occur on essential last-minute routes it may prove necessary to build a temporary bridge to take the traffic while the permanent bridge is destroyed.

mobility of the army and to allow of great mobility for small mixed detachments of all arms. The increase in the mobile and armoured forces in the hands of the enemy results in a constant menace of surprise attack against the front or flanks of troops in motion.

The complete mechanization of the engineers not only saves them from fatigue and makes them therefore more efficient for work, but it allows the engineers to waste no time in movement and permits them to undertake tasks at distant points and on very wide fronts which before would have been impossible.

Engineers in the Withdrawal.

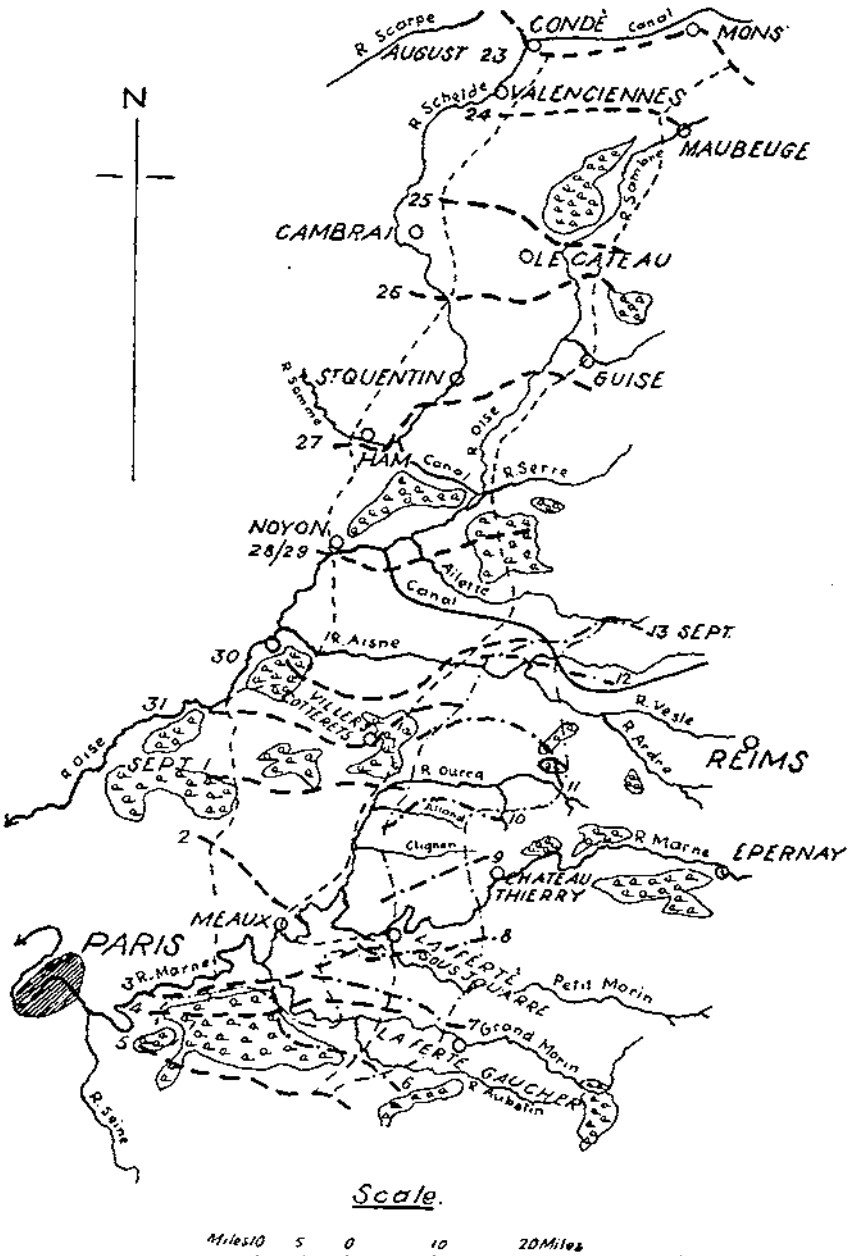
I think that I can best illustrate the effect of these developments by looking back to the open warfare period of 1914, which is so familiar to all of us. I do not pretend to be a strategist, and the picture which I shall suggest is, as I hope you will realize, only for the sake of illustration. During the retreat from Mons we suffered from a continual fear of the envelopment of our flanks, especially of our left flank. How much greater would our fears have been had the enemy possessed and vigorously employed considerable mobile and armoured forces. At any moment we might find him breaking through our marching rearguards, or cutting in on the flanks of our columns. Our first instinct would, I feel sure, be to put a physical obstacle between ourselves and the enemy mobile forces.

What lines of obstacles offer themselves as we look at the map? The Mons-Condé Canal with the ground on both sides presents (to judge from the map) an area almost impassable to tank forces except by the roads. I suggest that we might have been tempted to hang on here for a longer period with rearguards, consisting of mechanized M.G. battalions, lorry-carried infantry, and mechanized engineers, while the main bodies made their first long bound to the rear.

Blocking forces from the cavalry—or, as we should now say, the mobile—division with engineers would cover the flanks of the rearguards by destroying and then watching all passages over the Schelde (Escaut) on the left and over the small streams running north from Maubeuge towards Mons on the right. The main bodies, passing west of the Foret de Mormal, would, I think, endeavour to keep within the corridor formed by the Sambre and Oise on the east and the Schelde and St. Quentin Canal on the west; blocking these water lines on their flanks by mobile detachments formed mainly from M.G. battalions and engineers and supported by tank units for counter-attack. Such "blocking" is a new employment for the engineers and one which their new mobility alone allows them to carry out. It requires dispersion in small parties and calls for a very high degree of training among the junior N.C.O's.

No obstacles of any value for covering the rear of the army run

MONS TO THE AISNE
1914.



east and west between these two flanking obstacles, and we should have endeavoured as soon as possible to get behind the line of the Somme–Crozat Canal and later behind the major obstacles of the Oise and Aisne.

We have here two characteristics of modern warfare: the use of physical obstacles and of "blocking" detachments to cover open flanks to considerable depths, and a progression by bounds from physical obstacle to physical obstacle to which one side or the other will look for protection. To make good these river lines we should have sent back, in one bound, from the Mons–Le Cateau area, corps and army engineer units to prepare and execute extensive demolition belts based on these water lines, leaving only a minimum of passages for last-minute (or "final") demolitions.

These engineer units would be completely mobile, since there is to-day no essential difference between the functions of the corps or army engineers and those of the divisional engineer units. Their organization and equipment will be identical, and to secure the full effect of their mobility their allotment must be completely fluid. Such units could have reached the river lines which I have mentioned, and successive river lines in further retirement, one, two or even three days ahead of the army. Meanwhile the divisions in their retirement would also have sent a portion of their fully-mechanized divisional engineers back by shorter bounds to prepare such tactical demolitions as the ground permits; the cratering of roads in defiles, the destruction of railways, the laying of delay-action mines, the preparation of extensive tree blocks where the roads pass through forests.

When we remember that in 1914 a pause of twenty-four hours allowed our "foot-slogging" engineers with their primitive equipment to destroy the whole of the bridges over the Marne from Meaux inclusive to La Ferté, we may imagine the extent of the obstacle belts which the modern engineer with his mobility and specialized equipment ought to be able to create. We could seldom undertake such tasks in 1914, because our engineers not only marched at the same pace as the army, and at the same pace as the enemy, but also because they were equally exhausted by this marching. Moreover, we had no corps or army engineer units to undertake work well to the rear of forward formations. We certainly succeeded in demolishing a number of bridges, but, if we ever thought of cratering, the thought was dismissed because a crater involved a forty-eight hours' job of mining. The military engineer is now in fact capable, if properly used, of very rapidly creating over wide fronts in a very short time the conditions which the whole of our engineer resources in France in the autumn of 1918 could only painfully and slowly overcome.

But the engineers will only be able to do this subject to four conditions :—

(*a*) That the command appreciates the value of such obstacles and takes definite decisions in good time.
(*b*) That the staff understand the technical requirements of the engineers.
(*c*) That information has been accumulated in peace or that reconnaissances have been initiated in good time.
(*d*) That the engineers are sufficient in numbers and in mobility.

In 1914 none of these conditions obtained on either side. I might add a fifth condition :—

(*e*) That the divisional, corps and army engineers down to the lance-corporal, are fully trained and practised in peace : a condition which requires peace establishments adequate both for peace training and to meet mobilization requirements and peace strengths adequate to fill peace establishments.

ENGINEERS IN THE ADVANCE.

We have considered the British Army in retreat. Let us reverse the picture, as on September 5th, 1914, remembering that it is now the enemy whose engineers are endowed with modern mobility and demolition equipment. You will remember that the B.E.F., with little in front of it, pushed forward over the Morin and Marne and almost without interruption up to, and over, the Aisne. Armies imbued with the offensive spirit are peculiarly apt to ignore the value of demolitions, and the German cavalry divisions in 1914 were almost incredibly feeble in this respect. With the exception of the completion of our own partial demolition of the eastern bridge at La Ferté, no bridges over the Marne were destroyed on the front of the B.E.F. Kluck's First Army tried, you will remember, to repair this failure by sending down Kraewal's detachment but forgot to issue the orders to the engineers which were to form part of it. It is impossible to imagine such failure to-day. All first-class armies recognize fully the importance of water lines, and they all are studying and practising intensively the thorough and rapid execution of belts of demolitions and blocks. None will make the mistake of leaving bridges undestroyed in the hope of a subsequent advance. Nor will anyone risk failure of essential demolitions for fear of cutting off a few stragglers. In the case which we are considering, a prudent commander of the German First Army, or a foreseeing Chief Engineer, would have collected information about all bridges in the army area and would have taken preliminary steps to prepare the bridges over the Marne for demolition.

Let us visualize the British advance in these circumstances. On September 6th, the B.E.F., anxious to use its new mobility, tries to push forward rapidly. It finds the bridges over the Grand Morin and Petit Morin destroyed, and their approach roads cratered. The divisional engineers will repair these passages with portable girders and trestle bridges—all for heavy loads—with wire track approaches. But these are mobile equipment bridges and must be replaced at once by heavy girders and other semi-permanent types in order that they may be available for the further advance. The approaches on essential routes, too, must be reconstructed to first-class standard. This is the duty of the corps and army engineers. We reach the Marne, a very serious obstacle 80 to 100 yards wide, held by strong mechanized rearguards and requiring a co-ordinated attack with a large programme of ferries, of light and heavy pontoon bridge construction and of bridge approaches. An operation requiring on the average certainly not less than five field companies on each divisional front of attack. Beyond the Marne again cratered roads and broken bridges. The marshy valleys of the Clignon, Alland and upper Ourcq, become serious tank-proof obstacles. The Vesle has to be bridged. The Aisne with its lateral canal becomes a serious engineer problem, while the heavily-cratered roads running down the steep slopes to that river have to be rebuilt before the crossing of the river can be undertaken. These problems require large engineer concentrations at a time when corps and army engineer units are busy on repairing the rearward communications, replacing the temporary bridges and putting through roads fit for fast and heavy traffic.

What I am endeavouring to show is that where a country presents water obstacles, or even where the movement of lorries is mainly restricted to the roads, the engineer alone can keep the army in movement; and that the task of the engineer has immensely increased owing to the equipment and mechanization of the enemy. You may say that his resources have also increased, he also is mechanized and has new patterns of equipment. It is true, of course, that the mechanized engineer loses little time and energy in movement from job to job. But a crater requires in 1938 as many man-hours and as much material for its repair as in 1918, and craters are likely to be far more numerous. They present, in fact, a far more serious obstacle than is generally realized or allowed on manœuvres.* Then again a pontoon bridge to take divisional loads, which in 1914, or even in 1918, could have been built in 2½ hours by 42 Sappers, would require to-day 7 hours and 90 Sappers, that is to say, six times

* As an illustration of this, an average crater, 30 feet in diameter and 7 feet deep, requires (failing the use of bridging equipment) some 20 to 30 tons of material and 200 man-hours' work at the site to open up a rough two-way route for normal traffic. In fact the engineer is here at least 20 times more efficient in destruction than in construction.

the man-hours. No mechanization can replace actual men on such tasks. On the other hand, the time required to replace temporary by semi-permanent bridges has undoubtedly been reduced by the introduction of improved standard types, the use of mobile derricks, internal combustion pile-drivers, and oxy-acetylene apparatus, and by the employment of pneumatic boring and cutting tools. These improvements should go some way to balance the increased demand for such replacements.

Now let us imagine that the front has to be stabilized as a defensive front where no natural anti-tank obstacle exists. The primary need to-day is then to create, if not a continuous artificial obstacle, at least tank-proof areas. The first item in the order of priority will be a comprehensive anti-tank reconnaissance of the defensive front followed by the improvement of natural banks and ditches, the blocking of defiles, the establishment of anti-tank minefields and even the making of lengths of anti-tank trenches and anti-tank barricades. These are tasks which will involve the engineers. They are new commitments since 1918—commitments which cannot, as yet, be met by mechanical appliances. And—as I mentioned before—we have now no longer available to help us the pioneer battalions and the large infantry establishments of 1918.

One thing which mechanization has done for us is that it has vastly reduced the water-supply problem, but that problem was never a large one in moving warfare in a European theatre. It was in Palestine, Mesopotamia and Egypt, that it assumed the proportions of a major engineer task.

ATTACK FROM THE AIR.

Now let us turn from mechanization to another development—the air—in the sense of improvements in methods of air attack on ground targets. Has that affected the problem of the engineer? I think it has. I for one do not imagine that the enemy will waste his air resources on the bombing of manufacturing plants and of open towns, when, at a critical period, those resources can be effectively used on the battle front, or against the communications on which it depends.

It is not easy to discover exactly what the efficiency of modern air bombing against bridges, roads and railways is likely to be. The air forces employed by Japan and by the contending sides in Spain are probably hardly up to European standards, and their energies seem to have been dispersed. I do not remember an instance where communications seem to have been permanently obstructed. There have been reports of the interruption of railways and the breaking of bridges, and we know that air attack on the bridges was largely responsible for the German lack of success at the crossing of the Marne at Dormans in 1918. On the whole, I suggest that we must expect that vital bridges, roads and railways (such, for example, as the

pontoon bridges over the Marne in the example which we were considering) will be a target for concentrated air attack and may suffer serious damage. I understand that some foreign armies doubt the possibility even of maintaining such bridges at all during the day-time; and contemplate the possibility of having to dismantle and re-erect bridges (perhaps on alternative sites) daily. This would represent a new and serious demand on the engineers. Photographs of bomb craters in Spain, which have appeared in the Press, show the damage which an accurately-placed or lucky bomb can do to road communications. We must be prepared for such damage, even although it may be exceptional.

Cross-Country Movement.

It has been said that the British Army consists entirely of generals and lorries, and it is a fact that the vast masses of vehicles in our mechanized army, together with the character of our manœuvre areas, tend to make the British Army very road bound. We ourselves proved in Palestine in 1918, and we have recently seen in Spain, the danger of air attack on massed lorry columns. Such columns offer in particular a perfect target for low-flying gas-spray attack. We must get off the roads, and move across country. And although the modern vehicle is better adapted to cross-country movement, and although all arms are now to be trained to get themselves across country and to bridge small obstacles, I foresee that here again there may be a new and increased call on the engineers for work, for which in front of G.H.Q., manpower has not been replaced by machines.

Nor can we altogether ignore, I suggest, the danger of attack on vital points in our communications by parachute troops. The Russians are not the only Power which seems to contemplate their use.

Then there is so much talk nowadays of "air raid precautions," and we are becoming so air-raid minded that I cannot help thinking that wherever headquarters and rear installations are even temporarily stationary, there is going to be a loud clear call for air-raid shelters, splinter protection, anti-gas curtains, and so on—perhaps even for tunnelled dugouts—which will demand the attention of the engineers. The fact that the engineers are now regarded as the experts and "parent arm" for anti-gas measures will tend, I feel sure, to increase the demand even for non-technical work.

The engineers of the army are responsible in war, as you know, for the Engineer Services of the Royal Air Force. The chief development here results from the increased speed of machines and their greatly increased loads. The effect of these factors is to be found in the increased dimensions of landing grounds and the greater necessity for a sound surface. This may make a call on the engineers for

levelling, the removal of obstacles and the provision of stabilized-soil, metalled or concrete runways. The maintenance of landing grounds against the effect of enemy bombing attack may also, I think, lead to a demand for engineers to stand by for this purpose.

CHEMICAL WARFARE.

The only other sphere of development on which I have time to touch is "gas." We sincerely trust that it will not be used, but the possibility that our opponent may use it cannot be neglected. Improvements here in the practice of foreign nations appear to be an improved technique of ground contamination, and the use of large gas bombs and, more important still, the use of air spray. We may, therefore, find craters, road blocks and bridge sites heavily contaminated, and areas of contamination covering important approaches; while gas bombs will, as I have said, add to the call for air raid precautions in back areas. The danger of low spray attack on lorry and marching columns will, as I mentioned before, tend to force us off the roads. Ground contamination and the danger of spray attack on the working parties will often force the engineers to work under gas conditions in protective clothing. This involves a reduction of 50 to 75 per cent. in their efficiency.

You may reasonably object that I have been talking in terms of Continental war, and Continental war, we are assured, is not, or ought not to be, "the British way in warfare." In other than Continental theatres it is generally true that river-crossings and demolitions of bridges play only a small part. In their place, however, we have the immense problem of motor roads and of the increased amenities demanded for modern armies. I ask you to compare the occupation of Nahakki in the Mohmand country in 1908, with the same operation in 1935. In 1908, the company of Sappers and Miners, which our Chairman commanded, constructed with the assistance of a Pioneer Battalion in two days by brute force an adequate camel road over the Nahakki Pass, and we thought ourselves rather advanced in wiring-in the village pond and pumping our drinking and animals' water therefrom. In 1935, working parties of Sappers and of all arms rising to 2,000 men each day, with machinery equivalent to a further 400 men, were required for several weeks to construct a lorry road over the Pass, and a pipe line eight miles in length was laid over the hills to carry water to Nahakki.

Compare again the campaign in Abyssinia under Sir Robert Napier in 1867 with the recent Italian operations. In the former a weak division included no less than ten field companies and a corps of Baluchi labourers, but these numbers in no way compare with the vast body of military and semi-military labour employed by the Italians on their motor roads. The engineer units supported by road

construction units were totally insufficient for the purpose and practically every man in the army was employed at one time or another on road work. Even so, these roads were in character and number far below those which would have been required in a war against a serious enemy.* It is true that road-making machinery and stabilized-soil or mix-in-place methods of road-surfacing, concrete mixers and other machinery add very greatly in such countries to our power to meet our problems, but such methods require the machinery to be ready on the spot with experts trained in its use.

Conclusion.

I may be a pessimist, but wherever I look it seems to me that the developments since 1918, have largely increased the destructive power of the military engineer without any equivalent increase in his powers of construction ; that, where all are striving for mobility, the engineer's power of creating obstacles to movement is advancing quicker than his power of overcoming them. It seems to me that the strategical and tactical employment of the Army depends daily more and more on the engineer and that there is an ever-increasing margin between what we shall be expected to do and what we can do.

How can that margin be reduced without a large increase in engineer establishments ?

I can only suggest :—

(*a*) That Commanders and Staffs must realize much more fully than they now do the engineer problem and the conditions under which the engineer can pull his full weight.

(*b*) That all arms must be much more self-reliant in field engineer work than formerly (that is the policy of the Army Council, and it remains for the troops to implement it).

And finally—

(*c*) That the engineer requirements of each possible theatre of war must be minutely examined and that wherever machines can help us they should be provided in peace and the engineer personnel trained in their use.

* It is perhaps not an exaggeration to say that a single efficient Sapper company on the Abyssinian side might have so delayed the final dash to Addis Ababa as to have materially affected the course of the war.

CONSTRUCTION OF R.C.C. BRIDGES IN THE FIELD.

By CAPTAIN W. F. ANDERSON, M.B.E., M.C., R.E.

I. INTRODUCTION.

REINFORCED concrete has several obvious advantages under active service conditions, the chief of which are :—

(1) The difficulty of demolishing an R.C.C. bridge once it has been made.
(2) The ease with which the materials for R.C.C. work can be obtained in most countries.
(3) The moderate weight and bulk of the materials for transport.

Its use, however, has been limited up to date by the following objections :—

(1) The need for skilled tradesmen for construction.
(2) The large amount of falsework required.
(3) The difficulty of carrying out detailed drawings and calculations in the field.
(4) The vulnerability of the work during construction, either to flood or hostile action.
(5) The general impression that " concrete work is slow, and so no good for rapid bridging on active service."

Probably it is this last objection, more than any other, that has turned the scale in favour of steel spans in the past ; it is seldom a valid one, however, as the approach roads and abutments are nearly always the deciding factor in the time of construction, and the bulkier the bridge parts, the better must the approach roads be before they can be brought up to the site.

This article describes briefly two R.C.C. bridges that were built during the recent operations in Waziristan, and ends with a proposal for a standard equipment that would, it is claimed, overcome the objections to concrete for spans up to 60 feet.

II. TWO R.C.C. BRIDGES IN WAZIRISTAN OPERATIONS, 1937.

As little bridging as possible was done in these operations, but there were two gaps, one of 35 ft. and one of 48 ft., where bridges were considered essential

Photo No. 1.

Photo No. 2.

Construction of RCC bridges in the field 1&2

Photo No. 3.

Photo No. 4.

Construction of RCC bridges in the field 3 & 4

(*a*) *Ahmadwam Bridge.*

The first bridge of 35 ft. span was made at Ahmadwam, on the Dosalli-Ahmadwam road, and is shown in Photo No. 1. It was a normal three beam and slab span, with an 18 ft. roadway. The photograph shows the forest of timber props required to support the shuttering during concreting ; these props were further supported on 25 ft. R.S.J.'s, as it was unsafe to rely on the spoil in the ravine during the spate season.

The bridge took about six weeks to build, a large part of the time being occupied with cutting and fixing the shuttering.

(*b*) *Mirki Khel Bridge.*

1. The second bridge of 48 ft. span was made at Mirki Khel, twelve miles farther up the road towards Dosalli ; as a result of experience gained at Ahmadwam, the experiment was made of designing the bridge so that the greater part of the shuttering could be done with 4 ft. by 4 ft. standard 5,000-gallon tank sections. (These are a standard store in India.)

2. Drawing W. 1, shows the system of shuttering used. Photo No. 2 shows the bridge ready for the pour, and Photo No. 3 shows the shuttering being struck.

The difference in the amount of timber in the shuttering is clear from the photographs ; the saving effected was approximately £50, or 15 per cent. of the cost of the bridge.

The spate season was over, so trestles could be safely placed in the river-bed ; but the steel tank sections were a self-supporting bridge in themselves, so that, had the falsework been carried away by a flood, no really serious damage would have been done, except during the three crucial days when the rapid-hardening cement in the beams was still green.

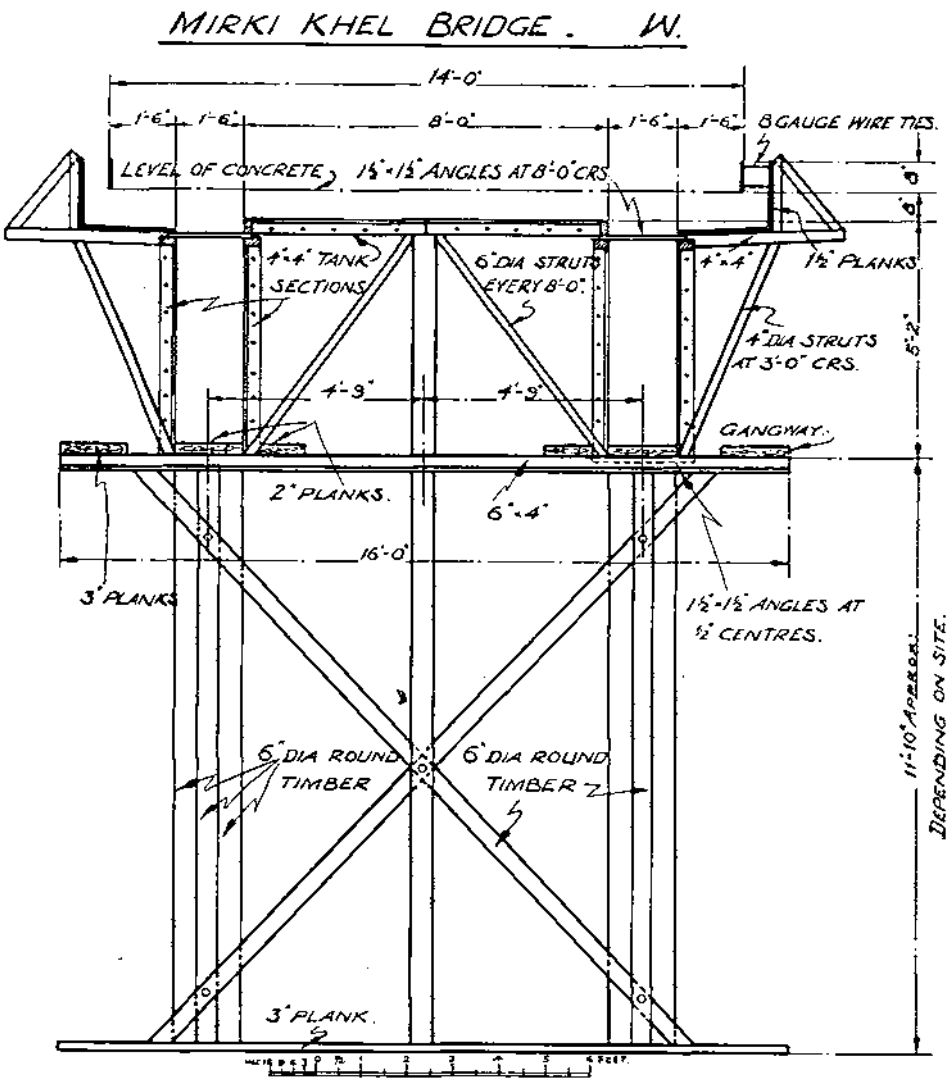
3. *Time and Costs.*—The bridge took a month and a day to build ; it exactly occupied the month of the Ramzan fast, about the worst conditions for work that one could imagine. There was also constant trouble with thefts of material from the bridge.

The labour and costs for the work were roughly as follows :—

	Labour in man-hours.		
	Skilled.	*Unskilled.*	*Costs in £*
Abutments ..	400	4,000	150
Approaches ..	100	3,750	55
Bridge	800	5,000	265
Transport ..	—	—	65
Total	1,300	12,750	535

The cost, therefore, worked out at about £11 per foot run of bridge, a price which would certainly have been reduced by 25 per cent. under normal peace-time conditions.

The increase in speed, compared to the 35 ft. span, was very



noticeable; the plates being standard and interchangeable, there was little need for measurements, and the bridge largely kept itself straight.

4. *Labour.*—The skilled labour available was never more than two carpenters, three blacksmiths, and twelve masons; the latter were mostly on abutment work.

The unskilled men were Kashmiris, Marwats, and Mahsuds.

5. *Method of Erection.*—The most foolproof and slowest method was used; plates were slid out on the flat bolted together in threes, then further assembled into sixes, and up-ended in the position they were to occupy on the trestle staging.

The bridge was ordered in a hurry, so that the number of special parts ordered from workshops had to be kept to a minimum; apart from the tank sections, the only steel parts were the 80 1½-in. by 1½-in. angle-iron distance pieces for the beams. The addition of a few more special steel parts would have greatly increased the speed and ease of erection.

II. Proposal for a Standard Equipment for R.C.C. Beam Construction.

From experience gained at Mirki Khel bridge, a design has been worked out for a standard steel equipment, capable of constructing simply supported spans of up to 60 ft. to carry a 12-ton road roller, the standard load in India.

This equipment contains about three tons of special steel parts in addition to the tank sections; all of these are quite easy to make. Photo No. 4 shows a specimen length of the equipment that was made up in the M.E.S. workshops in Bannu.

Drawings X and Y show details of the parts and of the various types of bridge that can be made with the equipment. Drawing Z is given as an example of how the necessary data for construction might be set out so as to do away with the need of any calculations in the field; this is on the lines of Table xxiv of the *M.E.S. Handbook* on roads, only rather less condensed, so as to be usable as working drawings.

The following are the advantages claimed for this equipment:—

(1) Erection is simple, since the insides of the beams and the bottom of the centre slab form a complete properly braced structure, and can be launched as such.

This structure then forms a platform from which the rest of the erection can be quickly and easily carried out.

(2) The steelwork is strong enough to stand launch up to 60 ft. and to take the weight of the green concrete in the beams over spans up to 24 ft. Thus the timber work can be restricted to a few struts driven in from below after the launch has taken place, a much easier operation than making up and erecting several heavy trestles.

(3) Apart from these struts, the use of timber is restricted to the shuttering of the bottom of the beam, apart from gang planks

and minor fillets and filling pieces. Thus, wastage of shuttering material is practically eliminated.

(4) The total weight of material for shuttering is less with this equipment than with timber: for example, the weights of shuttering required for a 48-ft. span are roughly :—

(*a*)	Using entirely timber ..	11 tons.
(*b*)	Using steel shuttering ..	6 tons for tank sections. $2\frac{1}{4}$ tons for specials. 1 ton for timber.
	Total ..	$9\frac{1}{4}$ tons

IV. CONCLUSION.

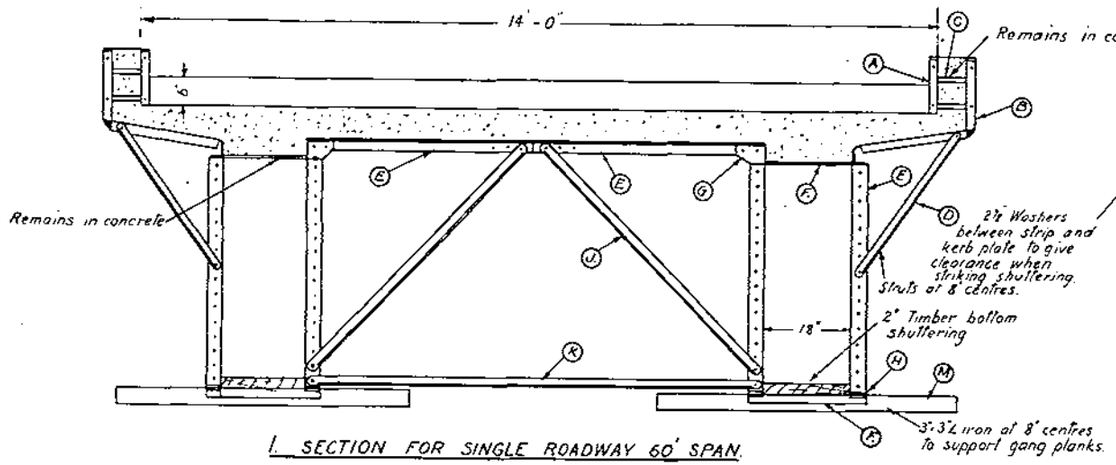
Bearing in mind the shortage of manufactured steelwork in war and the difficulty of transporting long or heavy units to the site, R.C.C. beams made in this way might very easily prove to be the quickest method of bridging spans up to 60 ft. in rear areas.

An equipment of steel shuttering would be cheap and easy to make up in peace, and would form a most useful addition to a base park bridging equipment in war.

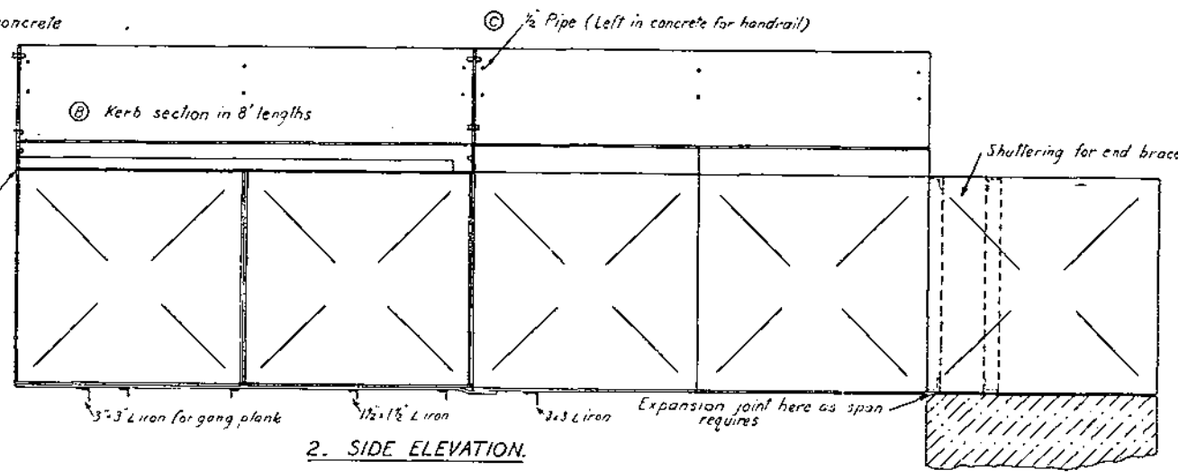
STANDARD STEEL SHUTTERING FOR R.C.C. BRIDGES FOR 12 TON ROAD ROLLERS.

Drawing. X.

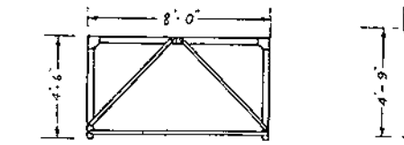
Scale = ½" to 1' or 1/24.



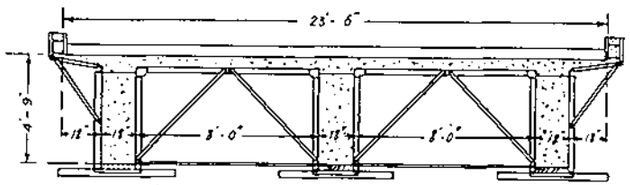
1. SECTION FOR SINGLE ROADWAY 60' SPAN.



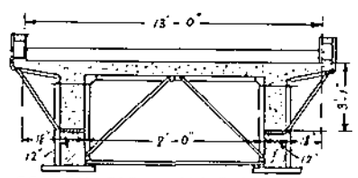
2. SIDE ELEVATION.



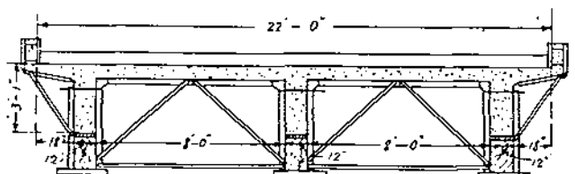
4. SECTION OF STRUCTURE AS LAUNCHED
Weight 192 lbs/ft run.



5. SECTION FOR DOUBLE ROADWAY 60' SPAN.

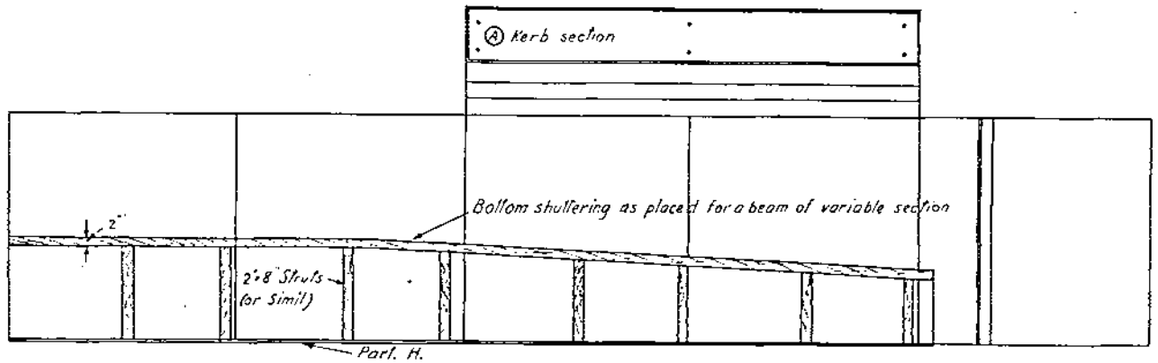


6. SECTION FOR SINGLE ROADWAY 24' SPAN AND UNDER.



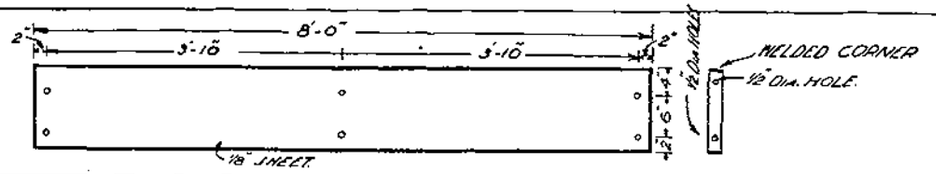
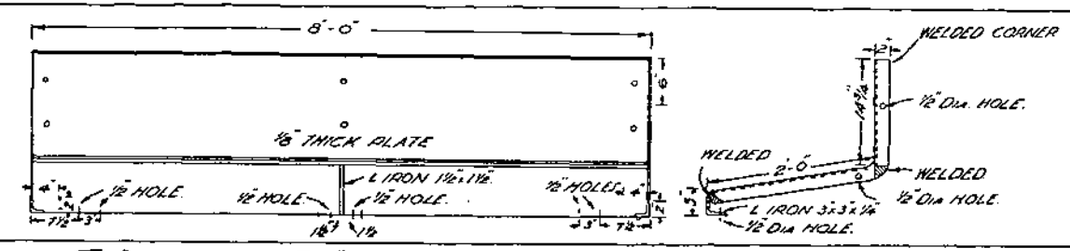
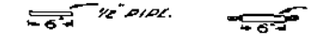
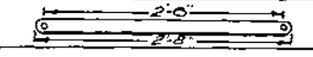
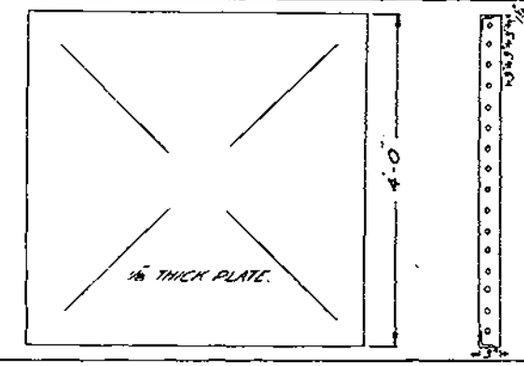
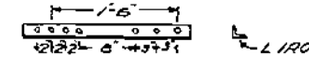
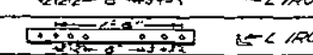
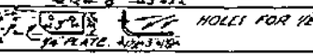
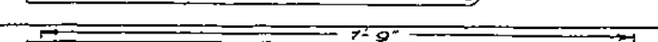
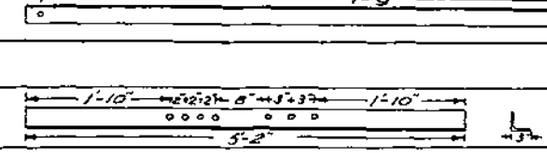
7 SECTION FOR DOUBLE ROADWAY 24' SPAN AND UNDER

Scale = 1" = 5'



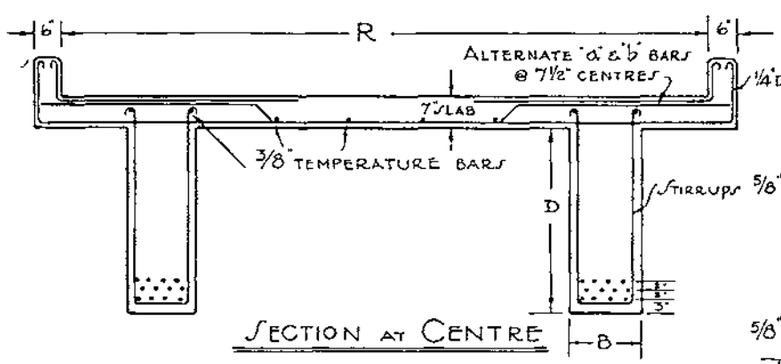
3. ELEVATIONAL SECTION THROUGH A BEAM, SHOWING HOW A BEAM OF VARIABLE SECTION IS MADE.

LIST OF COMPONENT PARTS — DRAWING Y.

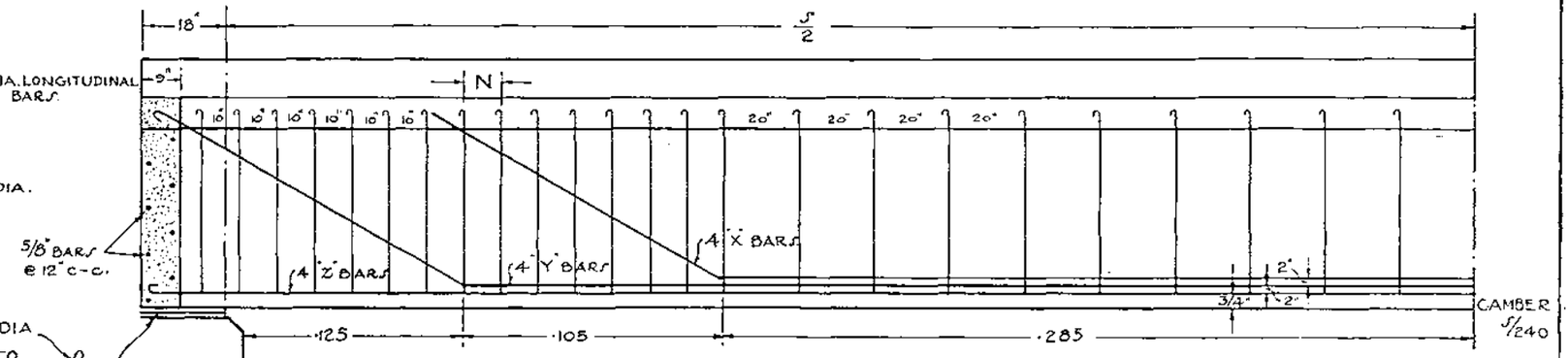
PART	DESCRIPTION	DIMENSIONS	WEIGHT IN LBS.	No. FOR BOSTON SINGLE ROAD WAY	TOTAL WEIGHT IN LBS	
A	INSIDE KERB PLATE		40	15	600	
B	OUTSIDE KERB PLATE.		167·72	15	2516	
C	KERB DISTANCE BOLT		68	90	61	EXPENDABLE.
D	KERB STRUT		6·6	65	43	
E	STANDARD 5000 GALLONS SECTION		160	105	16800	
F	BEAM DISTANCE PIECE (LOWER)		4·27	66	282	14 EXPENDABLE
F'	BEAM DISTANCE PIECE (UPPER)		6·11	66	403	
G	ANGLE GUSSETS		3·82	32	103	
H	BOTTOM FLANGE PIECE		46·8	18	842	
J	DIAGONAL CROSS BRACE		21·86	32	700	
K	HORIZONTAL CROSS BRACE		39·20	9	353	
L	NUTS & BOLTS 1½"x½"		0·25	740	185	
M	ANGLE IRON 3"x3"		37·2	9	335	
				TOTAL WEIGHT	23223	207·35 CWT.

RCC BEAMS 60′ TO 44′ SINGLE ROADWAY FOR 12 TON ROAD ROLLER

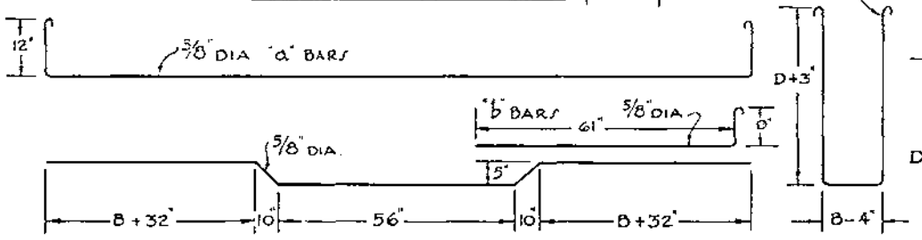
DRAWING Z.



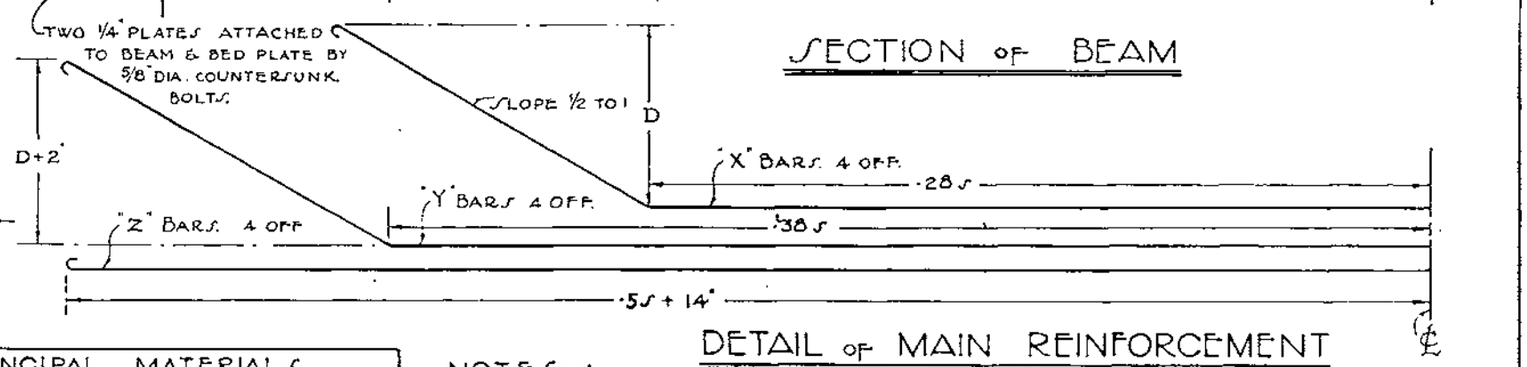
SECTION AT CENTRE



SECTION OF BEAM



DETAIL OF SLAB BARS & STIRRUPS



DETAIL OF MAIN REINFORCEMENT

SPAN	ROAD WIDTH	DIMENSIONS							PRINCIPAL MATERIALS								
S. FEET.	R FEET.	D INS.	B INS.	X BARS DIA.	Y BARS DIA.	Z BARS DIA.	AREA of STEEL AT CENTRE.	NO OF STIRRUPS	SPACING N	1½" R.I CWT.	1¼" CWT.	1⅛" CWT.	⅝" CWT.	12" CWT.	CEMENT CWT	SAND C.FT.	AGGREGATE C.FT
60	14	50	18	1½	1½	1½	21 INS²	112	10"	100	—	—	40	4	300	750	1500
56	14	48	18	1¼	1¼	1½	17·6 "	104	10"	30	35	—	37	4	280	700	1400
52	13'-8"	48	16	1¼	1¼	1¼	15·0 "	98	10"	—	54	—	34	4	250	600	1200
48	13'-8"	44	16	1¼	1¼	1¼	14·4 "	90	10"	—	45	—	31	3	220	550	1100
44	13'-8	40	16	1⅛	1⅛	1⅛	12·0 "	84	10"	—	—	40	29	3	290	500	1000

NOTES:—

1. ALLOWABLE STRESS IN CONCRETE = 600 LBS/SQ.IN; PROPORTION; 1:2:4.
2. " " STEEL = 16,000 LBS/SQ.IN.
3. THE SIZES OF IRON BARS SPECIFIED ARE THE BEST FOR EACH SPAN, BUT OTHER SIZES CAN BE USED AS LONG AS THE REQUISITE AREA OF STEEL IS PROVIDED.
4. OVERLAPS; 40 × DIA. OF STEEL.

G.M.

FIELD SURVEY.

By CAPTAIN S. G. HUDSON, R.E.

INTRODUCTION.

ACCURATE topographical information of a theatre of war is essential for preparation and execution of military plans. The object of this article is to outline the organization and main tasks of the Survey Service, which provides this information during operations.

THE SURVEY SERVICE, 1914–1918.

At the outbreak of war in 1914, the organization of this service was based upon the needs of a small force operating under favourable conditions and requiring only small scale maps, which could be obtained from England. It consisted of an officer (G.S.O.3) and a clerk at G.H.Q., an officer and a clerk at the headquarters of the Lines of Communication, and a Printing Company, R.E., divided between Army, Corps and L. of C.

During the Battle of the Aisne, the need of large-scale maps became apparent. It was met by utilizing existing French maps, mainly 1:50000 and 1:80000 scales, and also by original ground surveys. After April, 1915, much supplementary information of detail was obtained from air photographs. All survey work for the B.E.F., except printing, was at this time carried out by one section, consisting of an officer and eleven other ranks.

In 1915, methods of fixing enemy artillery positions by flash spotting and sound ranging were introduced. This new task, added to the rapidly increasing demand for maps of all scales, caused the formation of a topographical section for each Army. To it was attached an army printing section, the whole strength being thirty-eight of all ranks.

Requirements still grew rapidly, and early in 1916 a Field Survey Company, R.E., was formed in each army; the establishment by the end of the year was over twelve officers and one hundred other ranks. These units were responsible for all survey and topographical work, map reproduction and supply, observation, flash spotting and sound ranging; a very comprehensive task for a small unit working over a large area. In the meantime, the organization at G.H.Q. had also risen to a total of seven officers and forty other ranks by August, 1917.

The final organization was authorized in 1918 and brought into being in June. It provided a Field Survey Battalion for an Army, consisting of headquarters, Corps topographical sections, printing sections, observation groups and sound ranging sections. This steady growth of the survey organization was to a very great extent due to the increasing value put upon its work, a value very much greater than appeared probable at the outbreak of war.

THE SURVEY SERVICE, 1938.

The present day organization consists of a directorate and field survey units under the control of the Intelligence Section, General Staff.

The Director is at Army H.Q. with an Assistant Director at each Corps H.Q., acting as advisers to formations in all survey matters and responsible for co-ordination and control of all survey work in the field.

Decentralization of the executive units, proved so necessary during the concluding semi-mobile stages of the last war, is arranged by allocation of a Survey Battery R.A. and a Field Survey Company R.E. to each Corps, working in close liaison under the technical direction of the Assistant Director of Survey of the Corps. In addition, a larger R.E. unit is provided for an army.

The R.E. units are responsible for all survey work except that required within Corps Artillery areas solely for R.A. use, which is a task of the R.A. unit together with sound ranging and flash spotting.

R.E. FIELD SURVEY TASKS.

These tasks can be grouped under two main heads, provision of control and map production. Both Army and Corps units consist of sections equipped and organized for one of these tasks, those in the Corps units being mobile. These sections are named topographical, printing, proving, drawing and photographic. The first of these carries out all ground survey, whilst the remainder are concerned with the several stages of map production.

PROVISION OF CONTROL.

Accurate control over the whole area of operations is necessary to obtain data, and will normally take the form of a trigonometrical framework either based on data from a friendly power or on work initiated at the outset of the campaign. Army field survey companies establish this control in rear of forward areas, its data being used as a basis for the more detailed requirements of the Corps units.

One of the tasks of the R.E. Corps units is to ensure that whenever

possible accurate co-ordinate and bearing values are available for the use of the R.A. unit in or near the Corps Artillery area. Under average conditions this will present no difficulty provided that timely information of intentions is given to both units and that they are in close touch with each other. Peace-time manœuvres are apt to give a false idea of the difficulties of ensuring this co-operation, and foster the opinion that to use survey data will necessarily delay the execution of an artillery plan. This will definitely not be so under war conditions, in which the work of survey units is continuous and not carried out under unrealistic conditions of time and space.

Occasions will undoubtedly occur when, owing to an abnormal tactical situation or to very bad weather conditions, it will be impossible for the R.E. unit to provide the full data required. In order to allow for such instances, the R.A. unit is so organized as to be able to initiate its own control of a temporary nature and of as great an accuracy as the time available allows. The Corps Artillery is then said to be using a " temporary grid," the origin of which may be derived from map data by such means as resection, and the orientation obtained from an observed azimuth, or in the worst cases by compass. Whatever the means employed they will be as correct as possible in the conditions, in order to retain a close relationship between this temporary data and the map.

The Uses of Survey Data to the Royal Artillery.

The object of applying these methods to gunnery is to enable line, range and angle of sight to be predicted with the greatest possible accuracy in the time available. By means of this, mass artillery fire can be directed against targets invisible to O.P.s and to battery positions, by night or by day. There are three main advantages, namely surprise, security and quick accuracy of a high order at long ranges. Surprise and security are both obtained because in the majority of cases previous registration and ranging can be avoided. Accuracy at long ranges is given by a rigid survey control under conditions which would make firing much less accurate if the only available methods were observation and registration. Speed in hitting the target is often imperative, especially now that there tends to be more fluidity in back areas.

Map Production.

During the last war, approximately thirty-four million maps were printed for the western front alone. Since then, use of the large-scale map has become far more general, the full scale issue to a Corps now being over eleven thousand copies. Many more maps of each scale are required.

There are three types of map used in the field, small scale, 1:250000 or smaller, medium scale, 1:50000, and large scale 1:25000. Small-scale maps are used for strategical moves, medium scale for tactical moves, and large scale in battle by all arms.

The sources of supply are either existing material, revised up to date, or new survey. Revision may include entire re-drawing, preparation of composite sheets, rearrangement of sheet lines and several other processes. New survey can be carried out either by ground methods or by means of air photography. Air photo revision and mapping possesses two outstanding advantages over the normal process, namely opportunism and speed. Areas in which operations are likely in the future can be quickly photographed, and the preliminary plotting carried out as time is available so that accurate maps will be very quickly prepared once the requirement is definite. These maps will be of a high order of accuracy provided that the photographs are suitable.

Though the flying task involved is unusual it is well within the capability of a pilot after very little practice; it consists in its ideal form of a series of parallel strips overlapping one another laterally and longitudinally to a fixed extent, the courses being flown straight at a constant height and with the camera level. From the airman's point of view, the difficulties seem to be that cameras of the necessary automatic timed exposure type are not usually carried, and that he has so many other tasks to do. There can, however, be no doubt that in many instances foresight in obtaining suitable photographs will be well rewarded by large-scale maps being at hand when required for planning and carrying out an operation.

It is not possible to make a direct comparison in speed between the ground and air photo processes; there is, however, no doubt whatsoever that the latter is very much quicker (once the photographs are available), the work being timed by hours instead of days and weeks.

A drawing section of a Field Survey Company, R.E., is able to prepare a large-scale standard sheet in about thirty hours from the receipt of data. The final time, including printing and other processes, depends upon the style of map required. These times may be reduced by a mechanical plotter, but it is not yet likely that the present methods will be entirely superseded.

MAP PRINTING.

The printing sections of Corps Field Survey Companies, R.E., are responsible for printing the large-scale maps required in forward areas, and are therefore equipped with mobile apparatus, mounted in trailers and lorries. The other scales, medium and small, are produced by the Army units under more normal conditions and possibly using stationary equipment. In both types of unit the proving and photo-

graphic sections work in touch with the printing section, their main task being to provide plates ready for the press.

Changes in humidity and temperature affect printing processes very severely; it is therefore most essential that the style of map required from the Corps units which work under " open air " conditions shall be as simple as possible Every colour added requires a complete printing and by adding to the time taken to produce the final map greatly increases the chances of inaccurate register.

An all-black map is quite intelligible to anyone accustomed to it, whilst a two-colour map distinguishing hill features from other detail is very clear. Such maps can be very quickly printed in large numbers in the field under conditions quite impossible for anything more complicated. Provided that the Army is accustomed to using these simple maps during training there should be no difficulty during a campaign. These simple styles are in marked contrast to the multi-coloured maps normally provided for military training.

Conclusion.

It is probable that survey will be even more useful in the future than in the past. Its uses to the Army should be known at least in outline to all officers and in detail to those staff officers of formations which will have survey units allotted to them. This can best be arranged by the inclusion of realistic survey problems in collective training schemes; these can take the form of an opening survey narrative in accordance with the operation envisaged describing the data available in the form of maps and in the form of trigonometrical data. The actual working out of the means by which requirements are to be met should be left to a representative of the survey directorate, who will be able to have under his technical control both an R.A. and an R.E. survey unit. Only by the actual presence of the several links at such training, and by the inclusion of well-thought-out problems, will the peace-time units be able to prepare thoroughly for their most probable war-time tasks.

COAST DEFENCE 75 YEARS AGO.

By COLONEL A. G. B. BUCHANAN.

AT a time like the present when rearmament, including the refurbishing of our coast defences, is very much "in the picture," it is of no little interest to examine the contents of an old volume of reports on the defences of the United Kingdom bearing various dates from 1860 to 1866.

During the last hundred years it has happened, about once in each generation, that the political situation prevailing at the time has forced us to take stock of our means of defence, and as a result to make somewhat hasty provision for adding to them. It is evident from a study of this volume that the year 1859 marked the beginning of one of these periods.

The ball opened on 20th August, 1859, with the setting up of a Royal Commission to examine "the state, condition and sufficiency of the Fortifications existing for the Defence of the United Kingdom . . . especially such Works of Defence as are intended for the protection of the Royal Arsenals and Dockyards." The chairman was Sir Harry D. Jones and Major W. F. D. Jervois R.E., Assistant I.G.F., was appointed secretary.

The War Office, in a memorandum of instructions bearing the same date, enjoined the Commissioners to examine in particular the works at Portsmouth, Plymouth, Portland, Pembroke, Dover, Chatham and, furthermore, to report on defending the approaches to Woolwich.

The Commission did not waste time. It presented its report on 7th February, 1860, recommending a total expenditure estimated at £11,850,000 for guns, works, barracks and land purchase, a fairly stiff figure in those days. The conclusion of the report, which covers 45 foolscap pages of printed matter, is worthy of notice :—

> "We have now completed the task assigned to us by Your Majesty's Royal Commission. . . . We submit our unanimous recommendations to Your Majesty's gracious consideration, with a firm conviction that their adoption will place the power of this country, for self-defence, on a par with its other elements of greatness and strength ; will give security to its industry and commerce ; afford a guarantee for the maintenance of peace ; and add a new glory to Your Majesty's reign."

The defence committee presided over by H.R.H. The Duke of Cambridge endorsed the report on 9th April, 1860, and on the 28th

August, Parliament voted £2,000,000 for fortifications as the first year's instalment.

Much interesting matter may be discovered in the appendices to the report. These include the evidence before the Commissioners of various eminent men of the day such as Sir John Burgoyne, then I.G.F., and Sir William Armstrong, superintendent of the Royal Gun Factories. The naval officers of that period were evidently somewhat contemptuous of the powers of shore batteries. One witness said "I doubt whether a single vessel, although a wooden ship, could be stopped even in the daytime by the heaviest batteries which you could build at Spithead."

Sir William Armstrong gave a considerable amount of technical data about the new breech-loading rifled guns which he was then experimenting with. The extreme range reached was 9,175 yards.

It is noteworthy that conscription was a possibility considered at that time, as the Registrar General in reporting to the Commission mentions the number of men of conscription age, 20–25. In his report he gives tables showing the number of males in every county of Great Britain between the ages of 15 and 60. This total was only 5,784, 621 of which London furnished 671,543, the entire population of the country in those days being about 28,000,000. Vegetarian principles were evidently not in favour at that time. Hear the concluding remarks of the Registrar General. "This nation is the healthiest and most vigorous in Europe. The people in towns are kept in comparative vigour by the quantity of meat which they are able to consume; and altogether they are much better fed than the French."

We learn too from the Adjutant-General that the total strength of the regular army and embodied militia in Great Britain and Ireland on 1st September, 1859 was 110,154, of which the R.E. only mustered 1,706.

Lord Overstone, to whom the Commission had referred for an opinion as to the effect of the occupation of London by an invader, refused to discuss the question seriously. At the end of a remarkable answer, which reads like a present-day speech in Parliament, he declared, "We have means for defence of every kind; national wealth, engineering skill, personal courage, amply sufficient to secure our safety.

We have *warning* more than enough to awake our vigilance.

If we prove too apathetic to take the necessary precautions, or make the requisite efforts, or too short-sighted and selfish to submit to the necessary sacrifice, we must bow to the fate which the whole world will declare we have deserved."

The total estimate for the actual new works recommended by the Commissioners was £4,460,000, the cost of land amounting to an additional £1,030,000. By the end of the financial year, 1865–6,

sums of £2,934,062 and £1,008,338 had been expended on works and land purchase respectively. Many of the old forts in our defended ports were built during this period, for example :—

At Portsmouth	..	Horse Sand and No Mans and the forts at Gosport and on the Portsdown Hills.
At Plymouth	..	Breakwater and Picklecombe.
At Pembroke	..	South Hook and Chapel Bay.
At Portland	..	Verne Citadel and Breakwater.
At Gravesend	..	Shornmead.
At Sheerness	..	Garrison Point.
At Dover	..	Western Heights.
At Cork	..	Carlisle and Camden.

In all, over 70 works were constructed, the most expensive single work being No Mans in Spithead which was estimated at £285,000.

The recommendations of the Commissioners, especially as regards the defence of Spithead, did not meet with general acceptance. Ironclad ships were coming in, and the engagement in the Chesapeake between the *Monitor* and the *Merrimac* led to a request by the War Office that the Commissioners would consider "whether the experience gained in that action is of such a nature as to induce them to modify the opinion expressed by them respecting the erection of forts at Spithead." The Commission spent seven weeks examining the question, and then reported that they adhered to their previous recommendations. In doing so they relied to a great extent on the increasing power of ordnance, Sir W. Armstrong being at that time engaged on making a 22-ton gun which would throw a shot of 600 lb. Furthermore, the only alternative means of defence which suggested itself was by opposing ironclads by ironclads, which was not only more expensive, but would also confine a portion of the fleet to a purely defensive role.

The Government evidently accepted the views expressed by the Royal Commission.

One other task that was entrusted to them in 1860 was that of finding a site for a second Arsenal to relieve the congestion at Woolwich. A previous Commission had recommended Weedon, but this locality did not commend itself to the members then sitting, who finally reported that Cannock Chase was in their opinion the most suitable place. Doubtless those of us who know the Chase and are concerned with the preservation of rural England are glad that effect was not given to this recommendation.

A DESERT SURVEY.

By CAPTAIN D. W. PRICE, R.E.

I.—MAINLY HISTORY AND GEOGRAPHY.

IN 1929, at the request of the Royal Air Force, there was started a reconnaissance survey of the desert areas of Iraq. The object was to produce a series of flying maps of that country on the half-million scale. Although the work in the field has been going on for nearly ten years, and six sheets of the series are now either available or in production, no account of this survey has yet appeared in the pages of this *Journal*. In January, 1936, I was sent out to take my place in the succession of R.E. officers who had been posted to Iraq for this work. Having recently returned home with a memory still fresh, I feel that it may be worth recording in some detail a description of this survey, which has by its length of years almost become a regular Corps activity.

The country of Iraq may be broadly divided into three general areas: firstly the alluvial plain, which stretches from the latitude of Baghdad to the head of the Persian Gulf and has been formed by the perennial flooding of the Tigris and Euphrates: secondly, the desert, which closely edges the alluvial plain to east and west and fills the space between the two rivers north of the latitude of Baghdad: and thirdly, the mountainous country of the northern and north-eastern frontiers, the home of the Kurds and the Assyrians. In the *Liwa*, or province, of Mosul there also lies a belt of cultivated land in the rolling uplands between the desert and the hills.

During the Great War and in the troubled years which followed it in the Middle East, the Mesopotamian Expeditionary Force ran a system of triangulation up both the rivers Tigris and Euphrates and also into certain of the hilly frontier regions beyond. Two series of maps were published, one at two miles to one inch and the other at half that scale. Naturally the choice of areas covered was dictated by operational requirements, though the same maps were undoubtedly valuable in the administration of the country which we had progressively conquered. In fact, they are still used to-day.

In 1919 was formed the nucleus of what is now the Iraq Survey Directorate, as a department of the Iraqi Ministry of the Interior. This department has set itself the task of producing maps for purposes of land settlement and irrigation, both matters of vital importance

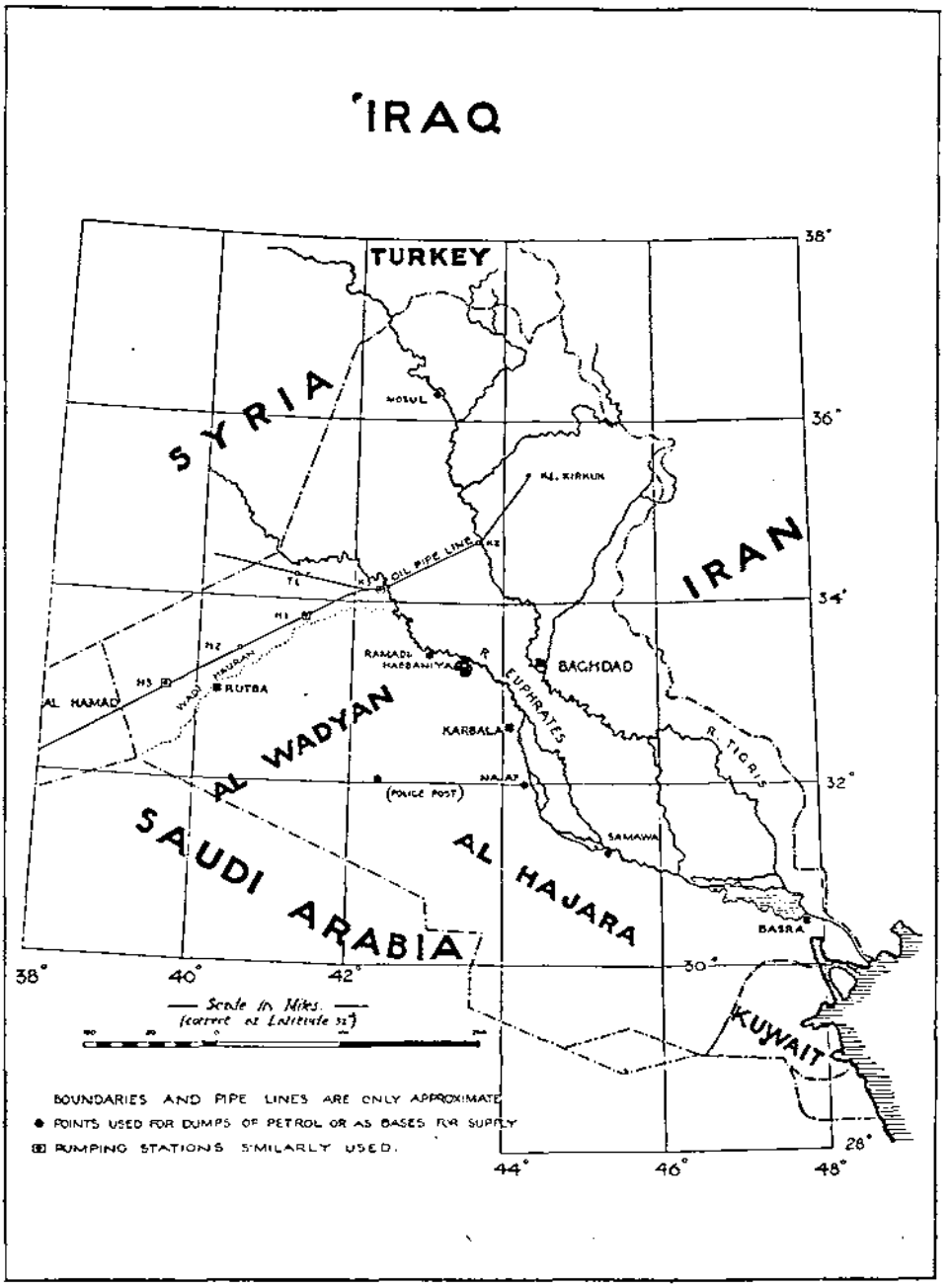
and no little difficulty in Iraq. Its work is therefore mainly concerned with cultivated and inhabited areas, and the scales used vary from $\frac{1}{8,000}$ to $\frac{1}{80,000}$. Within certain limits Iraq is surprisingly well mapped for so new a country. However, in 1929, except for the mountainous district lying along the northern frontier, there still remained unsurveyed in any sense all the area outside the cultivated belt near the rivers. This area is entirely desert and comprises about four-fifths of Iraq. To compile a series of flying maps of the country it was essential that the deserts should be surveyed. With that object there was formed in 1929 what has been known ever since as the Desert Survey Party.

The methods of work have varied in detail since it began, but essentially they have remained the same. The control for the survey is provided astronomically, by observing the longitude and latitude at certain stations distant apart about 25 miles. The detail is obtained by speedometer and compass traverses between these points and to other subsidiary points fixed from previous traverses. Heights are found by means of aneroid barometers.

The composition of the party has changed considerably since its formation. The party is now double its original size and is divided into two almost identical and self-contained sections, so that while one is providing the astronomical control, the other is employed on topographical work. The officer commanding the party has charge of one section, and a lance-corporal, seconded from the Ordnance Survey and carrying the local rank of serjeant, is in charge of the other. Each section requires two cars for traversing, for reasons which will appear later, and also one lorry to carry the tents, water tanks, cooking utensils, wireless sets, charging set and accumulators, personal baggage, rations, oil, petrol and other stores. With each section there are two B.O.R.'s of the Royal Air Force, one a fitter to look after the transport and the other a wireless operator. There are also four natives, two of whom are drivers and the other two a cook and a coolie. These comprise the essential minimum.

Besides these, however, two Arab guides are normally engaged for each section, and an interpreter is employed to help in the collection of names, a work which a slight knowledge of colloquial Arabic does not entirely fit one to perform. The guides provide, in addition, protection from molestation and theft, as they are drawn from the tribes local to the district.

The summer in Iraq is very hot ; life in a tent becomes unbearable, and water is difficult to find. The period for field work is therefore limited to some eight months of the year, from the beginning of October to mid-June. The hot and thirsty surveyor spends the summer months at air headquarters (originally near Baghdad, but now at Habbaniya) among the luxuries of fans and ice. There he may compile his work, transliterate his names, prepare for the following


'IRAQ
TURKEY
SYRIA
IRAN
SAUDI ARABIA
AL WADYAN
AL HAJARA
KUWAIT
MOSUL
KL. KIRKUK
OIL PIPE LINE
T4
T1
H1
H2
H3
RAMADI
HABBANIYA
R. EUPHRATES
BAGHDAD
R. TIGRIS
AL HAMAD
RUTBA
WADI HAURAN
KARBALA
NAJAF
(POLICE POST)
SAMAWA
BASRA
38°
40°
42°
44°
46°
48°
36°
34°
32°
30°
28°
Scale in Miles.
(correct at Latitude 32°)
BOUNDARIES AND PIPE LINES ARE ONLY APPROXIMATE
● POINTS USED FOR DUMPS OF PETROL OR AS BASES FOR SUPPLY
⊞ PUMPING STATIONS SIMILARLY USED.

season, and busy himself with the many varied things that always find their way into the sphere of his activities. I do not propose, however, to give in detail the programme of my particular tour, the limits of the areas covered, nor other items of mere temporary interest. The remainder of this account is more in the nature of a collection of notes on various aspects and incidents of the survey.

The deserts of Iraq are in two main areas: south-west of the Euphrates, and between the two rivers north of the latitude of Baghdad. The first area can be divided into two parts, which are for convenience termed the Southern Desert and the Western Desert. It is in these parts that most of the survey work has till the present time been done.

The Southern Desert includes what the Arabs call the Stony Country (*Al Hajara*) on account of the very rough nature of its surface. It extends south from the Euphrates into the borders of Saudi-Arabia and as far west as the meridian of 44° east. It rises to rather more than 1,000 feet above sea level and is gently undulating with occasional broad flat valleys, which are beautifully green in spring and afford good grazing for sheep and camels. The watercourses are mostly indefinite, but can be traced by the vegetation which lies along them. Separating this desert from the river is a belt of salt marsh and in places also a line of sand dunes. In 1936 these two features formed very serious obstacles to our transport; and I have memories of many hours spent in digging our way through the sodden salty ground, or in threading our way over and through the dunes with a sandstorm blotting out everything beyond the end of our bonnets. Until we changed our base for supplies, this heart-breaking journey through the marsh and the dunes was a weekly occurrence.

West of the meridian of 44° east lies what in Iraq we are pleased to call the Western Desert. This district includes the area which the Arabs know as *Al Wadyan*, or the country of *Wadis*. It is much cut up by these dry watercourses, whose winding beds of sand, shingle or boulders normally lie between cliffs and are most formidable obstacles to motor transport. This desert rises towards the west to nearly 3,000 feet above sea level. It is not so generally stony as the Southern Desert, as there are considerable plains of gravel almost without a feature. The most notable of these empty spaces is *Al Hamad* on the Trans-Jordanian border. Near the *wadis*, however, the country becomes rocky and intersected with tributary channels, often of some depth; and in certain parts there abounds a peculiar form of flat-topped terraced hill, much too steep and rough to climb by car.

In both deserts there are wells, mostly shallow pits scooped in the sandy bed of a *wadi*, and there are numerous water pools, which remain full for a short time after rain. The movements of the

bedouin are governed entirely by the prevalence of water and grazing for their camels; though each tribe normally pursues its way by approximately the same routes each year, coming to rest for the summer round the deeper wells. The riverain tribes, whose stock consists of sheep rather than camels, come out each winter and return to the river in summer.

I do not suppose that anybody can really know what a desert is like until he lives in it. The individual members of the party were changed from time to time, and there was considerable difference between their respective first impressions, both amongst British and natives. Some expected a blank and open space, and were struck by the number of different things the desert contained; others looked for vast areas of sand, and were surprised to find an abundance of rock and stone, gravel and even mud. To a few of us the silence, which literally rang in our ears, was at first a trouble. To all of us, however, the spring flowers and the gardens that grew amongst the rocks after the winter rain were an astonishment and a delight. During March, in certain parts of the desert, mignonette is so profuse as to fill the whole air with its scent, and, in the hollows where the scanty rain collects, dwarf iris and daisies, crowsfoot and miniature geranium spread a carpet of blue and white, gold and purple. These flowers spring up, blossom and fade in a few days; and the April dust storms scatter their parched fragments to the four winds.

It is popularly supposed that a desert is a very hot place, and this is generally true of the Syrian desert. Indeed the thermometer is apt to rise above 100° Fahrenheit during six months of the year; though the nights and early mornings are usually cool in contrast, and it is therefore rather misleading only to quote maximum temperatures. What is less realized, however, is that the desert can also be very cold. Quite severe frosts occur at night in the winter; in fact in 1937 and 1938 from 10 to 17 degrees of frost were several times recorded. On one occasion snow fell. We took the opportunity to further the march of western civilization eastwards by teaching the Arabs how to make a snowman. From November to February we had to lag the pipes and cocks of our water carts to prevent freezing and it was, of course, necessary to empty the car radiators each evening.

As at sea, there always seems to be a wind in the desert. The prevailing wind in the Syrian desert is from the north-west, and it blows regularly during the hours of daylight, mysteriously falling away each evening, until roused by the next sunrise. It brings much relief in the summer, but it can be bitterly cold in the winter. We learnt, however, to dread the days when the south wind blew. It could be hot enough to hurt, and khaki drill was too scanty a covering to protect us from its blast. It was on such a day in June that the thermometer reached 125° Fahrenheit in one of the tents. This was, of course, rather higher than the temperature in the shade (of which

there was incidentally none), as a tent has similar properties to a glass house.

Another phenomenon of the desert climate is dust. It may occur in a violent storm lasting from two to twenty minutes; or it may on the other hand work up gradually with a southerly wind, till everything is blotted out in a fine haze, which sometimes persists for days.

I never bore the first kind any malice; it used to behave in a thoroughly sporting way, give full warning of its approach and cause us as much fun as discomfort. When we saw a dust cloud bearing down, we would pack our kit away, secure the stores and equipment, and earth the vehicles to prevent them being charged with the static electricity that these storms brought. Then every man would stand to his tent to await the onslaught, ready to accept battle, with both his hands firmly gripping the windward pole. After a few minutes of blindness, in which the sound of the driven sand and the thrashing of canvas drowned all else, the wind would suddenly drop and the sun would reappear; and we would emerge to repair the damage. The storm would be over.

Dust of the second kind should properly be classified as a plague. Except for an occasional lull at night, one of these storms once lasted for four days. We ate, drank and breathed dust. It would fill our eyes till it hurt to read, and then we would lie on our beds listening to the wind, dust and sweat mingling to cover us with a gritty mud. No wireless communication is possible in such conditions as the dust is highly charged. Fortunately the seasons for these visitations are short, being confined to the late spring and late autumn; and they caused surprisingly little loss of time.

Long after I have forgotten heat and cold, wind and dust, I will, however, remember those evenings of unimaginable stillness. Summer or winter they rarely failed, however boisterous the day. Then would settle upon oneself an indescribable sense of peace, and no other place on earth would seem so good as one's own desert solitude.

II.—MAINLY ORGANIZATION.

The period of the year available for field work was divided into three spells of about two and a half months each; October till Christmas, January till Easter, April till mid-June. At the end of each spell in the field the vehicles were always in need of overhaul; and, although the times at headquarters were made to coincide with the usual service holidays, they were therefore full with the business of refitting. Supplies also had to be replenished.

For each period in the desert the party had to be self-supporting in respect of petrol, oil and water. A dump of petrol and oil was made before starting at some convenient place, such as a pumping station on the oil pipe-line or at a desert police post. A pumping

station was particularly suitable, as good water would be available there. For the collection and storage of water we used twelve-gallon camel tanks, twelve to each section. If, however, access to the oil pipe-line was inconvenient, a water cart trailer was towed behind each lorry, so that water from such sources as pools, wells and *wadis* in spate could be clarified and chlorinated for our use. The capacity of the tank was 150 gallons, which was about equal to that of the twelve camel tanks. This was convenient, as we still continued to use them for storage purposes in order to lighten the trailer, which we preferred to tow empty. With a full complement of ten in each section and allowing for a weekly collection of water, our ration therefore worked out at about two gallons per man per day. For emergency purposes only, a tank holding about 12 gallons was also fitted to each car, and 10 gallons in drums were carried in each lorry.

We normally took about one month's supplies with us at the beginning of each period in the field, replenishments being brought out from time to time by air. The frequency of these visits depended on our distance from headquarters. When we were on the Syrian border in 1936 the double journey required a flying time of six hours, and consequently our supplies were only replenished at intervals of three weeks; but when we approached the river in 1937, and the flying time had been reduced to three hours, except for occasional interruptions, we were able to enjoy a weekly service. The aircraft would land either at the camp of one of the two sections or else at some desert landing ground, if there was one conveniently near. These flights were popular with pilots, as it gave them an opportunity of leaving the normal routes and of practising their navigation. I used to give the aircraft my position in geographical co-ordinates by signal to headquarters on the previous day. Seven dirty white tents on a yellow drab ground are not easy to see from the air unless one is close to one's correct course, and there was considerable rivalry amongst pilots as to which would spot us first. On occasions we were never found at all.

When aircraft landed stores at one camp there was always the problem of getting part of them to the other section, which might be from 50 to 100 miles away and usually one day's return journey by car. This situation was scarcely realized at headquarters. The normal means of communication between the sections was by wireless, though once a week the serjeant and I would exchange letters by means of the refuelling convoys which met at the petrol dump. Occasionally, perhaps once a month, we would arrange a "Livingstone-I-presume" meeting at some landmark half-way between the camps. It was therefore preferable that aircraft should land at the dump, wherever it happened to be, on the day that the refuelling convoy from each section met to collect petrol and oil. The other

advantages were that time was not wasted in the camp preparing a landing ground and waiting for aircraft, nor was there so much risk of the pilot being unable to find the dump, as it would normally be familiar to him.

We were often more than a hundred miles from our dump, and these journeys to collect water and supplies sometimes took as long as three days. I rarely went myself as I could ill afford the time, and I usually put the convoy in the charge of the fitter. This was always a popular duty. There was the prospect of collecting the mail, of meeting some of the other section, and possibly of hearing the news from the crew of the visiting aircraft; it was also an independent mission. On the occasions that I went myself I found too that the escape from the routine of the camp filled me with a sort of holiday spirit, which quite made up for the initial reluctance to spare so much time. Many prodigious feats of driving were performed on these journeys, sometimes more than two hundred miles a day, including filling up with water and petrol. More often, however, progress was slower, and it was not unknown for a convoy to be stuck for a whole day in mud or sand.

The Arabs use camels or donkeys to draw the water from deep wells. They tie one end of a rope to the animal, and the other end with a skin bag attached is passed over a roughly grooved wooden wheel and down the well. The animal is driven to and fro, and at the end of each outward journey the bag comes to the surface. It is then taken off the wheel and emptied. Possessing neither camels nor donkeys we were forced to use man-power instead, until we discovered that a motor-car similarly harnessed would produce accelerated results. On one occasion our source of water was found to have failed. It was a deep well; but it was June, and, all other sources having been exhausted, the *bedouin* had settled round it in large numbers and sucked it dry. It was an anxious day for the fitter. But with the aid of the guide he managed to find water elsewhere, and he returned to camp some hours after dark, much fatigued but triumphant. When a convoy was expected to return after nightfall we used to haul a light up one of the wireless masts. As soon as the convoy's lights were seen a Verey light would be fired, followed by others at suitable intervals if they were still necessary.

In the hot weather a tank was often carried with the cars on traverse work in case a chance source of water was encountered. Some very strange liquid was collected in this way. The possibility of drawing water from rainpools or *wadis* near the camp was always attractive. It was, however, found that the process of clarifying and the frequent need of scrubbing the filter cloths gave so much trouble that it really saved time to use the deep wells, even though they may have been very distant.

For many years the cars of the survey party have been 16 h.p.

Morrises. Each consists of an ordinary London taxi chassis with a body specially designed for desert work. They are very strong and have given excellent service in the most appalling conditions. There were few parts that we did not manage to break, but it was surprising that we did not break more. Broken springs were a weekly occurrence. Axles and stub axles were rather less frequently broken, but they were inclined to cause trouble in rough ground. Twice a windscreen fell off. Much resource was often required to bring a damaged car back to camp for repair. On one occasion the track rod on one of the Morrises broke, and the fitter succeeded in getting his vehicle back to camp by lashing the near side front wheel with my binocular case strap and steering on the offside wheel only. Soft going accounted for a number of breakdowns in the transmission system, and at one time in the Southern Desert three out of the four cars were laid up together with damaged clutches. Punctures were a daily occurrence, and on one day it was recorded that three vehicles sustained thirteen punctures in 22 miles. The average life of a tyre was incidentally 4,500 miles.

The lorries were Crossley six-wheelers with a special pressed steel body. They were excellent in every way, of ample power and of great carrying capacity. Very rarely did we have any mechanical trouble with them. The only serious damage ever sustained was in the gear-box, which seemed to be adversely affected by heavy going, and three vehicles were put out of action from this cause.

If a lorry did, however, become unserviceable, the difficulty of maintaining two camps was very great. The one serviceable lorry had to be used for the moves of both sections and also for the collection of supplies; and it had very little rest. This situation occurred in a most aggravated form in 1937. In November of that year the lorry of the serjeant's section broke down completely. After we had carried on with only one serviceable lorry for three weeks, a convoy was sent 150 miles across the desert to Karbala, near the Euphrates, to collect a similar vehicle to tow the damaged one back to headquarters. Almost as soon as the new lorry was taken over it burst its oiling system and ran a big end. Meanwhile the lorry of the other section succumbed to some mysterious disorder of the gear-box, which was found to be beyond local repair. All three lorries were now unserviceable; and that week we had to collect our supplies in the small cars. The vehicle recently taken over was however put in order by incorporating parts from the others, and it was then used to tow them separately back to headquarters. The total distance covered was 800 miles, of which 560 were with one or other of the broken down lorries and a water cart trailer in tow and only about 70 miles were on a road. Our adventures with breaking towing chains and the improvised lashings that we used for their repair will not easily be forgotten.

The water cart trailers were a great source of anxiety. The tank was very inadequately secured to the frame, and the wooden box of accessories seldom remained intact at the end of a spell in the desert. More serious still, the part of the frame that formed the towing member was quite unable to stand the strain of travel over rough ground. We usually managed to forestall a complete fracture by means of cunningly devised lashings. But once a trailer did break loose. It thereupon turned three complete somersaults before coming to rest, to our astonishment, upright and on its wheels.

The survey owes much to the indefatigable work of the fitters. It was clearly a point of honour that no vehicle should ever remain out of action for a moment if it was possible to repair it; and often they would work late after dark so that the survey would not be held up on the following day.

Next to the survey instruments, the most important items in the equipment of the party were the wireless sets. Both sections now carry long and short wave receiving and transmitting sets, though No. 2 section had till 1937 long wave sets only. Normally, the aircraft wave was used for all W/T communication, but in conditions of dust or bad weather a shorter wave produced better results. Nearly all communication with headquarters was made by wireless and included the daily location signal. Of great importance to myself was the regular reception of time signals; and hardly less vital to the camp was the Saturday night broadcast of football results.

The maintenance of the wireless equipment and of the Stuart Turner charging sets was the responsibility of the wireless operators. The fact that the few breakdowns of W/T communication were due only to faulty components or to unfavourable atmospheric conditions speaks well for the skill and care of these men.

All tents were of the Indian pattern. With each section there were two double fly tents for the British personnel and four single fly tents for the natives. A fifth single fly tent was used for housing the wireless sets and accommodating certain survey and electrical equipment; its secondary use was as a mess tent.

Cooking was done entirely by primus stove; and the cooks, besides roasting meat, managed to bake excellent bread and to make cakes and pastries with these primitive means. We used to surprise any who honoured us with a week-end visit by producing hot rolls for breakfast.

One medicine chest was carried with each section. It was fortunately little used except for the supply of bandages and iodine and to meet the demand from visiting Arabs for pills No. 9. Life in the desert seems to be a very healthy one; nor is one bothered with fever-carrying insects such as sand fly and mosquitoes, except very locally near certain wells.

There is a great deal more animal life in the desert than one would

suppose, and it is generally possible to vary a diet of tinned food with a change to fresh meat from time to time. After the winter rains have fallen in December, sand grouse are plentiful everywhere. They very conveniently fly about in close formation, and one shot may produce astonishing results; the record bag with one shot, held by one of the fitters, was ten and a half brace. We used also to shoot bustard, which tastes something like a mixture of beef and turkey; but I did not really care for it. Gazelle is very good to eat. They are common in the open plains but are not so frequently seen in the rougher country. During the winter, duck occasionally visit the pools in the *wadis;* and there was one memorable camp near the great Wadi Hauran where we enjoyed fish and duck at the same meal. The fish were landed in my mosquito net, there being no local by-laws to prevent this unusual procedure. There are a few quail in certain parts of the desert but we never shot any; and even more locally we found partridge and pigeon, of which we shot a few. The *bedouin* would probably also list lizards, hedgehogs and *jerboas*, or kangaroo rats, in the category of game, but we preferred bully beef to such experiments in diet.

In the springtime, truffles grow over the greater part of the Southern Desert, and they are much relished by those who like that sort of food. Occasionally we would find watercress near some pool, and there was another plant which when cooked had the appearance and taste of spinach. We found that we were not always dependent on the world-famed 57 varieties of canned food.

Although there was little similarity between successive days, a camp routine of some kind was obviously required. Réveillé was at 6 a.m. The first duty was the morning wireless watch with headquarters and with the other section. This was at 6.30 a.m. in the hot weather, or at 7 a.m. in the winter, and was followed immediately by breakfast. If camp was to be moved, the tents would be struck and all vehicles would be packed and ready by 8.30 a.m. Unless the destination had already been reached, it was usual to pitch camp again about 3.30 p.m., and while the tents were being put up I used to work out the evening star programme. If I was on traverse work, the two cars would normally leave the camp at 7.30 a.m., or half an hour later in the winter, and return about 4.30 p.m. At 5 p.m. a time signal was taken and the afternoon wireless watch was kept. If observing stars I used to take another time signal at 7 p.m., followed by a third at 11 p.m. Lunch was always of the picnic variety and consisted of tinned fish, ration biscuits and cheese; but the evening meal was a more solid affair, though it had occasionally to be eaten hastily in order to catch an inconveniently early star. We always made a point of changing into some clean kit before dinner, and it was then that we used to get our best wash of the day. Our store of water did not allow us to have

baths, but much could be done by a complete sponge down out of a canvas basin. Sunday was kept as a rest day, and some watchfulness was required to ensure that it did not degenerate into a day for M.T. maintenance. It was also a feast day, for our usual frugal lunch gave place to an elaborate repast, the basis of which was normally curry and rice.

The administrative details were manifold, in spite of the smallness of the party. Air Force regulations, however, governed all matters of engagement of personnel, of their pay, of the supply of stores and fuel, and of accounting. This simplified the work in many ways, and the authorities were generous in their interpretation of the rules as applied to so unusual a unit as the survey party. Nevertheless a fair amount of paper work was required, particularly in connection with stores accounting.

Camp sites were usually chosen in consultation with the guides. It was in general safer to avoid patches of scrub or grass, however pleasing to the eye, as they always indicated where water would collect if it rained. We also kept clear of large thorn bushes, as they seemed to harbour flies and mosquitoes. Once when I ignored the guides' advice, a sudden storm flooded the whole valley in which the camp was pitched and nearly washed it away. Fortunately the level fell before that occurred, and we were let off with a soaking of all our belongings.

The danger of fire, however, was much more real than that of flood. I was myself very fortunate in not having a fire, though previous parties have suffered loss in that way. For this reason every possible precaution was taken. Tents were pitched well spaced apart, a double interval being left on either side of the cook's tent, and anything inflammable such as petrol, oil and insecticide was stacked separately from all other stores and well away from the line of tents. Copies or tracings of the work were also made up weekly. They were kept separate from the originals, so that any accident would not involve both ; and when a sheet was completed, the plane table board would be returned to headquarters by air and the tracings retained in the field.

III.—MAINLY TECHNICAL.

The control for the work was supplied by astronomically fixed points. These astro-radio points, as they are called, were sited from 20 to 30 miles apart, depending on the type of country and the difficulties of traversing it with motor transport. Near the River Euphrates, however, use was made of suitable points in the triangulation system of the Mesopotamian Expeditionary Force, and connection with previous work was thus obtained.

The star programme at each station was designed to give four pairs of determinations of latitude from north and south stars at meridian

1.—The camp of one section.

2.—The vehicles of one section—mending punctures.

3.—The camp of some of our neighbours.

A desert survey 1-3

Photo No. 3.

Photo No. 4.

Construction of RCC bridges in the field 3 & 4

passage and six pairs of determinations of local time from east and west stars on the prime vertical. If, as was usual, north stars were scarce, sixteen readings were taken of the Pole Star instead, and a result was computed from each group of four readings. The azimuth of some local landmark was also observed at each station for the orientation of the plane tables. The theodolite was a Tavistock, which, being internally lighted and requiring only one reading of the circle instead of two, was very quick to use. If suitable stars followed each other at conveniently short intervals, the programme would be finished before the 11 p.m. time signal, which with the previous signal at 7 p.m. completely controlled the chronometer rate. These times are of course local.

The most convenient stations transmitting rhythmic time signals were Paris, Moscow and Naüen. Each signal was transmitted on short wave and had the same general form ; but those from Paris and Naüen were the more reliable, and their notes were less affected by atmospheric disturbances. The method used for computing the chronometer time was a modification of method No. 3 on page 103 of *Field Astronomy*, but was rather quicker.

Booking was done by the wireless operator. All the operators who came with me were very keen to produce good results. As an example of their work, it is perhaps worth noting that 0·25 seconds would normally cover any discrepancies between different determinations of local time from the same star. The chronometer was only read to 0·2 seconds, so that these results were about as accurate as the system of measurement allowed.

I usually computed the results of all the observations on the following day. This was a trying task in hot weather, as it was then necessary to close both sides of the tent and to work in a heavy concentration of "Flit" in order to keep out the flies. The atmosphere inside was that of a hot house. Mesopotamia proper is traditionally renowned for flies, but even it cannot compare with the desert during certain seasons of the year. If I wished to move camp at once, I used to analyse the time observations and work out the latitude observations approximately on the same night that they were taken. The final answer would be converted to the rectangular co-ordinates of the projection used, which was conical orthomorphic. Both geographical and rectangular co-ordinates would then be signalled to the other section, and a cairn or mound built to mark the place and to assist the serjeant in locating it.

Cairns were the chief concern of one of the native drivers, a Kashmiri, who possessed a quaint sense of humour and illimitable energy. Some fantastic marks were created under his direction, one being an imposing monument about 18 feet high.

After a little experience of topographical work in the desert, we came to employ two types of traverse, which we called the Control

Traverse and the Detail Traverse. The first type was run between astro-radio points and kept as straight as possible, no particular attempt being made to pick up detail. Traverses of this kind formed the framework for all future work. The second type was run between points on different control traverses. This kind would naturally conform more to the ground features but would be kept as straight as reasonably possible, to ensure accuracy and aid the adjustment of any error in closing.

Distances were measured with a car speedometer, and bearings were obtained by drawing rays directly on a plane table oriented by trough compass at each traverse station. The optimum length for each leg was found to be about three miles ; but where there was much detail or if the country was difficult, one had to be content with a few hundred yards only.

At each traverse station a cairn was built and numbered. Rays were drawn to all important features, including the proposed forward station of the traverse, and any detail encountered in the previous leg was plotted.

Traversing was always done in two cars, so that the second car could be left behind at any traverse station to sight on to from the forward station. It was called up later by flashing a mirror. The importance of taking both forward and back bearings is very great in a desert country where freaks of mirage play such tricks with the surveyor. I remember occasions when we mistook a thistle for a wireless mast and a man's grave for a distant hill. Once, when making observations which included a distant house as an intersected point, it subsided and disappeared altogether between the first and second round of angles.

All the work on the plane table was plotted at a scale of 1/250,000, which is twice that of the published map. Though this probably made the work a little longer, I doubt whether the practical difficulties of drawing and the necessity for generalizing small features would have allowed us to use the smaller scale. The work was adjusted and inked in daily, any doubtful parts being left in pencil for checking up later.

Perhaps it is worth recording that the method of traversing that has been described above is probably the only instance of a car's speedometer being checked and corrected by astronomical means. In the open parts of the desert it was possible to do this with some accuracy.

Heights were determined throughout by aneroid barometer. The data available for basing the work in connection with heights were a series of spot heights of the M.E.F. system of triangulation along the River Euphrates and also a few bench marks of the Iraq Petroleum Company occurring at the pumping stations.

The method used for carrying forward heights across many miles

of desert was really only the application of the principle of working from the whole to the part. Heights were in fact carried only from base camp to base camp ; and the accepted level of each camp was the mean of between 10 and 20 good determinations obtained by separate visits to bench marks, spot heights, or points previously fixed. The values for the heights in any particular area were then based on the datum of the camp from which that area was surveyed. In this way, the possible individual error at any point could not be directly carried to another area, for the heights of points in neighbouring areas would be based on their own data.

There was nothing special in the procedure followed in making the observations in the field. As the survey party worked in two sections, often up to 50 miles apart, the camp of each section would provide the datum for its own area. With each section, three barometers only were used, one on traverse and the other two as the stationary battery in the camp. The observer in camp was usually the wireless operator, and he recorded the readings of the barometer and the thermometer every half-hour, producing at the end of the day a graph of the variations in pressure and shade temperature. This was a tiresome duty, especially when the soporific effect of high afternoon temperatures had to be overcome, but it was faithfully performed. At each traverse station the barometer was read and the temperature of the air taken. Many of the stations were visited several times, often from two or more camps, so that most of the finally accepted heights were the mean of several results, and it was further possible, by inspection and comparison, to detect discrepancies and reject work of doubtful accuracy. At the end of each day the difference in height between the camp and each station was computed.

For purposes of survey, the desert came to be divided up into triangles formed by the control traverses, and the base camps were usually sited at the centre of these triangles. Observations for height were therefore rarely made more than 15 miles distant from the stationary battery, and it was reasonably certain that atmospheric conditions at the camp and on traverse were almost identical. This was an additional safeguard of accuracy.

As the survey extended some 200 miles west of the Euphrates and southwards from the oil pipe-line another 150 miles, in fact from the border of Syria to the border of Saudi-Arabia, it seemed hardly possible that errors had not been introduced. I knew only that by the method of carrying forward heights from camp to camp the results in any particular area would be in sympathy with each other. In December, 1937, it was therefore decided to run a check traverse of aneroid heights back to the Euphrates from the Saudi-Arabian border. The nearest bench mark was at Karbala, and its distance from a suitably situated base camp near the border was about 140 miles. Two cars, each carrying a battery of three barometers and

travelling in leap frog fashion between stations sited about ten miles apart, covered this distance in two days. When we reached Karbala we found that the exact location of the bench mark was not apparently known to the inhabitants. But they were embarrassingly eager to help us in the search for it, and in a short time we found ourselves part of a procession. The discovery of the mark and the final reading of the barometer became a matter of no little ceremony, and it was attended by representatives of the municipal council, police, irrigation department and Iraq railways, each in his own particular uniform. Much to my astonishment the closing error was *nil*. This was admittedly a fluke, and it was looked upon with grave suspicion at first. But it was in fact a proof of the surprising accuracy of heights obtained by aneroid barometers systematically used.

Names were collected from the guides, who, in common with all illiterate people, had a remarkable memory for places and natural features. Occasionally matters were complicated by the fact that different tribes had different names for the same place. The main difficulty was, however, in hearing what the guides said, though by learning the meaning of the word used it was usually possible to arrive at the correct answer. Traces of names to fit the plane tables and lists in Arabic and English with meanings were kept in the field, but the final decisions in transliteration were made at headquarters, where a good interpreter was at hand.

I did not myself make use of air photography except for a survey in the Persian Gulf, where the scale of the map, amongst other factors, influenced me to abandon the methods of this reconnaissance survey. My predecessors did, however, find mosaics of air photographs useful in compiling maps of parts inaccessible to motor transport, either owing to flooding or to the very rocky nature of the country.

The survey equipment of the party was of the simplest. It consisted of one Tavistock theodolite, one Mercer chronometer, plane tables and spare boards, six aneroid barometers, trough compasses and a great number of thermometers.

The theodolite gave excellent service. The dusty conditions were not ideal, but very rarely did it require cleaning. In spite of the extraordinary amount of jolting which it suffered during travel across the desert, the instrument remained in adjustment remarkably well. The chronometer that I had for most of the time also survived the rough going. Its rate was negligibly small, gaining slightly in the winter and losing slightly in the summer. The barometers I never really trusted, as they were subject to strange moods of sluggishness or excitement. The results, however, seemed to be reliable, and I do not think that they suffered much from their desert journeys. The trough compasses behaved well, but the boxes were inclined to warp and their joints opened in the dry climate. The

compasses were therefore usually removed from their boxes before being placed on the plane table. The thermometers we never kept very long. Our thermometer-whirling exercises often ended disastrously by dashing the mercury out against the rocks. I do hope somebody invents another way of reading the air temperature.

In a survey of this kind methods should be simple and quick; and they should be elastic and capable of ready adaption to varying conditions. The equipment should consist of the absolute minimum required, as there is only a limited amount of space in the vehicles; and it should be very robust. As much work as possible should be completed in the field. There is not the time nor the staff to collect and tabulate elaborate records, from which later to compile a fair drawing in a well-equipped drawing office. Nor is there always a well-equipped drawing office at headquarters. Only what is absolutely necessary should be left to be done after the party returns from the field.

I can think of few more attractive appointments for a subaltern than that of officer in charge of such a unit as the Desert Survey Party. He will never find the work monotonous, nor will the life seem lonely. There will be enough responsibility for interest and as much independence as he will possibly ever have in all his career. His only regrets will be when the time comes for him to hand over at the end of his tour.

THE FRENCH EMIGRANT ENGINEERS.

By MAJOR M. E. S. LAWS, M.C., R.A.

EARLY in 1793, Republican France declared war on England, and within a few weeks British troops had landed in Holland to assist the Austrians, Prussians and Dutch against the common enemy. During the course of the campaign a number of foreign corps, raised and led by French emigrant noblemen, fought against the Republicans, and in view of the shortage of British recruits, it was suggested that certain of these regiments should be taken on to the British establishment.

On 9th May, 1794, an Act of Parliament was passed " to enable subjects of France to be enlisted as soldiers in Regiments to serve on the Continent of Europe and in certain other Places and to enable His Majesty to grant commissions to subjects of France to serve and to receive Pay as Officers in such Regiments or as Engineers under certain Restrictions." Under this authority many French refugee noblemen volunteered to raise regiments for the British Service, though at first these offers were confined to corps of cavalry and infantry.

On 21st of August, 1794, the Duke of Richmond (Master-General of the Ordnance) wrote to the Secretary of State concerning a proposal by a certain Captain Haddon for the establishment of a French corps of artillery and a company of sappers and miners (1).* Though agreeing in principle to the formation of a French emigrant artillery corps, the Duke stated that " the Plan for a Company of Sappers and Miners does not seem very necessary, but if Mr. Dundas wishes it, I will also take that into Consideration."

The artillery corps (2) was in fact formed on 1st November, 1794, but the plan for raising a sapper and miner unit seems to have been rejected in favour of an alternative scheme submitted in February, 1795, by Monsieur de Moriencourt for organizing a French engineer corps, composed only of refugee noblemen all commissioned as officers (3). It is uncertain exactly when this corps was officially formed, but the draft warrant of establishment was submitted by the Board of Ordnance to the Secretary of State for His Majesty's signature on 6th April, 1795 (3). The first pay list of the corps was dated 12th June, 1795 (4).

On its formation, the French Emigrant Engineers consisted of the following officers :—

* References are listed on page 565.

Lt.-Colonel Commandant ..	L'Engle de Moriencourt.
Major	A. J. L. du Portal.
Captain	C. J. D. Ivory.
Captain	A. de Folment.
Captain	J. B. de Beaumont.
Captain	A. M. de Fouigeray.
Captain	L. F. de Proger.
Captain-Lieutenant	A. P. H. J. de Kervegan.
Captain-Lieutenant	E. F. L. de Lenequesaigue.
Captain-Lieutenant	J. M. de Missy.
Captain-Lieutenant	A. R. Masson de Foulaine.
Captain-Lieutenant	A. Poisson de Londes.
Captain-Lieutenant	S. L. L'Espagnol.
Lieutenant	J. B. F. de Villaizy.
Lieutenant	J. L. Monton de Nchou.
Lieutenant	C. L. Ivory de St. Morel.
Lieutenant	M. J. B. A. de Moncrieffe.
Lieutenant	C. C. de la Houssaye.
Lieutenant	J. S. Cazotte.

There is nothing to show on what plan ranks were assigned to these officers, but it is probable that they were commissioned in the same rank which they had previously held in the French Royal Service. In some cases also, noblemen who had escaped from France penniless were deliberately given comparatively high rank in emigrant corps in order to allow them to draw sufficient pay and allowances to meet their necessary living expenses in England.

According to the corps pay lists (4), a Lieutenant-Colonel of French Emigrant Engineers drew as monthly pay for a 31-day month £31, a Major £23 5s. 0d., a Captain £15 10s. 0d., a Captain-Lieutenant £9 6s. 0d. and a Lieutenant £7 4s. 8d. In addition Captains were entitled to £15 a month as subsistence allowance, Captain-Lieutenants £9 and Lieutenants £7.

Besides the officers mentioned above, two Frenchmen—Colonel D'Arnaudin and Chevalier d'Auvray were specially commissioned as temporary Major and temporary Captain respectively for employment as Engineer officers at the Cape of Good Hope (5). They do not appear to have belonged to the French Emigrant Engineers, but were entitled to pay and to bat and forage allowance on the same scale as British officers of equivalent rank. They were required to provide themselves with "instruments for drawing plans as is usual in respect of all officers in similar situations" and were ordered to wear the same uniform as they wore on the Continent, viz. "red with yellow facings and plain gilt buttons." They embarked at Portsmouth for the Cape at the end of 1793, but appear to have been back in London by August, 1796 (6).

No sooner had the French Emigrant Engineers been formed than

the corps was ordered to accompany the expedition to Quiberon Bay in 1795. The corps embarked at Cowes, I.O.W. on board the transport *Middleton* early in June as part of Count d'Hervilly's 1st division of the French Emigrant Army, which sailed on 17th June, 1795, and twelve days later landed at Quiberon on the French coast. Fort Penthièvre, which guarded the neck of the peninsula of Quiberon, was captured on 3rd July after a feeble resistance by its Republican garrison of 700 men, but the Royalists failed to follow up their initial success by a vigorous offensive. When, thirteen days later d'Hervilly attacked, his army was repulsed with heavy loss and retired on to the peninsula in considerable disorder. Here the Royalists were joined by the 2nd division of 1,500 men under de Sombreuil from Jersey, but as most of these troops were recently enlisted French prisoners of war their loyalty was open to grave suspicion.

On the night of 19th July, the Republicans attacked Fort Penthièvre (7). Many men of the garrison refused to fight, opened the gates and welcomed the attackers, who thus had no difficulty in gaining possession of the works. The unfortunate Royalists were driven back to the end of the narrow peninsula of Quiberon and though nearly 2,000 were rescued by the boats of the British naval squadron, 6,000 men surrendered to the Republicans on 21st July. Of these prisoners, 600 were later shot in cold blood by order of the Convention.

The French Emigrant Engineers took part in the fighting at Quiberon, the following officers being killed or captured.

Colonel	L'Engle de Moriencourt.
Major	A. J. L. du Portal.
Captain	A. de Folment.
Captain	J. B. de Beaumont.
Lieutenant	J. B. F. de Villaizy.
Lieutenant	J. L. Monton de Nehou.

The actual fate of these officers was never definitely established, but after being shown for a year on the muster rolls as "missing," they were eventually struck off as "presumed dead" in July, 1796.

Of the officers of the French Emigrant Engineers who escaped from the disaster at Quiberon, Lieutenant St. Morel appears to have proceeded direct to the Isle d'Yeu, where he was later joined by Captain Ivory, Captain de Proger, Captain de Kervegan, Captain-Lieut. de Missy, Captain-Lieut. de Foulaine and Captain-Lieut. de Londes. Captain de Fouigeray appears never to have left England with the expedition to Quiberon but to have been dispatched direct to India for duty as an engineer officer. He died at the Cape en route on 18th October, 1795, and was struck off the muster roll of the corps in April, 1796. The remaining officers rejoined later in England.

The island of d'Yeu was occupied on 29th September, 1795, by a British force under Major-General Doyle and the survivors of the French Emigrant Engineers rejoined there after their escape from Quiberon. Though there can have been little enough engineering work for seven sapper officers on this tiny island, six miles long by four miles broad, the period spent there was one of extreme hardship owing to the shortage of food and the severity of the weather. But by mid-December, 1795, the last of the British and Emigrant troops had been re-embarked, and the French Emigrant Engineers were moved to England—probably to Lymington, Christchurch or the Isle of Wight, where most of the Emigrant corps were stationed.

Lieutenant Chevalier de la Houssaye was posted away in May, 1796, to the Regiment of Royal Ètranger and later passed into the artillery company formed from that corps in the West Indies in 1798. Thus the corps of French Emigrant Engineers had been reduced from a strength of one Lieut.-Colonel, one Major, five Captains, six Captain-Lieutenants and six Lieutenants in June, 1795, to two Captains, six Captain-Lieutenants and three Lieutenants in July, 1796. It was not until November, 1796, when the corps had again been warned for service overseas, that these vacancies were made good and the following appointments were made. Captain Robien to be Captain vice de Fouigeray w.e.f. 19/10/96. Captain C. J. D. Ivory to be Lieut.-Colonel, vice de Moriencourt, w.e.f. 1/12/96. Captain L. F. de Proger to be Major, vice du Portal w.e.f. 1/2/1796. Captain-Lieutenants A. P. H. J. de Kervegan, E. F. L. de Lenequesaigue, J. M. de Missy and A. R. de Foulaine to be Captains, vice Ivory, de Folment, de Beaumont and de Proger, w.e.f. 1/12/1796. Lieutenants C. L. Ivory de St. Morel, M. J. B. A. de Moncrieffe and J. S. Cazotte to be Captain-Lieutenants.

In the autumn of 1796, Spain declared war against England and threatened to invade Portugal unless that country closed her ports to British ships. It was therefore decided to dispatch an " auxiliary army " to Lisbon under General Charles Stuart in order to assist the Portuguese. Most of this force was composed of foreign regiments in the British service and the majority of these units came from Corsica via Elba and Gibraltar. The French Emigrant Engineers, together with the French Emigrant Artillery, were dispatched to Lisbon from England late in 1796, except Major de Proger and Captain de Missy who were sent to the West Indies on special duty. The pay list for January, 1797, was made out at Lisbon, where the corps remained for nearly four years.

The foreign regiments of the " auxiliary army " in Portugal were very badly reported upon by General Stuart, who proceeded to tighten up discipline and carry out a vigorous training programme. On 3rd April, 1797, Stuart wrote to Mr. Henry Dundas, Secretary of State, complaining that the French Engineer officers were ignorant of their

professional duties (8). He stated that though the " Chief Engineer " and four of the Captains had previously served in the Royal Corps du Génie they were unfit to hold their commissions, while three other Captain-Lieutenants had no knowledge of military engineering at all. At this time there were only ten officers of the corps in Portugal (one of whom was on leave), but it is probable that the General's complaint included also certain French Emigrant Engineer officers, who with some 93 artificers, had accompanied the troops from Corsica to Portugal, though they did not belong to the corps.

On 27th April, 1794, the Secretary of State forwarded this complaint to the Board of Ordance, on whose establishment the French Emigrant Engineers were borne. Mr. Dundas declared that " measures should be instantly taken for relieving the Country from the Charges incurred on this account by discontinuing the Names of such Officers on the Establishment of Foreign Engineers in the Pay of Great Britain."

The Board of Ordnance replied on 3rd May, 1797, to this letter by pointing out with evident satisfaction that the names of French gentlemen recommended for commissions in the Emigrant Engineers had been submitted to the M.G.O. by Mr. Dundas himself. As, however, neither General Stuart nor the Secretary of State had mentioned any officers by name, the Board was unable to take the action demanded. The Board then questioned " whether in humanity some Consideration should not be allowed to Gentlemen so situated, either of a pecuniary Nature (as has in cases where any of the Corps of French Emigrant Artillery has been reduced) or by granting them commissions in some other corps of Foreigners in British Pay."

Presumably as a result of this correspondence, Captain-Lieutenant J. S. Cazotte resigned on 31st July, 1797, but on 1st September, of the same year, was gazetted as Second-Lieutenant in Captain Pagandet's Independent Company of French and Maltese Gunners at Lisbon (9). Captain S. L. L'Espagnol, Captain C. L. Ivory de St. Morel and Captain-Lieutenant M. J. B. A. de Moncrieffe left Portugal for England in August, 1797 and were struck off the establishment by order of the Board of Ordnance, but in these three cases the officers were given six months' pay as gratuity. Only one of these vacancies was filled and that not until 1st February, 1798, when Captain F. P. G. de Preval was appointed to the Corps.

Meanwhile the British force remained inactive in Portugal, though its presence undoubtedly helped to restrain the Spaniards from invading the country and to persuade the Portuguese to settle their internal differences and prepare to defend themselves. General Stuart handed over command to General Frazer in June, 1798, and in September sailed for Minorca with a small body of troops from Gibraltar. He took with him Captain de Preval, of the French Emigrant Engineers, who seems never to have rejoined the Corps.

Early in 1801, the Spaniards showed signs of at last yielding to French pressure and in May the auxiliary army moved up to support the Portuguese forces in the Alemtejo. This province was invaded by the Spaniards, but peace was soon arranged on the Portuguese ceding Olivenza and promising to close their ports against British shipping. The auxiliary army was not engaged during these operations but their presence persuaded the Portuguese to delay taking action in accordance with the terms of peace. The French Emigrant Engineers moved out to Cintra during these operations, but in June, 1802, orders were received from London for the withdrawal of General Frazer's army to England (10).

The corps was therefore embarked at Lisbon and arrived in England, where it was at once disbanded together with the majority of the foreign regiments on the British establishment. By orders of the Board of Ordnance dated 23rd July and 6th August, 1802, the officers were required to surrender their commissions and to declare in writing that they had no further claims on the British Government to pay, rank or precedence.

In consideration of their services, the Board of Ordnance authorized the issue of gratuities of £730 to Lieut.-Colonel Ivory and £365 each to Captains de Kervegan, de Lenequesaigue, de Missy, de Foulaine and de Londes. These sums were distributed at the end of July, 1802, and represented two years' pay. The official date of disbandment of the French Emigrant Engineers may be accepted as 31st July, 1802.

NOTES.

Note No.

1. Public Record Office W.O. 1/779.
2. ,, ,, ,, H.O. 50/372.
3. ,, ,, ,, W.O. 1/780.
4. ,, ,, ,, W.O. 54/702.
5. ,, ,, ,, W.O. 1/618. Page 395.
6. ,, ,, ,, W.O. 1/618. Page 463.
7. ,, ,, ,, W.O. 1/176.
8. ,, ,, ,, W.O. 1/217.
9. ,, ,, ,, W.O. 10/323.

This Independent Company was raised in Corsica as the French Marine Refugee Artillery in 1794, and was later absorbed into the French Emigrant Artillery in Portugal. It was disbanded in 1802 at East Cowes, I.O.W.

10. Public Record Office W.O. 1/222.

WORKS SERVICES AND ENGINEER TRAINING.

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

THE article on Engineer Training in the June number of *The R.E. Journal* will give rise to much discussion and thought. There are many contentious arguments and it is hoped that others will take up the challenges so attractively offered.

Employment on works services appears to have been somewhat summarily dismissed without due consideration of its demerits and merits; as so many R.E. officers are employed on works, a more detailed examination of this side of engineer work is worth making.

It is dangerous to attempt to paraphrase an argument but it is fair to say that the writer suggests that works in general are useless as a training for war and that only certain appointments which can be shown to have a real value should be retained. The weak point in the argument is that no attempt is made to analyse what the "real value" is and it is this particular aspect of the case that is discussed in this article.

Some little while ago, the writer was asked by a young R.E. officer for some advice on the subject of his future career. The young officer was considering whether he should specialize, go to the staff college or continue as a regimental officer. In the course of his letter he made a very curious remark, which was as follows: "Works do not appeal to me very much; as soon as any really interesting job comes along, the M.E.S. always put it out to contract." There was no opportunity of discussing this statement as the officer was not in the same station but it would have been very interesting to have done so and the following is an attempt to construct this imaginary discussion.

Q.—I take it from your remark that you think that the contractor's work is far more interesting than that of the M.E.S. officer.

A.—Of course, he is responsible for really doing the work and we merely look on.

Q.—Do you mean the interesting part is really the design and that, if the M.E.S. did the design, you would be happy? Remember that, except for bridges, contractors very seldom do M.E.S. designs.

A.—No; design is interesting but I realize that it is a very specialized job and not one that a sapper could stay in for ever. I mean the execution of the job itself.

Q.—Supposing that you could be lent to the contractor for a job

of work, you would find that much more interesting than the normal M.E.S. work?

A.—Yes, then I should really have something to do.

Q.—Have you ever thought how the contractor would employ you? Obviously, in the beginning you could not expect to be in complete charge of the whole of a big job but I take it you would be satisfied with being put in charge of some section of the job suited to your capacity.

A.—Yes, as long as I had a show of my own to run.

Q.—In running your section, how do you want to be employed? I take it that you do not want to be employed as a manual labourer, however skilled you may be as a tradesman; nor do I suppose you wish to be a mate or foreman of a gang of skilled men, a tradesman in fact with added experience.

A.—Obviously not; I want a job to run on my own with all the necessary labour and machinery all under my own orders.

Q.—You have said several times that what you want is a job to run. In other words you want to organize a show and run it.

That is the end of the imaginary discussion and it ends up on the magic word "organization." Anyone who has ideas beyond mere manual skill must be able to organize.

Actually, a young officer in charge of a big contract has far more powers and responsibility than he would have if he were employed by the contractor; he is in charge of the whole job and is responsible for seeing that it is properly carried out. He may not do design, but hundreds of points in design will be continually cropping up and he has to settle them if he is competent to do so; plans have a way, unfortunately, of containing errors however much care is taken in their preparation and the delay caused by a reference to the office which prepared them may be serious.

Supervision of work is not a lazy job which can be conveniently carried out from one's bed after lunch or even from an office. It means constant watchfulness on the job and a very considerable knowledge of design and technical detail; a young officer who has learnt to compete successfully with the wiles of "sharp and businesslike" contractors has gone a very long way in learning to run a job.

The writer of the article also remarked that rules and regulations stifle initiative. It should not be imagined that a contractor has no rules and regulations. He has a good many, including even audit—a fact which seems to surprise many people. The penalties for breaking rules differ. The young officer may collect a bad report and a "raspberry"; the young civilian engineer gets the sack and has to look for another job.

Rules and regulations do undoubtedly stifle initiative. The wing three-quarter making a bee-line for the corner flag has his initiative stifled by the fact that he must not cross the side line, but no one will

claim that the game of Rugby should be played without rules. All of us can, of course, quote regulations which are obviously futile, though we perhaps should modify our criticism if we knew more about the actual reasons for producing the rule. Most rules have a reason behind them, however much that may have been obscured by exasperating interpretations of it. No one would claim that rules and regulations are perfect; in fact, judging by the numbers of amendments that are produced, it is safe to say that their defects are fully realized but that is no argument for their abolition.

The conduct of war has many rules and regulations also; they are contained in *F.S.R.* and the many other manuals; they do not contain much about finance but the penalties for breaking them are more serious, since lives not money are involved.

Can everyone be quite certain that their initiative is the right one? Rules and regulations are necessary to stifle the ill-balanced initiative of many cranks who exist; such people would spend all their time and money—and other people's also—in pursuing their own particular hobby to the great detriment of others who do not see eye to eye with them. This is a state of mind that is in no way confined to young officers.

Surely the answer is to recognize that rules and regulations are essential for any ordered scheme of things, whether it is playing a game or running a war, and to learn to run the show within the framework.

So far, it appears that the R.E. officer in charge of a big job or work is being usefully trained for war, as the writer of the article agrees, but investigation showed that the value obtained on a job was largely training in organization, and also that regulations are necessary, even though they appear to make the task more difficult.

Now let us digress for a moment and consider the task of the officer in war, not merely the sapper, but the officer generally. His task may be correctly and conveniently considered under the four main heads into which the War Office is divided.

General Staff Branch.
Quarter-Master-General Branch.
Adjutant-General Branch.
Master-General of the Ordnance.

The military operations side is clearly a class apart. Although their plans must depend on practical possibilities, the conception of the plan needs a touch of genius as well as mere knowledge. The staff duties side is pure organization from start to finish. The other three branches are nothing but organization, in many cases approximating very closely to commercial work.

Looking at the matter from the point of view of the Commander in the field, once he has made his plan, the greater part of the energies of

his staff are devoted to organization, the G branch to ensure that the troops get to the right spot at the right time, the Q branch to ensure that they are fed and supplied, the A branch to ensure that they are kept up to strength and the sick removed, the M.G.O. branch to ensure that they are fully equipped.

It must be conceded that, apart from the initiation of the plan, a very large proportion of the time of officers in war is spent in organizing, *i.e.*, running a job. If this is admitted, then any training in running a job must be good training for war.

The writer of the article gave several reasons why ordinary works services are the antithesis of military engineering, and these are discussed below.

" The nature of the work is totally different from that of military engineering in the field." Remembering that the job of the officer is to run the show, is there such a vast difference ? Anyone who has learnt to organize one job, starts with a flying start in organizing another, however different the jobs may appear to be on the surface. The organization of a job is a very difficult thing to teach and experience is undoubtedly the best tutor ; fundamentally, all jobs are the same from the point of view of the person who is starting them. What is the job ? What labour and material is available or procurable ? How can they be most efficiently employed ?

" In works services economy is normally the all important factor " (and although the writer does not actually say so, he tacitly implies that, in war, finance is unimportant, as it possibly is) and " speed is seldom a vital consideration."

In organizing a job, there are four main factors to be considered.

Time and money.
Labour and materials.

These four items are inextricably interconnected. Not one item can be changed without affecting the others. The old adage that time is money shows the connection and, in commercial work, an organization that takes no account of time is heading for a crash. It is not claimed that in peace-work, time has the preponderating importance that it frequently does in war, but it is a factor that is always present in the mind of the man running the job ; if he suddenly finds himself on a job in which time is overwhelmingly important—and that is not limited to war work by any means—he must modify his organization accordingly.

The necessity for economy in labour and materials is obviously of vital importance both in peace and war. There is therefore no real difference between organizing a job in peace or war. It is merely a matter of arranging the four main factors in order of importance and making the organization fit the job accordingly.

" Improvisation never arises." This is, of course, an old and very

real difficulty. The power of improvisation comes generally from experience based on knowledge plus an agile and resourceful brain, which is born not made. Admittedly, in purely routine works jobs the chances are few but not entirely lacking, while on big jobs they are problems with which the man running the show is faced daily or even hourly ; there is never exactly what is needed and the problem is always how to " make do " either with time, money, labour or materials.

" Opportunities for independent thought are few and initiative is stifled by regulations."

The necessity for regulations has already been considered but why are opportunities for independent thought few? Surely they are unlimited even if few ever see the light of day. And the reason for their strangulation at birth must be that they are inefficient. One hears of the genius who is suppressed by his jealous superiors but the cases in which a young officer has been forbidden to make some improvement in the job under his charge must be very limited. He may not have been able to persuade his superiors that it is an improvement, or perhaps the idea breaks one of the rules of the game, but that is a different matter.

Summarizing then, an attempt has been made to show that

i. A very large part of every officer's job is organization.
ii. Rules and regulations are necessary though they may appear to make things more difficult.
iii. Any employment in peace which gives an opportunity for practising organization is valuable training.
iv. The employment of R.E. officers on large contracts under present methods is one of the best opportunities for the practice of organization.

With these conclusions few will disagree but the next step will probably create violent opposition. Is there any real reason why good training in organization should not be obtained from a small job nearly as well as from a big job? It will be admitted that every job, however small, requires organization and if that is admitted, then some degree of training must be gained in devising the organization.

To take the dullest of works jobs, say an assistant garrison engineer who is in charge of an area which is running more or less efficiently and where the work to be executed is purely maintenance and routine. It is a counsel of despair to sit down and say that there is no possibility of improvement. It is not pretended that the work is so interesting as the execution of a large work, but there is, without question, a scope for improving the organization if the individual cares to get down to it. Whitewashing barracks, petty repairs offer a very big field for improvements in organization and it is probable

that a considerable amount of time and money is wasted on the inefficient performance of these necessary evils merely because the individual thinks they are dull and uninteresting. They may be dull in themselves but the creation of an efficient organization is not.

The officer has under his control all the items which constitute the main factors requiring consideration, viz., time, money, labour and materials even though they are in small quantities and there is the problem ready for him if he is prepared to tackle it ; it is excellent training for anyone and certainly is not easy. If anyone after a year at this apparently dull job finds he has kept things going properly and saved ten per cent. of the cost, he may well congratulate himself and he will also find that he can tackle any job, either in peace or war, with more confidence than he had before.

In conclusion, the writer would like to state that in all his regimental service, he spent about nine months as garrison engineer and about eighteen months as a C.R.E. He cannot therefore be accused of being a works maniac.

IDEAL FIELD COMPANY TRAINING

OR

THE RECONSTRUCTION OF EASTRIGGS DEPOT.

By MAJOR B. C. DAVEY, R.E.

IN June of this year the 55th Field Company was ordered to carry out the reconstruction of Eastriggs Depot. As the order was presented as an offer, the job was assumed to be unpleasant, but we hoped for the best. It was to take at least three months to complete and the company would be accommodated under canvas.

The first reconnaissance confirmed our fears. The area situated in flat, uninteresting country, on the north side of Solway Firth, was desolate and studded with ruined brick huts that from a distance looked like gravestones. Although used as a farm, some of it was overgrown with brambles and shrubs, and there were many rabbits. The solitary farmer assured us that no civilian labour was obtainable. The dimensions of the task seemed appalling. The depot area measured 1 mile by half a mile, there were obviously several thousand cubic yards of digging and filling to be done, the working strength of the company was no more than fifty and several N.C.O's and men were already being warned for abroad. The reconstruction entailed the following jobs :—

1. Connecting the depot area to the main railway with some six miles of light railway, including a large number of turn-outs and curves. The old formation existed in places, but required de-grassing, re-grading and repair, and there were about fifty new curves to be built up.

2. The repair of 34 old mounds, the sheds of which had been burned out, leaving a good deal of wreckage.

3. Filling up wells in some of the floors in the mounds (requiring some 1,500 tons of rubble) and breaking up the floors in others.

4. Covering the floors with 5 inches of concrete (about 1,200 cubic yards).

5. Erecting a shed in each mound (some 350 tons of shed materials).

6. Revetting the entrance to each mound.

7. Constructing three wagon sheds, an oil store and a workshop.

8. Opening up and repairing the entrance road (about ¾-mile long).

The remaining jobs such as fencing, the provision of a Warrant Officer's Quarter and accommodation for depot police, were reserved for execution by contract.

It was obviously going to be no easy matter to get the job done before the winter and we had to get a move on. The company was not available until the early part of July, but two officers were sent up on June 23rd, to begin work with whatever labour could be obtained.

The local officer of the Ministry of Labour proved most helpful and, to our relief, labourers began to tumble over one another to get employment. Work was therefore started immediately.

The only real difficulty was in dealing with Insurance Cards, and in adhering to the multitude of regulations of which we were ignorant. No guide to the employment of direct labour could be found, but D.C.R.E., Scotton, at Catterick, very kindly lent us a clerk for a couple of days and, in the meantime, he instructed one of our officers in the administration of direct labour. It was therefore possible to get the administrative side going before the first pay day.

It should be explained that, although the company belongs to the Northern Command, the job was administered by Western Command, Eastriggs being situated in the Scottish Command. This promised all sorts of complications which, however, failed to materialize. C.R.E., Lancashire Area, very kindly gave us plenty of financial latitude and it was not until our plans were too mature to be altered that we were reminded of the estimated cost—£55,000. We were, therefore, working at first to a time factor only and under conditions closely resembling those of war.

In making preparations we learnt the following useful lessons :—

1. It is quite possible, if one deals with the regular camp contractors and does it all by telephone, to get four tenders for constructing camp structures, accept the cheapest and order construction in a couple of hours. The contractor started to build the camp the following day.

2. That experts are kind and helpful people and always ready to assist the inexperienced. The Railway Training Centre, Longmoor, came to our aid with officers, a surveyor, and, later, several platelayers. These came to help us over the more difficult obstacles and ended by leaving us no obstacles at all.

Secondly, machines were obviously required; but we were a bit vague as to what to order. The C.R.E. had, however, authorized us to deal direct with a contractor and the latter, having warned us that we were up against a "racket," gave us advice as to what we wanted, which proved remarkably honest and fair.

3. That it is worth while visiting the contractors responsible for the supply of materials. It means a free trip to London, an excellent

lunch at the contractor's expense, and an interesting tour of inspection. Moreover, it sometimes ensures speedy delivery.

4. One is apt to forget that stores have usually to be inspected by Woolwich before they leave the contractor's hands, and that it saves several days if Woolwich is warned beforehand of the urgency of the job.

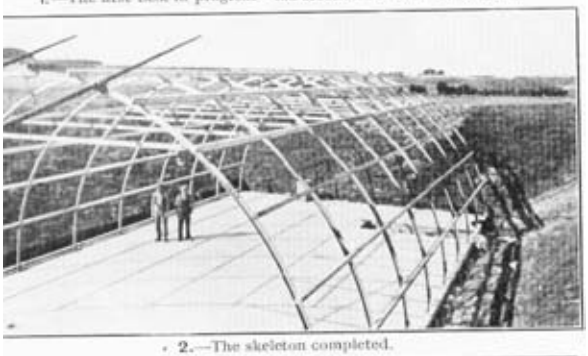
The field company reached Eastriggs in the wet afternoon of Friday, July 8th, and started work on the following Monday. By that time there were 150 civilians on the job and the number rose steadily to over 400. They were working in gangs of about 20 under their own gangers and we wondered at first how best to fit in the N.C.O. and Sapper labour. It was soon found that both N.C.O's and Sappers work well with any labour, and in a short time all were on excellent terms. Working hours were from 7.30 a.m. to 5.0 p.m. with half an hour for lunch, and the 50-hour week seemed to depress no one. Perhaps it was the joy of building something that would not have to be dismantled that made such a strong appeal. At any rate, the 9-hour day made no difference to the amount of energy left for tennis, football, dances and other sports beloved of the troops.

In allotting jobs to the N.C.O's and sappers the aim was, naturally, to give responsibility and experience to as many as possible. The only tradesmen used regularly as such were the bricklayers, who had been short of practice, the carpenters, and the electricians who were needed to get the camp comfortable. The remainder, both N.C.O's and men, were either in charge of a portion of the work or of one of the machines. There was, however, a good deal of incidental trade training.

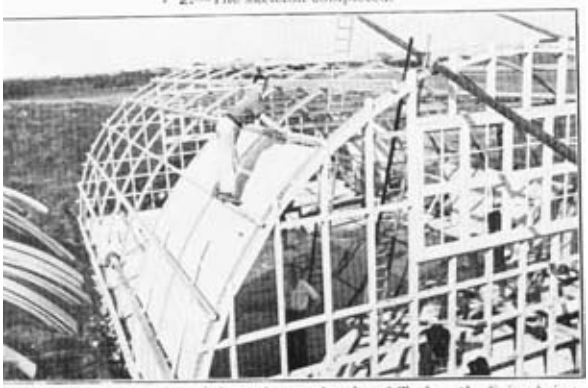
In the depot area the work to be done on each mound divided itself naturally into a sequence of operations: the repair and trimming of the mounds, the filling in and levelling of the floors, delivery of cement, sand and aggregate, placing of shuttering, laying of concrete, erection of the steelwork skeleton of the sheds, completion of sheds, painting, repair of entrances, laying of the railway track and so forth. Each of these operations was put under an N.C.O. or Sapper, who had to work to a timed programme and was entirely responsible for his own labour, tools and stores. The organization hung fire a bit at first but the men gradually got the hang of it, and it became a point of honour to overtake the job in front. We soon found ourselves moving on from mound to mound in steady sequence.

The machines in use were a ¼-yard dragline excavator, a ¼-yard digger, 2 mechanical rammers, 3 compressors, 6 concrete-mixers, 3 dumpers, 2 brick-crushers, the derrick lorry and the machinery lorry—quite a formidable array. We were possibly a bit extravagant in ordering so much mechanical plant, but we wanted to get as

1.—The first task in progress—the erection of the steel skeleton.



2.—The skeleton completed.



3.—Task 2, the erection of the ends completed and Task 3, the lining being placed in position.

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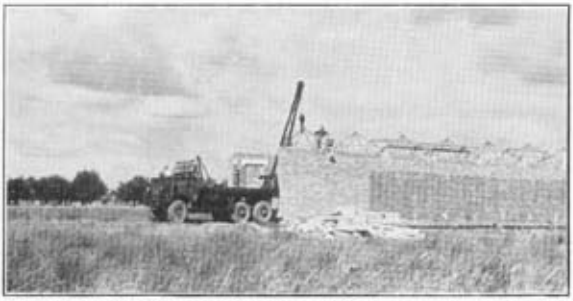
4.—Task 4. Fixing the curved corrugated sheeting.



5.—One of the many uses of the derrick lorry—the erection of roof joists.

6.—A blacksmith lance-corporal and his gang of village smithies.

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much training out of the job as possible and it was an unusual chance to give the men experience of the sort of machines they will, one imagines, be asked to use in war.

Soon after the plant arrived we realized what the contractor meant by calling his job a "racket." All the machines were old and worn, gave a lot of bother and caused endless waste of time. We had, of course, specified for the contractor's operators to remain only long enough to instruct Sapper personnel in the use of the machines and it was perhaps natural for him not to hand over new plant to amateurs. By making a fuss, however, things gradually got right. In the meantime, the N.C.O's and drivers, the fitters and engine hands, I.C. had had very good experience in patching up old machines. As the weather grew gradually worse, the depot area was found to be floating in a sea of wet peat, and the company six-wheelers, in continual use throughout the job, had first-class training in both driving and maintenance. The contractor's machines themselves do not call for any special comment except, perhaps, the dumpers. A dumper is a sort of glorified mechanical wheelbarrow holding about 1½ cubic yards. It has front wheel drive and rear wheel steering, gets across very rough country, and is invaluable in any cut-and-fill operations.

The derrick lorry was a great asset. It salvaged bogged lorries, unloaded plant on arrival, pulled down old brick huts for the stone crushers, lowered heavy concrete culverts into position and erected roof trusses. The acetylene plant cut the rails. The compressors were at work throughout, breaking up old floors.

The handling of the "B" stores provided valuable experience. Aggregate was obtained from brick, crushed on the site; sand and cement were delivered by road; railway track and sheds by rail. As the quantities in each case amounted to several hundred tons, it was important to organize collection and distribution carefully if labour and transport were not to be wasted.

We nearly came to grief over the plans for the erection of the Nissen sheds. Under the impression that they were more or less the old war-time Nissen hut, sketchy arrangements were made for their assembly; but, fortunately, Captain Folkes, an old member of the Corps, and now Managing Director of Nissen Buildings, Ltd., arrived beforehand and put us wise as to what to expect. This was fortunate, as each shed proved to be about the size of a moderate ball-room.

In the ordinary way, where only a few are concerned, the Nissen shed is erected and completed by one party in 5½ days. In this case, in which 34 sheds were involved, it was decided to adopt the principle of "division of labour," and allot each phase of the erection process to one party throughout. Thus, there was one party for the steel skeleton, one for the roof lining and sheeting, one for the

gable ends and so on. The plan worked well and it was soon found possible to complete one phase per shed per day, resulting in an exact schedule of progress.

From handling such a relatively large number of Nissen sheds, very favourable impressions were gained of their design and ease of construction. As, therefore, they may be used in large numbers in depot areas and concentration camps in a future war, when erection on a mass production system would be economical, some details of suitable working parties and stores are given as Appendix A to this article.

As a result of the schedule of progress, we were working automatically to daily tasks and the introduction of task work was seriously considered. Unfortunately, all the regulations seemed to prohibit the idea and, moreover, the civilian labourers were obviously suspicious. As time went on, however, the departure of two serjeants abroad, a couple of unfortunate accidents to N.C.O's, and the gradual increase in labourers, reduced the available supervision to inadequate proportions, and the labourers began to slow down in their work. To remedy this, a novel and only slightly irregular type of task work was introduced. It appealed to the labourers and the results proved most satisfactory.

Thanks to the great help received from the Railway Training Centre, the light railway went into place without any difficulty, once the re-grading had been carried out and the new curves built up. The Lance-Corporal and four platelayers from Longmoor soon trained sufficient of the company Sappers and civilian labourers to lay the track at the scheduled rate. Without this expert help we should have undoubtedly have been in serious difficulty. It is for consideration, therefore, whether elementary training in light railway construction should not be included in the annual fieldworks training of a field company. Several Sappers learnt to drive and maintain the Diesel locomotives and our one and only shunter had at last an opportunity to show his form. As it is understood that only a small number of R.E. officers have experience of laying light railways for permanent use, some notes on the subject are given in Appendix B.

The value of the progress charts in the control of work spread over a wide area was particularly well illustrated. Without them it would have been impossible to obtain any sort of picture of the development of each job.

It was also found very helpful to provide each party leader with a time table of the progress required. It gave him a definite target to aim at and was an incentive to his party. In this case a programme was essential, in order that the work could be arranged to enable the company to get away before the winter weather set in.

It remains to be explained why the job was given to a field company to carry out; and why it gave such ideal training. It

was given to the company because of the difficulty of putting it out to tender. The sum of money allotted was £55,000 and, although the final figures are not yet available, the cost was well within the estimate and the job was completed in exactly the estimated time of three months.

As to why it was ideal training, the reasons were firstly, that the conditions of mud, rain and going were identical with those most of us associate with war; secondly, it was mainly a problem in the organization of work in which all officers, N.C.O's and men had to play their part and carry their own responsibilities; thirdly, it gave experience to a very large proportion of the personnel of the company in the control of unskilled labour in carrying out semi-skilled work; and fourthly, it was a grand antidote to the relative idleness of ordinary training. Every officer and man had an interesting job. There was no sickness, no grousing and no trouble.

The N.C.O's and men obviously enjoyed having a job to do and their gain in self-confidence and general improvement as the time went on were very marked. They began to think for themselves and to look ahead.

The only real anxiety, beyond occasional delay in the arrival of stores, was in the maintenance of the hired plant and the company vehicles. The personnel of the M.T. section were too few and their facilities inadequate. Both vehicles and plant were admittedly in continuous use for nearly three months; but such are the conditions of war. Had there been a Field Park Company with L.A.D. attached all might have been well, but there is evidently need for fully qualified mechanists in a field company. At present, the lowest rank of mechanist is Staff-Serjeant and there appears to be a strong case for providing such specialists of more junior rank, so that they could fit into the organization of the M.T. section.

In conclusion, it remains only to be said that the whole company hopes to get a similar job to do next year and the O.C. strongly recommends this form of training to the other field companies at home.

NOTE.—This article was written before the company left Eastriggs. There was some trouble after all for, a "depression of unusual intensity" arrived over the Solway Firth just after the last shed had been erected, and blew away six store tents, including the Company Office, the C.Q.M.S. Store, the N.A.A.F.I., the Serjeants' Mess and the Men's Mess.

APPENDIX A.

NISSEN SHED CONSTRUCTION.

The following table gives a suggested organization for the erection of Nissen sheds in large numbers (say for 10 or more). Where necessary, the N.C.O's can quite well be replaced by senior Sappers.

Job No.	*Working Party.*	*Tools and Stores required.*	*Remarks.*
1 Erect Steel Skeleton.	1 N.C.O. & 10 men	Spanners, podger, $\frac{5}{8}$ in....6 ,, ,, $\frac{1}{2}$ in....6 ,, ,, $\frac{3}{8}$ in....6 Hammers, claw .....3 Ladders, 25 ft. .....1 Planks, scaffdg., 14 ft. ...6 Spars, 6 in. butt, 25 ft. ...4 Pickets, park, 5 ft. .....4 Ladders, 20 ft. .....2 Lashings, 1½ in. .....8 Blocks, 2 in., double .....1 ,, 2 in., snatch .....1 Falls, 2 in. .....1 Falls, 2½ in. .....1 Mauls .....2 Spunyarn or twine.	Lay out roof sectors. Erect bottom sectors. Hoist roof sectors into position with sheer legs and fix with purlins.
2 Paint Skeleton.	1 N.C.O. & 10 men.	Pots, paint, 1 gallon ...10 Brushes, paint, flat, 3 in.10 Ladders, 25 ft. .....3 Boards, scaffolding, 14 ft.3	All steelwork in contact and overlaps of C.G.I. sheets are painted before erection; the steelwork skeleton is painted after erection.
3 Erect Gable-ends and Doors.	1 N.C.O. & 6 men.	Chests, tools, carpenters', filled .....1 Bits, twist, carpenters', $\frac{7}{8}$ in. .....1 $\frac{3}{4}$ in. .....1 Blocks, snatch, 2 in. ...1 Falls, 2 in. .....1 Lashings, 1½ in. 1	Carpenters are required for this.

Job No.	*Working Party.*	*Tools and Stores required.*	*Remarks.*
4 Erect Lining and Sheeting.	1 N.C.O. & 14 men.	Chests, tools, carpenters', filled .....1 Punches, pointed .....6 Hammers, claw 6	The lining is done first, straining wire and C.G.I. sheet afterwards.
5 Erect End Sheeting.	1 N.C.O. & 9 men.	Hammers, claw .....6 Punches, pointed .....6 C.G.I. cutters .....2 Ladders, 29 ft. 2	Sheets are cut to fit curved ends with cutter or with hammer and flat chisel.
6	1 N.C.O. & 6 men.	Chests, tool, carpenters', filled .....1 Hammers, claw .....4 Ladders, 25 ft. 4	Carpenters' job.
7 Glazing; Erect Doors and Fittings.	1 N.C.O. & 6 men.	Knives, putty .....2 Hammers, glaziers' .....2 Chests, tool, carpenters', filled .....1 Ladders, 29 ft. .....2 Trestles, painters' .....2 Planks, scaffdg., 14 ft. ...2	
8 Guttering and Flashing.	1 N.C.O. & 2 men.	Hammers, claw .....1 Screw Drivers, 6 in. .....1 ,, ,, 12 in.....1 Bosses, lead .....1 Ladders, 10 ft. 1	
9 External Painting.	1 N.C.O. & 8 men.	Brushes, paint, 5 in. ...8 Pots, paint, 1 gallon .....8 Ladders, 25 ft. .....4 ,, 20 ft. 4	
10 Internal Painting.	4 men.	Brushes, paint, 3 in. .....4 ,, ,, 2 in. .....4 Pots, paint, 1 gallon .....8 Ladders, 20 ft. .....4 Trestles, painters', 15 ft. 2 Planks, scaff., 14 ft. 4	

APPENDIX B.

CONSTRUCTION OF LIGHT RAILWAY FOR PERMANENT USE.

1. *Lessons Learnt.*

(*a*) The line should be ballasted as early as possible. If used for traffic before being properly ballasted, it very soon becomes distorted.

(*b*) Where a large number of branch lines is involved, a considerable amount of cutting of rails is necessary, and it is somewhat difficult to estimate at all accurately the amount of track required. To run short may entail serious delay. Repeated checking of distance left to be done against track in hand is very necessary.

(*c*) Until the track has settled, the wastage in fish bolts and clip bolts under heavy traffic is considerable. Ten per cent. spare should be allowed.

(*d*) With light railway (in this case 20 lb. rail) it is advisable to stagger joints on all curves. Staggering is most conveniently done after ballasting.

(*e*) The bending of rails for curves, together with mounting on sleepers, was done centrally. On the advice of the contractor, short rails, cut to the exact length for the inside of the curves, were ordered specially. As, however, the ordinary lengths of rail varied by several inches, this proved a waste of time and money.

(*f*) A maintenance party is essential from the moment the line is used for traffic.

(*g*) Two acetylene torches are advised; one for cutting rails for curves at the central dump, and one for the party staggering joints.

2. *Organization of Working Parties.*

The following table gives the numbers of men found suitable for progress at the rate of 200–250 yards per 9-hour day. This rate varied with the amount of curve involved.

One Serjeant in Charge. Labour: 5 N.C.O's and 42 O.R's, organized as follows:—

Operation.	*N.C.O's.*	*Men.*	*Commence Work.*
1. Rail Bending	—	3	Z day
2. Mounting	—	4	Z day
3. Plate Laying	1	4	Z plus 1
	1	4	
4. Ballasting	1	15	Z plus 2
5. Staggering joints or curves ...	1	3	Z plus 3
Acetylene cutters	1	4	
6. Track Walking	—	2	Z plus 3
7. Tumblers	—	3	Z plus 3

LYDD RANGES.

By LT.-COLONEL T. T. BEHRENS.

GENERAL.

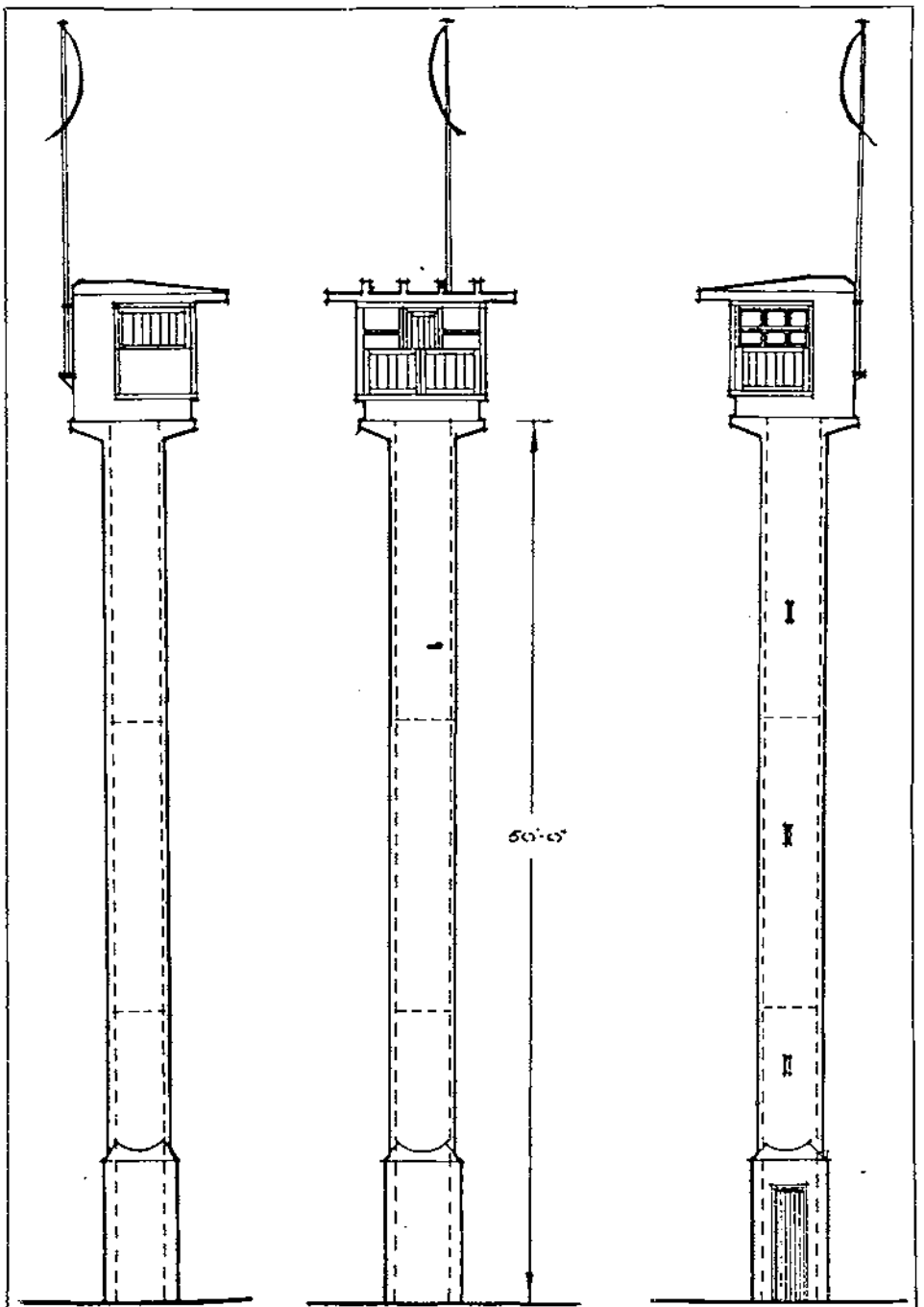
THE adaptation of these ranges for modern practice with the new infantry and anti-tank weapons has taken many months. To find the best arrangement for fitting in four separate range areas so as to allow all of them to be used concurrently, without unduly increasing the sea danger areas which were in use before, has been difficult.

The ranges now consist of two classification ranges, battle shooting range, A.A. hosepipe range with triangular track for moving trucks, and the A.T. and field firing range to accommodate all infantry weapons. These are fitted in on about 2,500 acres and a sea danger area extending about 2 miles to sea.

To ensure the safety of the public and of all those using the ranges, the central safety control has been placed in a " control " tower from which a general view of the whole area can be had. This tower is in telephonic communication with each range. Two observation towers 50 ft. high, also connected by telephone to the control tower, have been built at each end of the foreshore. The observers in these towers provide for the safety of the sea danger area and the foreshore which they overlook, and they warn the control tower at once when any vessel approaching is likely to be entering the sea danger area.

OBSERVATION TOWERS.

Each of the observation towers is provided with a squared and oriented board (chart) and alidade, with which the bearing and approximate position of the vessel is taken and telephoned from each to the control tower. At the latter is an exactly similar board, on which the bearings are laid off and the position thus fixed. As, however, this method, at first installed, easily gives rise to confusion when several boats are in the neighbourhood, a depression range-finder has been fixed in each observation tower, so that positions can be taken rapidly from either tower alone without the intervention of the second. These two towers were erected at short notice at a time when delivery of structural steel work could not be had without quite uncertain delay. Reinforced concrete was therefore decided upon, in the form of a thin-walled reinforced-concrete tube supporting an



ELEVATIONS OF EXISTING TOWERS

SCALE IN FEET

10 5 0 10 20 30 40

observation cabin big enough for two men—normally to accommodate one—50 ft. above ground. The base of the column is solid concrete, 5 ft. thick and 14′ × 14′ in plan at ground level; the ends of all the vertical reinforcement are anchored into the bottom of these 36 cubic yards of monolithic concrete.

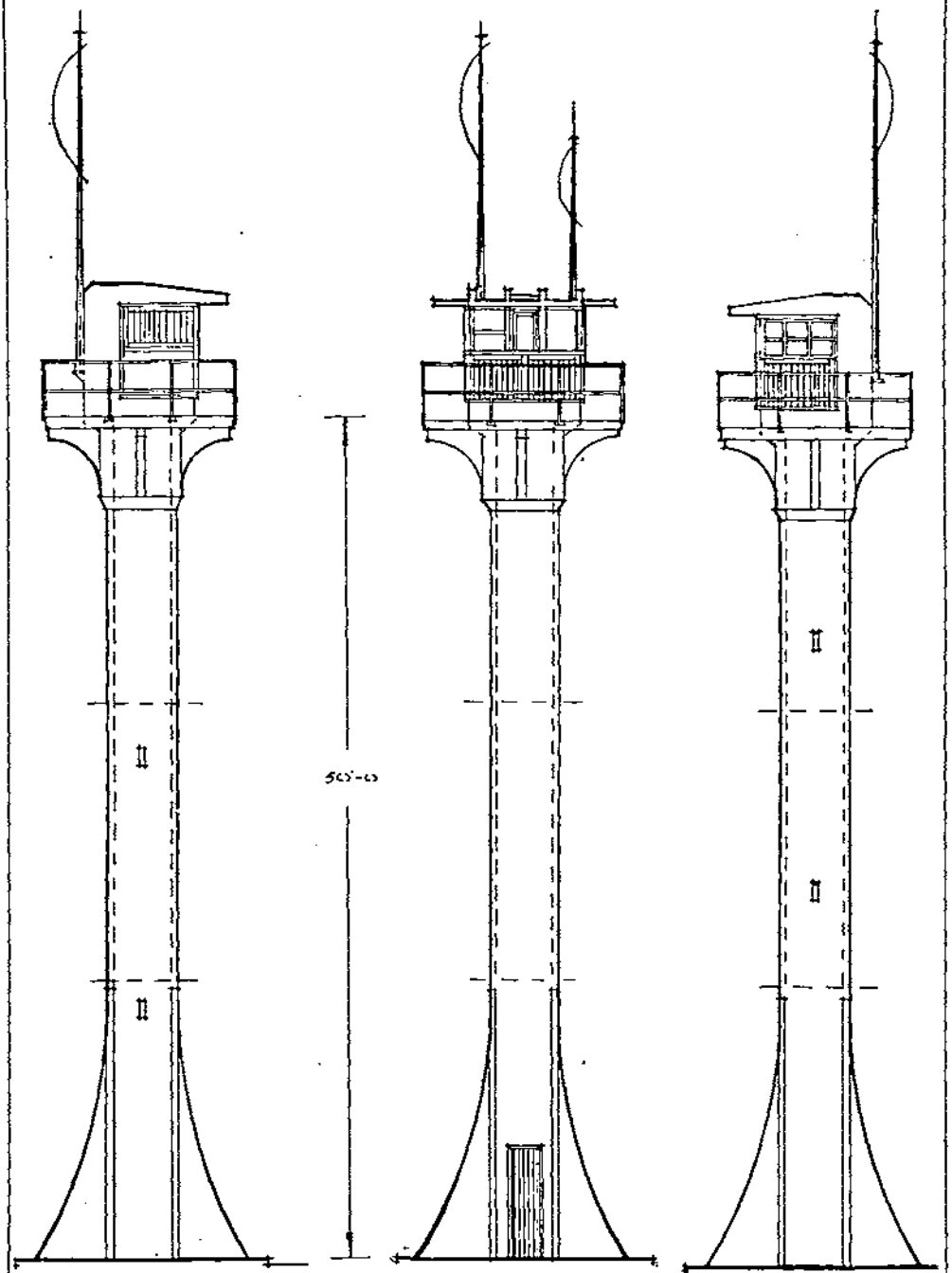
An unobstructed view over an arc sufficient to cover the whole of the sea and most of the land danger area is provided in each tower by cantilevering the flat roof, so as to enjoy this unobstructed view on one whole side and most of the two adjacent ones. Four rising sashes with small glass panes are fitted to the inside of the walls, to provide shelter in rough weather; and four rising shutters on the outside securely close the cabin, when not in use, from the weather. However, the fixing and any subsequent repair to the outside joinery 50 ft. above the ground is so difficult and costly that the revised design (illustrating this description) has a light verandah added to avoid this difficulty. It also makes the working of the two flag hoists (a second one was later found necessary) both easier and quicker.

Plate No. 1 illustrates the construction of the existing towers. The photograph gives a good idea of the present appearance. The concrete has been painted with aluminium Bitumastic paint to keep the concrete dry and this prevents any chance of the reinforcement rusting. The concrete is so thin (3 in.) that some parts of the steel are probably scarcely one inch from the surface.

The two towers were erected concurrently in six weeks, a specialist firm using their own expanding shuttering and quick-setting cement, so that the tube itself moved upwards one shutter length (about 6 ft.) a day. The scaffolding is seen in the photograph.

Owing to the urgency of the work, this firm neither supplied nor fixed any of the fittings (joinery and the steel access ladder inside, etc.): the provision of these and their fixing gave an immense amount of trouble; but with the detailed drawings now available and the addition of the verandah these things need cause none in future. Plate No. 2 shows the developed design, the result of local experience.

The vertical steel access ladders were made from flat mild steel bar, sides and steps of the same section, electrically welded. The inside height to the floor of the crow's-nest was divided into three equal heights by trap doors (for those who dislike heights) and the ladder sections were designed so that six exactly equal and similar sections, when put together, reached from floor to the entrance trap at floor level in the crow's-nest. Each section is supported on a pair of galvanized iron supports fixed by the contractors for us in the concrete, and one pair of oval holes in the top end of each section allows enough tolerance to prevent any fitting being necessary during erection. The clearance between the concrete and the inside face of the concrete is sufficient to allow the hand to grip the sides while climbing.



ELEVATIONS OF REVISED DESIGN

SCALE IN FEET

The inside of the crow's-nest provides room enough for the lookout man ; the direction board is in one corner on a housing which automatically orients it against fixed stops, but which allows it to be taken down if not in use ; the D.R.F. on a steel pillar fixed to the floor in the other corner ; an exit door to a small platform at the back, from which the danger flags can be run up and down on the flagstaff ; and two niches, each with a seat and shelving, on either side of this door, which are used to accommodate the telephone instrument, and to put away the D.R.F. instrument, binoculars, telescope, etc. The entrance at the bottom is securely closed by a stout door opening outwards.

It has been found necessary to provide a small hut near the foot of the tower, where the relief man can stand by in warmth and comfort during the long hours in winter.

There is one flagstaff with two halyards, but the revised design provides two flagstaffs, a long and a short one, so that when there is no wind there may be no confusion between the single red flag or a hoist of two red flags. The windows in the tubular column which light the ascent, have had to have wire netting fixed to keep out the birds.

The height and position of these two towers were worked out so that the foreshore slopes along the three miles between them could be overlooked with glasses, as a necessary safety precaution.

Doubts were expressed by some about the stability and strength of the structure and as to its suitability for a D.R.F. platform. The two towers have stood through the winter and are now a year old : they have developed no structural defects whatever yet. It is true that the deflections are such as to make the accuracy of D.R.F. ranging just sufficient for safety purposes and perhaps no more. It is for this reason that the improved design is a stiffer one, calculated to reduce the deflections to about a quarter of those experienced with the present towers.

Some consideration of the question of deflections in these towers will be of interest.

External Forces.—The principal consideration to be taken in the design of the tower is the effect of wind pressure causing the structure to bend vertically. The shape of such a structure influences the total wind pressure acting on one side and a circular form offers less resistance to the wind than would be given by a square or rectangular tower. This coefficient of reduction has been established by tests and is generally accepted as approximately 60 per cent. of the normal wind pressure.

A secondary consideration is the weight of the tower itself. Owing to the slender form and thin walls, this weight produces a minor effect on the resultant stresses in the shell, but nevertheless it is necessary

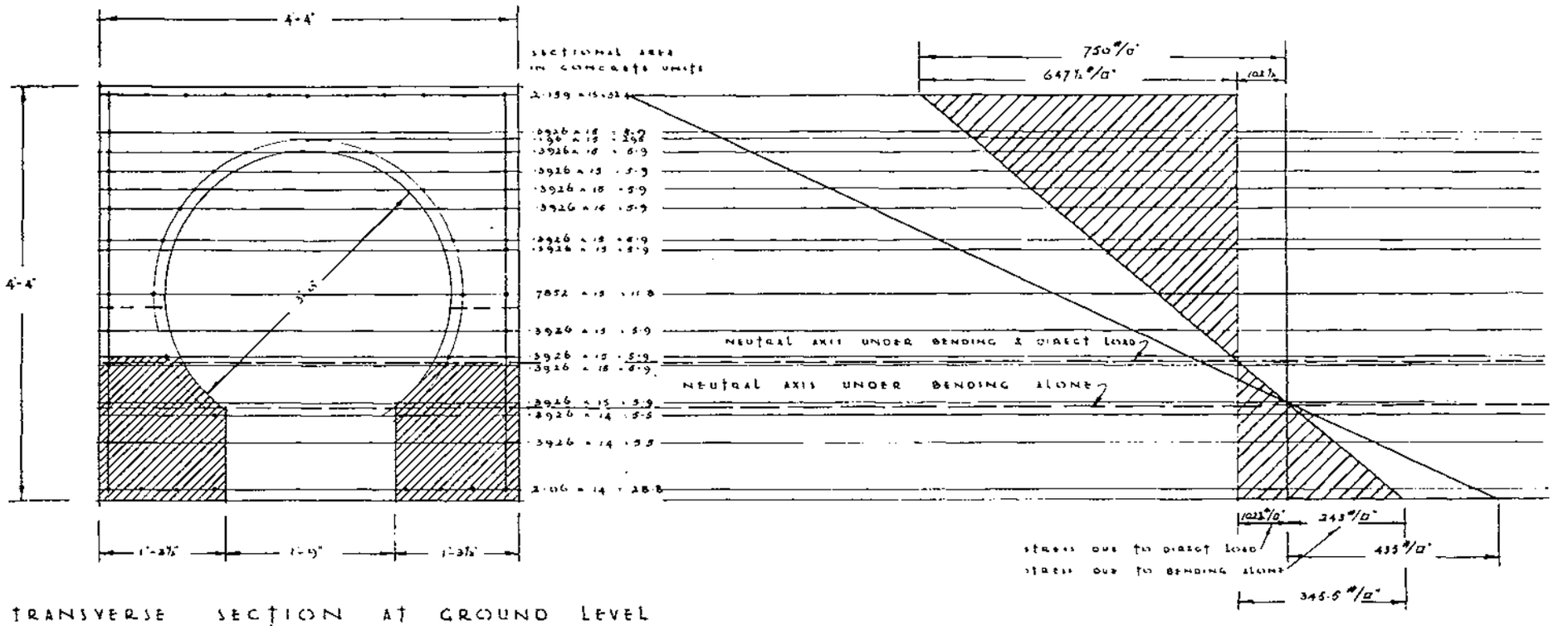
to include this effect, particularly in the lower portion of the tower.

Internal Stresses.—Both tensile and compressive stresses are induced in the shell, due to the effect of wind and an additional compressive stress due to the vertical load. The exact analysis, even for a symmetrical section, is somewhat tedious and necessitates the solution of a cubic equation. By making a few preliminary assumptions, however, it is possible to prepare graphs for simple sections and with the aid of these curves the stresses can be easily and readily calculated. This method has been used for investigating the stresses in the circular portion of the shaft above the plinth.

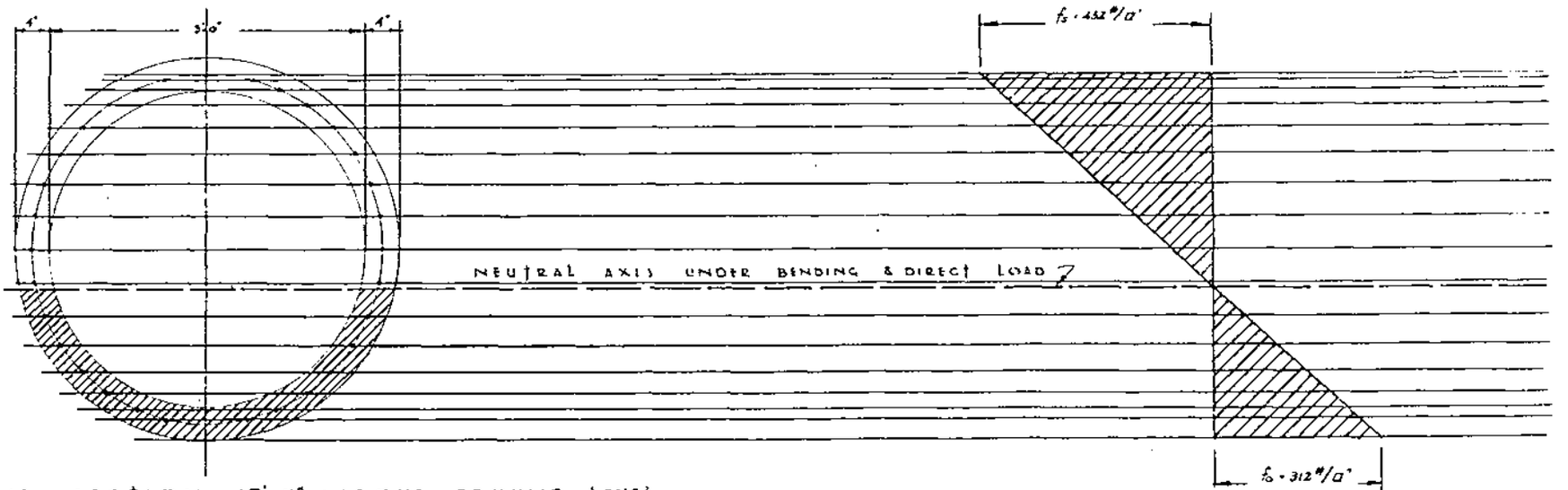
When considering the lower portion of the tower, it will be realized that the door opening reduces the available area of concrete and destroys the symmetry of the section. For this portion it is therefore impossible to use graphs and the analysis of the stresses must be worked out from first principles. The treatment is of a semi-graphical nature which consists of drawing the complete section, including the area and position of the steel reinforcement, to a large scale. This section is divided into narrow strips. It is necessary to increase the actual area of the steel reinforcement by the modular ratio between steel and concrete, owing to the difference in Young's Modulus between the two materials. The value of this ratio usually adopted in calculations is 15. From this basis it is possible to calculate the position of the neutral axis, assuming pure bending on the section and neglecting the tensile resistance of the concrete. The moment of inertia of the section can then be evaluated, from which the maximum compressive stress on the concrete and the maximum tensile stress on the steel are readily obtained.

As stated above, the effect of the direct load produces increased compressive stress and decreases the tensile stress. No simple means can be used for obtaining the final stresses and it is necessary to assume an increment of stresses as a first trial, calculate the moment of resistance of the section and proceed by trial and error until the total internal forces acting on the section are equal to the applied forces from the bending moment and direct load. After several trials an exact distribution of stress is determined, from which it is possible to calculate the final maximum stresses on the section.

Two typical calculations are given in Plate No. 3, which illustrate the distribution of the stresses, both for the circular portion of the shaft and for the plinth. It will be noted that these are lower than those usually adopted for reinforced-concrete structures, but it was thought prudent to use low stresses to cover for sudden reversals of stress, such as may occur in the towers during a series of gusts.



TRANSVERSE SECTION AT GROUND LEVEL



TRANSVERSE SECTION 17'-0" ABOVE GROUND LEVEL

LYDD RANGES ~ STRESS CALCULATIONS OF EXISTING TOWERS

	Area. sq. in.	*Stress.* #/in²	*Total Force.* lbs.	*Dist. from N.A.* ins.	*Moment of Resistance* lbs. ins.
	32·4	1345	45,200	38½	1,740,000
	5·9	1190	7,020	34	239,000
	2·95	1160	3,430	33	115,000
	5·9	1100	6,480	31½	204,000
	5·9	1020	6,220	29	175,000
	5·9	945	5,580	27	151,000
	5·9	860	5,070	24½	124,000
	5·9	725	4,280	30½	88,000
	5·9	680	4,010	19½	78,000
	11·8	485	5,730	14	80,000
	5·9	325	1,920	9½	18,200
	5·9	190	1,120	5½	6,200
	5·9	165	970	5	4,850
	5·9	10	60	¾	45
Σa ...	112·0		96,890		3,021,295
	5·5	25	140	1	140
	5·5	180	990	4½	4,460
	356·0	232	82,600	6	495,600
	28·8	380	10,950	10	109,500
Σb ...	395·8		94,680		609,700
Σa + Σb ...	507·8				3,630,995

Average stress due to direct load $= \frac{52,200}{507·8}$ $= 102·5$ #/inch²

Maximum stress due to 3,630,995 in. lbs. $= 435$ #/inch²

Maximum stress due to 2,030,000 in. lbs. $= 435 \times \frac{2,030,000}{3,630,995}$

$= 243$ #/inch²

Stress due to direct load (as above) $= 102·5$ #/inch²

TOTAL MAXIMUM COMPRESSIVE STRESS $= 345·5$ #/inch²

Maximum tensile stress due to bending $= 1345 \times \frac{2,030,000}{3,630,995}$

$= 750$ #/inch²

Deduct direct stress $\frac{102·5}{647·5}$ #/inch²

MAXIMUM TENSILE STRESS IN STEEL = 647·5 × 15 = 9700 #/inch²

B.M. due to wind = M	= 1,095,000 in lbs.
Total Vertical Weight = W	= 35,000 lbs.
$e = \frac{M}{W} = \frac{1,095,000}{35,000}$	= 31·3 ins.
D (c/c. of steel)	= 40 ins.
$\therefore \frac{e}{D} = \frac{31·3}{40}$	= 0·78
Percentage of Vertical Steel $= p = \frac{6·28}{502} \times 100$	= 1·25 %
From graph : $\frac{W}{Dt\ fc} = \frac{35,000}{40 \times 4 \times fc}$	= 0·7
$\therefore$ MAXIMUM COMPRESSIVE STRESS (fc) $= \frac{35,000}{112}$	= 312 ♯/inch²
n = 0·11 *i.e.*, neutral axis = 0·11 × 40	= 4·4 in. from ℄
$f_s = 312 \times \frac{24·4}{17·6}$	= 432 ♯/inch²
MAXIMUM STRESS IN STEEL (f_s) = 15 × 432	= 6,480 ♯/inch²

Deflection of the Shaft due to wind.—Reliable formulæ have been established which determine the deflection of a member composed of a homogeneous material such as steel or timber. Reinforced concrete, however, consists of two materials having different coefficients of elasticity (Young's Moduli) and the moduli for concrete can vary within wide limits. Further, the assumption made in the design of the sections that concrete on the tension side of the neutral axis does not assist in the total resistance of the section, leads to calculated results for deflection which are in excess of those from observed tests.

Several empirical formulæ have been suggested to determine the deflection of reinforced-concrete members but no satisfactory solution to the problem has yet been found. In order, however, to arrive at an approximation to the displacement of the tower the following formulæ applicable to a homogeneous material have been used :—

Horizontal Deflection. $\Sigma \frac{Mx\delta x}{EI}$ where M = Bending moment at any section.

x = distance of section from fixed point.

Angular Deformation. $\Sigma \frac{M\delta x}{EI}$

E = coefficient of elasticity (Young's Moduli).

I = Moment of inertia of section.

Control Tower.

Lydd ranges - control tower

Observation Tower.

Lydd ranges - observation towers

Applying these formulæ to the structure and assuming a wind blowing at 35 m.p.h., the following results have been calculated :—

Horizontal Deflection	..	0·15 inches.
Angular Deformation	..	30 minutes.

No deflections of this order have, however, yet been registered. A maximum deflection of ten minutes has been obtained by allowing two men in the crow's-nest to rock the tower.

Control Tower.

The control tower illustrated in Plate No. 4 and photograph is situated at the back of the ranges in order to overlook the F.F. and A.T. ranges. It is built in brick on generous concrete footings in the shingle. This coarse shingle, without any sand or fine stuff, is very unstable on the surface, but careful tests showed that 3 tons per square foot would be safely carried two feet below the surface or, provided that the shingle was somehow contained at the sides, at shallower depths.

It will be seen that the principle of unobstructed view (over 180 degrees from the centre of the platform in this case) has been provided by a cantilevered R.C. roof, covered with three layers of bituminous felt laid in mastic.

The windows are single sheets of plate glass, one on each face, which slide up and down like the windows of a car. Water-tightness of the outside joint at sill level is provided by a strip of rubber and canvas on the underneath, which throws the water off on to a sloping teak sill.

When the tower is not in use all the windows are securely shuttered on the outside to protect the glass from damage and keep the weather out.

The platform is 20 feet above the ground ; it is approached by a wooden staircase to a half-way landing from which a circular C.I. staircase rises into the corner of the cabin above. This saves floor space and reduces the plan size of the tower itself. The floor is R.C. concrete.

The tower grew from small beginnings and has had to be constantly altered as new requirements were called for during the range development. The corbelling, at about platform level, became necessary when an air-space in the cabin walls was called for to ensure the inside against damp. The veranda, was added last of all to make it easier to hoist the flags, signal with hand-flags, and to increase the standing room at platform level.

The tower now contains the telephone exchange ; this connects together the two observation towers, as well as the 19 markers' shelters, the 4 other ranges, the winch-house for towing targets,

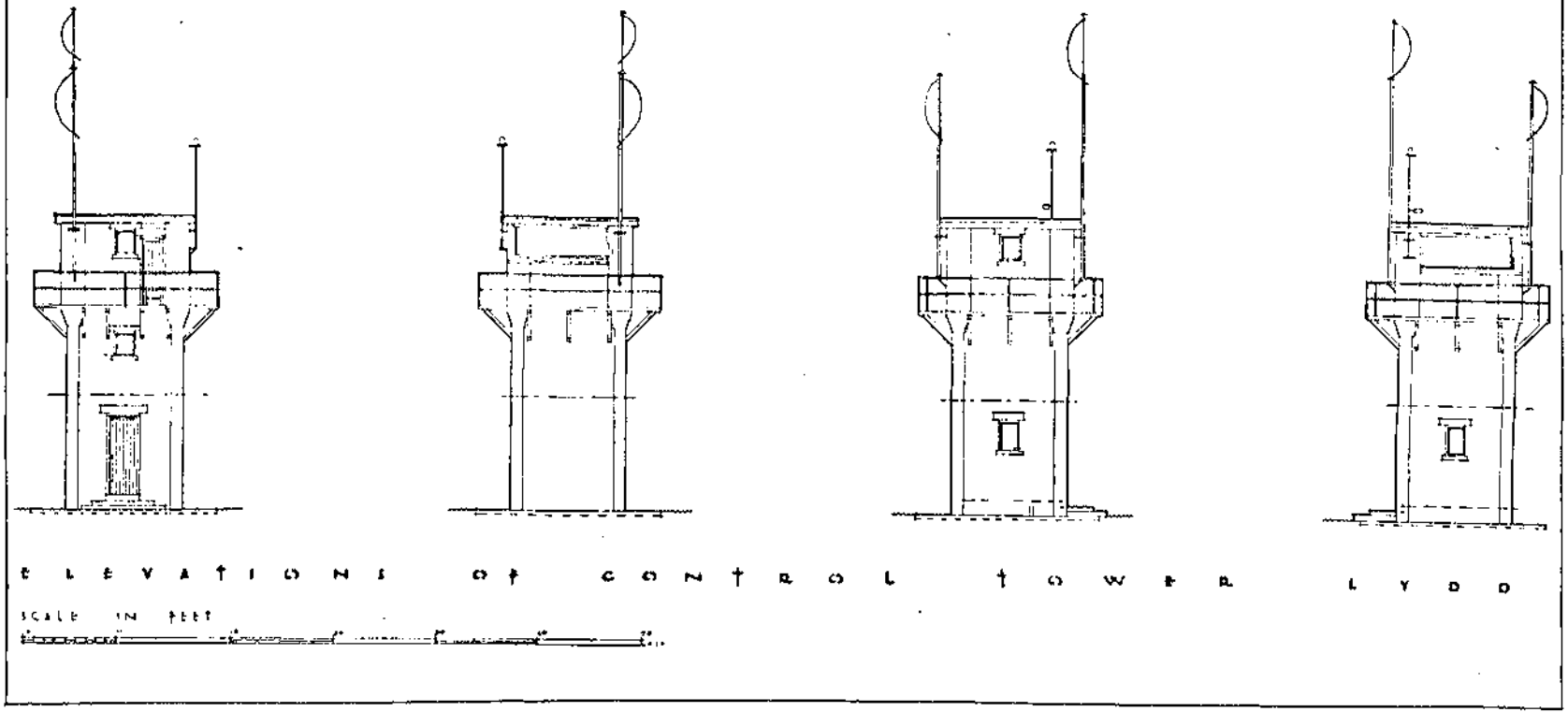


PLATE No. 4.

and the camp exchange. About 13 miles of telephone cable has been buried 18 in. to 30 in. deep, at a cost of £65. The wireless set for communication with the patrol launch at sea is on the ground floor; the direction board chart, on which the positions of approaching vessels in or near the danger area are plotted, is in the cabin above.

The joinery is teak and of the stoutest, the entrance door opens outwards and all the glass is securely shuttered against breaking-in, a necessity in this isolated and open situation. The fittings of yellow metal prevent rust, and so reduce maintenance to a minimum.

The inscription seen in the photograph is for the lintel of the lower window, to mark the spirit in which all connected with the intricate construction of these ranges have given their services to the work.

As it is impossible to publish the large scale detail drawings required for construction and joinery, upon which the success of the building depends, prints from the detail drawings are available (on application to D.C.R.E., Shorncliffe Camp) to any who may require assistance in carrying out similar work.

Our thanks are due to Messrs. Considère Constructions, Ltd., for their very kind permission to reproduce the stress diagrams and calculations and to the Cement and Concrete Association for permission to reproduce their photograph of the observation tower.

HISTORIES OF THE INFANTRY BATTALIONS. TERRITORIAL ARMY.

Which have become Anti-Aircraft Battalions, Royal Engineers.

[*Continued.*]

35TH (FIRST SURREY RIFLES) ANTI-AIRCRAFT BATTALION R.E. (T.A.).

ACCORDING to history, military men were not very numerous in South London in the " first yere of the Reign of our Souvrain Lady Queen Elizabeth." In a return of all the " able men, harneys, weapons, munycons within the hundred of Brixton " compiled by two gentlemen, namely Richard Scott and John Bowyer, to the " Right Noble Henry, Earl of Arundel, lord leuten'nt to the Queeny's highness within the said Countie of Surry," the fact was disclosed that Camberwell had five archers and five billmen ; Peckham boasted also five archers, but only one billman ; whilst Dulwyche had four billmen.

During Queen Elizabeth's reign, however, considerable increases were made in the armed forces, partly owing to the Papist intrigues against the Queen herself. A muster roll published some forty years later shows that the Elizabethan forefathers of the Camberwell men were not behind in proving their loyalty. The Camberwell military force was still divided into three Companies, Camberwell, Peckham and Dulwich, each commanded by Esquires. The men were designated as " Pikemen of the best sort," " Bowmen of the second sort," " Billmen of ye second sort," and so on.

This rising of the Camberwell and the Surrey men in general, brought special commendation from the Queen, and in a letter written from Greenfich in April, 1585, to the Sheriffs and " Commissioners of Musters " in the county, thanked them for the readiness they had shown to exert themselves for the " preservacion of their naturall countrye."

Two centuries later the activities of Napoleon on the Continent gave impetus to the volunteer movement, and the year 1798 saw military associations springing up all over the country to defend the rights, and, as many people thought, even the very homes of England. As in Elizabethan days, the parish of Camberwell was well to the fore and showed considerable enthusiasm and loyalty,

which culminated in the formation of the " Camberwell Military Association " in May, 1798.

The following quotation from a publication of the early nineteenth century will show that the Camberwell Military Association was not backward in time of national emergency.

> " At a Time when these kingdoms were involved in an arduous and extensive war, and the revolutionary Spirit, which gave its Birth, had infused its baneful Influence into the minds of many of our countrymen, voluntary and armed Associations were formed throughout the Kingdom, in Defence of our Religion, Law and Liberties.
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> " The inhabitants of the village of Camberwell evinced their loyalty and patriotism, at this important crisis, by forming themselves into a military corps, on the 5th of May, 1798. It was supported by voluntary subscription, and continued its service with unabated Zeal, until the Defensive Treaty of Peace with France was signed at Amiens."

The Major Commandant of the Corps was Claude Champion de Crespigny, Esq., and the regimental colours, said to have been the envy of other military organizations and the pride of the men, were presented by Mrs. de Crespigny. One colour was embroidered with the cypher " C.A." (Camberwell Association) and the other bore the motto " Concordia Victrix," which is borne to this day on the cap badge of the men of the First Surrey Rifles (formerly the 21st London Regiment), now an Anti-Aircraft Battalion of the Royal Engineers. Mrs. de Crespigny, in presenting the colours, alluded to the inscription : " The motto chosen for the colours I am now to have the honour of presenting to you, will, I hope, meet your approbation. The justice of the sentiment it conveys, cannot, I think, be denied. It has been truly said that a kingdom divided against itself cannot stand. It is, I believe, not less true that a people united together in concord shall not fall, but will be triumphant over all enemies."

The dress of the Corps at this time was blue with scarlet facings ; a helmet cap crested with a black plume ; pantaloons and gaiters.

Following the burst of patriotic indignation throughout the country in 1803, when it was learned that the threat of French invasion was not passed, the volunteer unit formed two years previously commenced to reassemble. When, in 1804, Bonaparte assembled over 160,000 troops at Boulogne in preparation for his intended invasion of this country, over half the adult male population had joined the volunteer forces, and the coasts of Kent and Sussex were alive with soldiery. In August, 1804, two companies were raised in Camberwell, one in Peckham and one in Dulwich. The uniform this time was of scarlet with blue facings and pantaloons

of grey. The Battalion was about 360 strong and drill was carried out in Grove Park, whilst grand field days were held in Hyde Park. On one occasion, in October, 1803, there was a large muster of volunteers which was honoured by the presence of King George III.

It was at this time that the Camberwell Corps of Volunteers became known as the First Surrey Regiment of Volunteers. In 1814, however, it was decided to disband the volunteer army, and, in June of that year, all men were released from the military engagements. With the fall of Napoleon after Waterloo, the volunteer organizations almost fell to pieces, and were not revived until 1859, when the European situation, coupled with the fiery address of certain officers to Napoleon III, fanned the flame of patriotism into the practical gesture of reforming the volunteer regiments.

For some years previous to 1859, a valuable nucleus of a unit had been formed in Peckham, as the Hanover Park Rifle Club. At this time each man's uniform cost £14, which he purchased himself, as well as his rifle, which cost six guineas. As soon as official sanction was obtained for the recognized formation of Volunteer Units the First Surrey literally sprang into existence; in June, 1859, the services of the regiment were accepted by Her Majesty Queen Victoria, and the First Surrey's claim to be the first metropolitan corps whose services were so accepted.

The progress of the railway deprived the regiment of their headquarters in Hanover Park, but in 1865 the buildings till this very day occupied by the First Surrey Rifles in Flodden Road, Camberwell, were opened by the Lord Lieutenant of the County, the Earl of Lovelace, the regiment under Colonel Macdonald mustering to full strength.

Since their formation, the First Surrey Rifles had always been to the front in their volunteer service, and at the National Rifle Association's meetings at Wimbledon, the "First Surrey Camp" became a local institution. At this time, the First Surrey (or South London) Rifles had an establishment of six companies, each one connected with a certain district, from which it drew its recruits. The districts allocated to the companies were as under:—

No. 1 Camberwell; No. 2 Kennington and Clapham; No. 3 Camberwell; No. 4 Peckham; No. 6 Brixton; No. 7 Newington.

No. 5 the Clapham Company, was absorbed with No. 2 whilst two other companies, No. 8 (New Cross) was amalgamated with No. 3, and No. 9 (Dulwich) with No. 1.

Right until the close of the nineteenth century, the First Surrey Rifles continued to flourish. Their uniform was then rifle green with scarlet facings, identical with that of the 60th (King's Royal Rifle Corps), the only changes there had been were in the matter of head gear. Firstly, the shako; followed by the spiked helmet, which was introduced in the 'eighties following the Cardwell Reforms, and

lastly the black astrakhan cap with the scarlet plume which is still worn in full dress.

General Sir George Pollock, a veteran of many campaigns in India and Afghanistan, was the first Colonel of the Regiment. In 1868, at the time of the Fenian troubles, the whole of the personnel of the First Surrey Rifles enrolled as special constables. The regiment always had a good reputation for shooting and all-round efficiency. For many years it was the custom for all officers to serve in the ranks before being commissioned, a notable instance being Colonel W. F. Branston, who joined the corps as a boy bugler and eventually rose to be Commanding Officer. In the early days of the corps, a scheme was set afoot for a troop of volunteer cavalry to be raised as an integral part of the regiment and to be known as the First Surrey Light Horse, with a uniform consisting of "a green tunic with scarlet facings, a light helmet resembling a hunting cap, with plumes for the occasion of parade only, pantaloons, and Napoleon boots"; but this scheme does not seem to have matured. In July, 1899, a review was held in Hyde Park to celebrate the Volunteer Centenary, and the First Surrey Rifles, together with over 30,000 other volunteers, were inspected by King Edward VII (then Prince of Wales).

During the South African War, the First Surrey Rifles were not mobilized as a unit, but sent five officers and eighty-four N.C.O's and men to the campaign, earning thus their first battle honour "South Africa, 1900–01." The irregular mounted unit known as "Loch's Horse" was raised at the headquarters of the First Surrey Rifles. Among the First Surrey Riflemen who distinguished themselves in South Africa may be mentioned Serjeant W. E. Maclean (commissioned in the field, who became Adjutant of the South African Light Horse, one of the best-known irregular units) and Colour-Serjeant A. E. Crombie, who was twice mentioned in dispatches.

August, 1914, found the First Surrey Rifles under canvas for their annual training at Perham Down on Salisbury Plain, but on the outbreak of war they returned immediately to Flodden Road for the general mobilization. Leaving Camberwell towards the end of the month, they marched to St. Alban's to commence a period of intensive training, which lasted for almost seven months. The First Surrey Rifles landed in France at Havre on March 16th, 1915, and entrained *via* St. Omer for Bethune, where they joined the 2nd London (later 47th) Division.

On April 2nd, they went into the line with the regular battalions of the 1st Brigade, and, later in the month, together with the rest of the 142nd Brigade, took over the line. The first action in which the F.S.R. took part was the attack on Givenchy on May 25th. From this time until the Armistice in November, 1918, the first Battalion of the First Surrey Rifles were actively engaged on the Western Front.

Their gallant action at High Wood on the Somme, on September 15th, 1916, will long be remembered.

The Battalion, commanded by Colonel (later General) Kennedy, received orders to drive the enemy from their position and join communications with the remnants of two isolated brigades. They moved off at four o'clock on that hot, sunny afternoon. "The First Surreys have gone over just as if they were on parade," said Major Lord Gorell of the Artillery, who watched them from his observation post, speaking on the field telephone. During their advance the Battalion came under the withering, concentrated blast of enemy shell-fire and, although the assault was accomplished, further advance was impossible owing to the weakness of the unit . . . of the 19 officers and 550 other ranks who went into action, only two officers and sixty men remained.

In October, 1918, the regiment with the 47th Division marched into Lille, in the first phase of the allied advance to the Rhine. Demobilization commenced in January, 1919, but was not completed until July; the final public act in which the battalion took part was the triumphal march of the London troops through London in the same month.

When the First Surrey Rifles marched away from Flodden Road in August, 1914, they left behind them a number of officers to form the nucleus of a second battalion. It was originally intended to have been merely a draft-finding unit, and a training ground for recruits. Time, however, changed this, and after two years' training at Redhill, St. Alban's, Bishops Stortford and Salisbury, the battalion, then known as the 2/21st Battalion, The London Regiment, embarked for France in June, 1916. They remained on the Western Front until November of that year, when they sailed for Marseilles to join the British forces in Macedonia, where they took over part of the line in the Vardar Valley.

The regiment was not, however, destined to remain long in the Balkans, for in June of the same year, they returned to Ushanta camp, above Salonika, prior to embarking for Egypt to join the Egyptian Expeditionary Force. The 2/21st landed at Alexandria and travelled *via* Ismalia, El Ferdan and Kantarah to the railhead in the Sinai Desert. From here the battalion took part in General Allenby's victorious advance into Palestine, being present at the actions before Gaza, on the El Mughar Ridge and at Nebi Samwil. They were present at the final attack and were one of the first units to enter the city. Advancing on the heels of the retreating Turks the battalion added "Jerusalem," "Jericho" and "Jordan" to their list of honours. They also fought east of the Jordan. In all the operations in which they took part throughout the long and trying months of trench warfare, the London Divisions have always shown

an unconquerable spirit and more than upheld the noble traditions of the City of London.

2nd-Lieut. A. L. Hockey of the 2/21st London Regiment was awarded the Military Cross for bravery at the capture of Jerusalem (9th December, 1917) the official record of his service being as follows: "For conspicuous gallantry and devotion to duty. On a heavy enfilade fire being opened from a house on the flank, he, with great dash and initiative, attacked and drove out a much superior force under cross-fire from machine-guns, displaying the most courageous determination and energy."

Finally, no further reinforcements were forthcoming from England, and the forces in the Near East were to be supplemented by Indian troops and in consequence, all the white units were reconstituted, the depleted ranks of the 2/21st marched out of the Jordan Valley, to be disbanded on a rock-strewn hill-slope a few miles north of Jerusalem . . . a far cry from that little Camberwell side street where they came into being as First Surrey Riflemen in August, 1914.

The Territorial Force was disembodied at the conclusion of hostilities. The Army Council was then faced with the enormous task of reorganization and in 1921 the First Surrey Rifles (21st London Regiment) started life again at Flodden Road. Fifteen years passed, the unit forming part of the 47th (2nd London) Division, playing its part and upholding the traditions of the First Surrey Rifles.

The uniform of the First Surrey Rifles, green with red facings, and their regimental march, "The Wild Hunt" were similar to those of the King's Royal Rifle Corps. The regimental cap badge is a small black Maltese Cross, with a scroll above having the motto "Concordia Victrix" (Friendship Conquers) and the words "21st County of London Regt.," on a similar scroll below. The stringed bugle, which is a feature of the badges of most rifle regiments, is in the centre of the cross, surrounded by a circle inscribed "First Surrey Rifles." The whole badge being surmounted by a crown. Twenty-eight battle honours have been awarded to the regiment of which "South Africa" and ten of those for the Great War are permitted to be borne on the appointments, since the regiment, being Riflemen, do not carry colours.

The regimental headquarters of the First Surrey Rifles at Flodden Road, Camberwell, are probably the biggest in London, with the possible exception of the H.A.C. premises at Finsbury. The battalion has a very fine collection of silver plate, including a handsome cup presented by Sir Polydore de Keyser during his year of office as Lord Mayor of London, in memory of the days when he had served as a private in the ranks of the First Surrey Rifles.

Time must, however, of necessity bring changes, and it is only by such that the efficiency and standard of the fighting forces may be

brought into line, enabling them thereby to maintain the prestige and traditions built up in the past.

In April, 1935, the War Office announced that, consequent upon the expansion of the anti-aircraft defences of the London area, certain existing infantry units were to be converted into air defence units. The 47th Division was disbanded, the converted units being formed into the 1st Anti-Aircraft Division (T.A.). The First Surrey Rifles (21st London Regiment) were one of the units selected by the War Office for conversion. The regiment then became part of the Corps of Royal Engineers as an Anti-Aircraft Battalion.

THE 38TH (THE KING'S REGT.) ANTI-AIRCRAFT BATTALION, R.E., T.A.

THE "growth" of the Unit has been as follows:—

1859—5th Lancashire Rifle Volunteer Corps.
1862—Liverpool Rifle Volunteer Brigade.
1888—2nd Volunteer Bn., The King's (Liverpool Regt.).
1908—6th (Rifle) Bn., The King's (Liverpool Regt.), The Liverpool Rifles.
1920—6th (Rifle) Bn., The King's Regt. (Liverpool), The Liverpool Rifles.
1936—38th (The King's Regt.) A.A. Bn., R.E., T.A.

The threat of foreign invasion in the middle of the last century brought the great Volunteer movement into being.

Two Liverpool gentlemen, Robert Gladstone and Hugh Tinley, raised a Corps of Riflemen from members of the Liverpool Exchange. By the 27th May, 1859, forty gentlemen had agreed to form a Rifle Club and on the 20th June, 1859, their services were offered to Lord Sefton, the Lord Lieutenant of Lancashire, as a Volunteer Rifle Company. This was officially recognized in July, 1859, as the 5th Lancs. Rifle Volunteer Corps.

In 1862 the Corps was divided into two battalions and became known as the Liverpool Rifle Volunteer Brigade. The C.O's., Lieut.-Colonel A. S. Gladstone and Major R. J. Tinley, built at their own expense the Upper Warwick Street Headquarters, which were opened in 1863.

In 1881, the Corps, forming part of the 2nd Brigade, 1st Division, of the 2nd Army Corps, took part in the Volunteer Review held at Windsor by Queen Victoria. At this Review the Commanding Officer, Colonel Hugh Tinley, was awarded the C.B.

In the years 1883–6 the Corps was represented at the famous

Easter Reviews, held by H.R.H. The Duke of Cambridge at Brighton, Portsmouth and Dover. At the last the Corps was the only north county unit to be represented and was complimented by His Royal Highness. The Corps also took part in the great Aldershot Review of 1887, Queen Victoria's Diamond Jubilee and the Coronations of H.M. King Edward VII, H.M. King George V and H.M. King George VI.

Two companies in the Corps were Welsh and Scottish. Major Forbes-Bell, an Officer in the Corps, together with a number of the members of the Scottish company, were among the first to form the battalion that is now known as the Liverpool Scottish, Major Forbes-Bell being the first Commanding Officer.

In 1888 these two battalions became the 2nd Volunteer Bn., The King's (Liverpool Regt.). A volunteer contingent was sent to the South African War, 1900–01.

The formation of the Territorial Force in 1908 brought about another change, the Battalion becoming the 6th (Rifle) Bn., The King's Regt., or the Liverpool Rifles. In 1909 the Battalion took part in the Review held by H.M. King Edward VII in Knowsley Park.

In the Great War the Battalion proceeded to France on the 24th February, 1915, where it stayed until after the Armistice, taking part in the following engagements :—

1915—St. Eloi, Hill 60, Second Battle of Ypres (First German Gas Attack).
1916—Somme, Guillemont, Flers, High Wood, Guedecourt, etc.
1917—Third Battle of Ypres, Passchendaele, Cambrai (German Counter-Attack).
1918—Tournai, Givenchy, Crossing of Haute Deule Canal.

When in 1920 the Territorial Army was re-formed, the Battalion was once more ready to play its part.

Since its formation the Battalion has always taken very particular interest in rifle shooting. The first moving-target competition organised by the N.R.A. at Wimbledon was won by the 5th Lancs. Rifle Volunteers under Colonel Tinley, the prize being £100 divided into £50 amongst the team and £50 for the C.O. to expend in the encouragement of field-firing. In 1893 the Battalion distinguished itself further by ten of its members gaining places in the Queen's Hundred. In 1904, the " Roberts Challenge Cup " was won by the 2nd Volunteer Bn., The King's (Liverpool Regt.), which remains to this day the only Volunteer or Territorial Battalion to have won this trophy. Ever since, representative teams have taken their places at Wimbledon, Bisley and Altcar. Recent successes include the winning of the Lord Lieutenant's Shield three times in

seven years, the Quartette Cup, The Inter-Services' Competition, and culminating last year in the winning of the King's Medal.

On 10th December, 1936, after nearly 78 years of honourable service, the Battalion was converted from a Rifle Battalion into an Anti-Aircraft Bn., R.E., in the 2nd Anti-Aircraft Division, and six months later attended Annual Training at Filey with 40 officers and 600 other ranks.

Owing to the increase in establishment and the strength of the Unit, it was essential that another Drill Hall should be provided. This has been done and a new up-to-date building was opened at Mather Avenue by Captain the Lord Strathcona and Mount Royal, Under-Secretary of State for War, on June 20th this year.

By March, 1938, the full establishment was reached and at the Annual Training held this year at East Heslerton, Yorkshire, 45 officers and 1,333 other ranks were present, and 96 searchlight stations were erected and manned. On the day of arrival in camp, 80 sets of equipment were taken over from the R.A.O.C. and the same night 92 lights exposed.

The foregoing is surely a record of voluntary service and achievement of which to be truly proud.

E.M.M.

THE 50TH (NORTHAMPTONSHIRE REGIMENT) ANTI-AIRCRAFT BATTALION, R.E. (T.A.).

THE history of the battalion may be said to date from the formation of the Northampton Volunteers in 1859. Separate companies were formed at Towcester, Overstone, Northampton, Peterborough and Wellingborough and each maintained its own individuality. The original and special role of these volunteers was Riflemen, and green tunics and shakos were worn. In 1860, they took part in a massed review in Hyde Park by H.M. Queen Victoria.

In August, 1860, all these separate companies were grouped into one formation to be known as the 1st Administrative Battalion Northamptonshire Volunteer Rifles, with the Duke of Grafton in command.

The next big change in the history of the battalion occurred on the introduction of the Cardwell system in 1881, when the battalion became an integral part of the Northamptonshire Regiment and was named "The 1st Volunteer Battalion, The Northamptonshire Regiment." The permanent staff of the battalion from this date onwards was provided by the regular battalion of the regiment.

During the South African War, the battalion was allowed to send out one of its companies and as recognition of its services, the

battalion was awarded the battle honour " South Africa (1900–02)."

In 1908, yet another change took place with the formation of the Territorial Force, and the battalion changed its title to the 4th Territorial Battalion, the Northamptonshire Regiment. With the change, the unit ceased to be treated as a rifle corps and now became entitled to carry colours. These were presented by His Majesty King Edward VII at Windsor in 1909.

In the Great War, the battalion first saw active service on 15th August, 1915 at Gallipoli. From there they moved to Egypt, took part in the advance across the Sinai peninsula and distinguished themselves at the Second Battle of Gaza. Further outstanding actions were Wilhelma and Kefr Kassin. When an armistice was concluded with the Turks, the battalion had reached Beirut. Their record during the war had been a fine one and fourteen battle honours had been earned.

The final stage in the battalion's varied career was the conversion into an Anti-Aircraft Battalion, Royal Engineers, in October, 1937, thus making the fifth change in its seventy-nine years of history.

OVERLAND TO INDIA, 1938.

By LIEUTENANT A. C. LEWIS, R.E.

INTRODUCTION.

THE journey between England and India by car has been done many times, and has been described almost as often. In particular, there was a very comprehensive account in *The R.E. Journal* of December, 1935, and the general conditions of the journey have not materially altered from those described in it. The present article deals with the expedition undertaken by four members of 33 Y.O. Batch (Lindsell, Rosher, Lyall Grant and myself) on the occasion of their first posting to India at the beginning of 1938, and it has been written, not as a romantic story of the trip, but to assist those who receive inspiration for similar journeys, and who, inexperienced like us, have to arrange everything entirely from scratch. Our trip was exceptional in that we took a novel route and that, as impecunious Y.O.'s, we considered every penny of the cost to be of supreme importance. Further, we are probably the first party to have covered the whole journey so early in the year. In this account the preparations and what may be called the administrative details are fully described, and the story of day-to-day events, which make an expedition of this nature so enjoyable and memorable, have taken second place.

PREPARATIONS.

The idea of the trip was conceived at the end of November, 1937, and from that time until our departure at the beginning of the following February, a large proportion of our spare time was spent in preparation and discussion. The first move was a visit to the A.A., who pronounced the project to be feasible, but warned us that owing to our early start there was a distinct possibility that we would get held up by bad weather for a week or so.

After further inquiries and conversation with those who knew the various countries through which we would have to pass, we decided on the route. The direct way through Turkey would be impassable until April owing to the snow, so we would have to take a ship across the Mediterranean. For this there were four alternatives :—

(1) France—Morocco.
(2) Italy—Libya.
(3) Brindisi or Athens—Alexandria.
(4) Athens—Beirut.

The first was too indirect, the second clouded with doubt, the third alternative had no apparent advantage over the second, and the fourth, which is the most usual, turned out to be far too expensive. The Libyan route had been covered the previous year in the reverse direction and, as it showed a total saving over the others of about £30 on the sea route, we decided on it. From Palestine to Meshed, at the Eastern end of Iran, there is only one main route, but from Meshed to India we hoped to go through Afghanistan. If when we got there this proved impossible, we had the alternative route south through Baluchistan.

So, having decided on the route, we applied for the necessary leave. Here fortune favoured us, for it so happened that our "trooper" was not due to leave for seven weeks after the end of our final course at Gosport, and, if we left immediately the course was over, we had every chance of getting to India before the ship. Our leave was eventually granted, and we agreed that, if we arrived after the "trooper," we should forfeit pay during the interim period.

Now that we had burnt our boats, there was no turning back, and the more detailed preparations began. Although to a certain extent we were able to sub-divide the work and to give each individual a definite responsibility, it was obvious that all the major points would have to be decided by conference. So a new Soviet was born and was entirely successful from start to finish. The choice of a car was the first consideration, and a good deal of time was spent in consultation with various firms. From the start we had our eyes on a Ford V.8 Utility Van (variously called bread van, station wagon and shooting brake), as it appeared to be the only standard design that would accommodate the four of us and as much kit as we had to take. It had the further advantage that we could dispense with tents and fit up bunks inside the car.

We were strongly advised to take two cars, and this would obviously have been a wise precaution, but we decided that we could not afford the double running expenses, nor the wear on nerves in driving 7,000 miles in convoy. At this stage, too, opinions were divided as to whether or not we would be required to pay the 33⅓ per cent. customs duty on entering India. The matter was settled when a V.8, in excellent condition and at a reasonable price, appeared on the second-hand market. The alterations and additions which we considered necessary were done partly by the suppliers and partly by ourselves. A list of spares to be carried was also compiled, and the purchase of them made.

The necessary *visas* for our passports were obtained through Messrs. Thos. Cook and Sons without difficulty. Only one embassy required a personal visit from all of us; another was unable to supply the papers in time for our departure from England, but we picked them up safely in Cairo. Investigations with regard to money

were also made, and we decided to carry World Letters of Credit together with a few English pound notes for emergencies. In addition we started from England with sufficient French and Italian money to get us through France, Italy and Libya. Our general policy as regards finance was to obtain the currency of any country before we got to that country, and to avoid carrying any of that currency out of the country. This is the most economical method, but it requires careful budgeting, and in some cases it is subject to official restriction. Any emergency, of course, has to be met by buying at the lower rate on the spot, and any surplus can usually be expended on petrol before passing out of the country, as there appears to be no customs' restriction on petrol.

One matter which was not easily decided was whether or not to accept a generous offer of a fitted wireless at half-price. We were warned against possible customs difficulties and against poor reception, and so decided against it—a definite mistake. We longed to take some shot-guns, too, but this was absolutely impossible.

The provision of maps and route sheets was done entirely through the A.A. and the War Office, and we started off with a very satisfactory set, which we supplemented *en route*. The A.A. routes, though sometimes inaccurate in detail, are invaluable, as they are kept up-to-date by reports from those who, like us, use them, and they obviate the necessity of carrying great numbers of large-scale maps. There was never any doubt as to where we would be able to obtain petrol and water, though we were wisely advised always to carry sufficient for the next filling point but one.

Among other matters which required detailed investigation before we set out were :—

(*a*) Cross-Channel tickets (through A.A.) and tickets for the Mediterranean crossing (through C.I.T.).
(*b*) Collecting as much advice as possible from those with experience of the countries on our route.
(*c*) Collecting introductions to various people on the route.
(*d*) Ensuring that all papers were in order.
(*e*) Provision of tinned food and cooking utensils, Primus stove, etc.
(*f*) Supply of medicine chest.

These, and many other minor details, were done by individual members of the party, and we came to consider Rosher as the mechanical expert, Lyall Grant as the financial wizard, Lindsell as the document merchant, while I administered succour to the needs of the inner man.

The date of our departure had to be decided very early in the proceedings, to fit in with the sailings across the Mediterranean, and February 10th was named. During our two and a half months of

preparation there were naturally times of doubt and misgiving, and others when things went forward with a rush. Vital arrangements were being made even in the last week, but we eventually left Folkestone confident that our preparations were as complete as we could ever hope to make them, and with enough optimism to banish any feeling of apprehension for the future.

The Journey.

As a starting-point, Boulogne has the distinct advantage that from it the road to the south is both wide and straight, and one can travel fast although unaccustomed to driving on the right of the road. We reached Paris the first night, and 48 hours' later some fast driving brought us to Cannes. We had decided on the slightly longer route to Italy *via* the Riviera rather than *via* Switzerland, as the latter entailed entraining the car through the St. Gothard Tunnel. The next day we entered Italy, where petrol worked out at over 3s. per gallon, and spent one night at Rapallo and the next in Rome. We had allowed 10 days to do the 1,800-odd miles to Syracuse, and as we had done 1,300 miles in 4½ days, we felt justified in taking a day's rest in Rome. We found that the system, which we adopted, of changing over drivers every 50 miles was most satisfactory throughout the trip.

Up till now the weather had been cold and extremely wet, even on the Riviera, and on 16th February we encountered snow between Rome and Naples. That day we clocked 90 m.p.h. on an *autostrada* near Pompeii, and then made a detour through Sorrento to see the Isle of Capri. Another day's motoring through the poverty-stricken South brought us to the Straits of Messina—memorable for the remark made by the captain of the ferry boat when we told him our ultimate destination: "The English, they are so brave." In Sicily, the road runs *via* Taormina, the renowned honeymoon resort, to Syracuse, which we reached on the evening of the 18th. The s.s. *Milano*, upon which we embarked next day, is an Italian Colonial boat, and was full of settlers and soldiers for Libya. An exceedingly rough sea and third-class berths made the next 36 hours quite the most uncomfortable part of the whole journey for at least one member of the party.

The harbour of Bengasi in Libya is purely artificial, and dredgers are unable to compete with the continual silting up alongside the quay. The steamer therefore stood out in the middle of the harbour, and the sea was so rough even inside the harbour that it was impossible to transfer the car to a lighter. What was worse, was that we had gone ashore without any kit, and nobody would risk rowing out to the ship again to fetch it. So we had to wait 24 hours in Bengasi without any kit, and we therefore had plenty of time to see the

place and its inhabitants. Now as always we were treated extremely well by the Italians, who, like all foreigners, are susceptible to the offer of a Players' cigarette, a visiting card and a joke. In Bengasi, as in many other places, we used our cameras discreetly, and no one at any time took any active dislike to them.

"Mussolini's Highway," which runs all along the Libyan coast, is a well-engineered road through rocky desert. There are only three or four towns on it, and these are principally military or naval garrison towns; in between there are hamlets and lone settlers' homes. The road itself lies from one to two miles inland, and south of it there exists nothing but the sandy desert; between sea and road exists a narrow green belt containing what little cultivation there is. Between Bengasi and Cairo we camped at nights—usually rather a wet proceeding. This was especially the case one night, when we woke up to find ourselves ditched, and got out only through the assistance of an Italian officer who happened to pass by. On entering Egypt roads vanish, and we were fortunate to find it just dry enough to cross the Western Desert. We camped for a night between Mersa-Matruh and Alexandria, and that night it pelted with rain so much that we needed good navigation and good luck to reach the new Alexandria to Cairo road. The track was closed behind us for two or three days immediately afterwards.

The hospitality of many friends in Cairo gave us a welcome rest and enabled the engine to be de-coked—the only time throughout the trip that we had to "have the top off," and a sufficient testimony to the reliability of the V.8 engine.

The Suez Canal was crossed at the free ferry at El Kubri, a few miles north of Suez town, and once east of Suez we pushed on across the Sinai desert with renewed energy. The surface of the road was for the most party sandy, with occasional metalled and tarred stretches. Fortunately there had been little rain, and beginners' luck favoured us; the rain which we had encountered in North Africa pursued us all the way to Jerusalem but never quite overtook us. The Cairo–Jerusalem run can be completed in a day in the dry season (it is only 360 miles), but in February the road has not recovered from the winter. Even so, we were later to appreciate the wise action of the Governor of Sinai in closing the road in wet weather, so as to prevent it being broken up and rutted by heavy traffic. We passed only one car between Suez and Beersheba, and over the dangerous stretch of road from Hebron to Bethlehem, a favourite place for Arab attacks, and ideal country for bandits, we were comforted by our own automatics and a police armoured-car as advance guard.

It rained heavily and continuously for three days about now, and our prospects for the future looked gloomy, as swollen rivers would make the fords beyond Amman impassable. However, at the first

opportunity we set out from Jerusalem, and we were fortunate to have as a pilot car that of the Officer Commanding the Trans-Jordon Frontier Force, who was returning to Zerqua. After the steep drop from Jerusalem to Jericho and the Dead Sea, it was refreshing to reach the High Plateau at Es Salt; we encountered some difficulty near Amman, where the rain-filled *wadis* were eating away the foundations of the road.

About 80 miles from Jerusalem one enters the South Syrian desert, and we drove due north for about 20 miles until we hit the long straight telegraph line which marks the Iraq Petroleum Company's pipe-line. Across the long stretch to Baghdad it is usual to travel in a convoy of some sort, and we were strongly advised to arrange one. This again would have entailed extra expense, and we would have had to have gone north to Damascus to pick one up. We decided to risk it, and to carry with us an ample supply of food, water and petrol. We did, however, take the precaution of arranging telephone or wireless communication between our various stopping points, so that if we had a breakdown, it would be known. The conditions of the travel across this desert have improved enormously during the last few years, thanks to the activities of the I.P.C., who have built a metal road over the bad stretches, cleared a track through the basalt rock, and set up capacious pumping stations, at 100-mile intervals, where a warm welcome is given to travellers. At "H.3" pumping station, the track leaves the pipe-line, and strikes across the featureless desert to Rutbah Wells. From here to Ramadi there is no definite track, and one chooses what appears to be the dryest and smoothest route, at the same time keeping an eye open for the sign-posts which have been erected every five kilometres. These are an absolute godsend in a desert, where, twisting and turning to avoid ruts and soft patches, one loses all sense of direction. The going is monotonous and one is glad of such diversions as drinking tea with men of the Arab Legion, watching an Imperial Airways flying-boat go over, or chasing a grey fox across the sand.

Between Baghdad and the Iranian boundary extremely wet conditions were experienced, and once inside Iran we were confronted with the snow problem. The two passes of Assadabad and Aveh, each between 8,500 and 9,000 feet, were snow-covered, and on the former a gang of 20 to 30 men were working continuously in a blinding blizzard in order to keep it open. In Iran the roads are well metalled, but there is a continual stream of heavy petrol lorries which hold the centre of the road, working it into small corrugations, which cause intense discomfort in a touring car, and shake the body to pieces. As a result of the continual vibration, all our shock-absorbers eventually became broken, and our springs began to disintegrate.

From Teheran, the modern capital of Iran, we made a detour to see

the Caspian Sea—memorable for the large number of wild duck which we saw, and the excellent fresh salmon which we ate, and, of course, for its caviare—and it was between here and Meshed that our major troubles befell us. We had been unable to acquire new shock-absorbers anywhere (and welding proved useless), and the continual vibration and knocks caused the leaves of our back spring to shift so much that we were compelled to put in our spare spring on the road. The five hours spent doing this with the able assistance of two lorry drivers was not our only trouble that day, for we were pushing on to the next village (Nishapur) in the dark when the road suddenly disappeared from beneath us. Recent heavy rains had washed away nine-tenths of a culvert, and we landed astride the small strip that remained. Five hours' digging and levering was necessary to get us clear, and that day involved 16½ hours on the road to cover 75 miles

The eastern end of Persia will be remembered for its hordes of beggars and its large snowdrifts, and here began the practice which was continued right through Afghanistan, of providing a police guard at the *massis* and rest-houses at which we spent our nights. In Meshed we were lucky enough to see two immense carpets being made, one for the Shah and the other for the Iranian Parliament. Every stitch and thread was being inserted by hand, and each carpet represented a four-year task for two gangs of 16 men, who worked alternatively throughout the 24 hours of every day.

Our short stays in Teheran and Meshed had enabled us to get the various special passes and other papers to carry us through Afghanistan without trouble. Most people doing this trip avoid Afghanistan by going south from Meshed to Seistan and Baluchistan, and therefore it was something of a thrill to find ourselves outside Iran and inside Afghanistan. The track as far as Herat took careful negotiation, and we had one very anxious moment when our engine stalled in an unpleasantly deep ford and refused to be restarted for some minutes. Herat is a likeable city, and there was many a laugh to be had from the robot-like police, and from the difficulty of getting Afghan money in return for an English cheque. Here we were more than grateful for the help of an English-speaking Government official, who came and visited us and made arrangements for help to be forthcoming in several of the difficulties we would encounter ahead; especially at Jija, where we had to ford the flooded river Adraskand. In recent years much progress has been made in building new roads and bridging the many large Afghan rivers, which in March are swollen by the snow melting in the mountain tops. At Jija the construction of a bridge has barely begun, and as the ford was three feet deep and 70 yards across, we decided to abandon the car in favour of camels, while about 40 labourers pushed the car through the fast-running stream. Again, at Girishk, the formidable river Helmand was crossed by a dilapidated raft without landing stages, cables, or

1.—A snowbound road in Iran.

2.—Teheran. A main street.

3.—Filling up in Afghanistan.

Overland to India, 1938 1-3

4.—Ditched, in the centre of the road near Farrah in Afghanistan.

5.—Many hands make light work, when unditching.

6.—Crossing the River Helmand in Afghanistan.

Overland to India, 1938 4-6

discipline. It took two attempts and three nerve-wrecking hours to get us across this last obstacle. The going throughout Afghanistan had been very laborious, and we were quite relieved to get to Kandahar, ahead of which we knew that there were no serious obstacles, except the possibility of snow on the high plateau between Ghazni and Kabul. With plenty of time to spare we were more than glad to accept the kind hospitality offered us by the Legation at Kabul, and then eventually to continue through Jallalabad to the Khyber. Surely there can be no grander way than this of entering India for the first time.

Nowshera, our finishing post, was reached on April 3rd, after $7\frac{1}{2}$ weeks, and a short detour through the cantonment enabled us to pass the post with the Odometer showing exactly 7,000 miles more than when we left Fleet.

Administrative Arrangements.

Sleeping.

Tents were not used. A canvas, stretcher-like arrangement, fitted between the top of the tailboard and the top of the front seat, enabled all four of us to sleep inside the car, two on the bunk, and two on the floor. Lilo air mattresses were taken, and proved indispensable, especially in some of the inhospitable Iranian *massis* and so-called hotels.

Food.

We ate a considerable amount of tinned food, and always carried at least three days' supply. In the majority of places the local food seemed wholesome if sometimes rather unpalatable. In particular, eggs and unleavened bread were obtained everywhere, and usually honey.

Good tinned food is obtainable at the N.A.A.F.I. at Jerusalem, and we found Harris' tinned stew particularly satisfying. An ample supply of chocolate and oranges was invariably with us.

Water.

A large supply of chlorinating powder was used, and proved invaluable; the addition of the correct amount of hypo before drinking effectively removes the taste. With this method of purification we were able to drink any water available, and at no time did we suffer any ill-effects from it.

A reserve of at least four gallons was invariably carried, in screw-top petrol tins.

Medicine.

Before starting we all had T.A.B. and anti-cholera innoculations, and also vaccination against small-pox. Out of the large stock of

first-aid requisites taken, quinine, castor oil, and chlorodine alone were used.

Petrol.

During our preparations we had seriously considered the idea of fitting an extra tank, and had decided against it on account of bulk and expense, and because over the longest stretch we would in any case have to carry some tins of petrol as well. The four-gallon tins which we obtained everywhere outside Europe were perfectly satisfactory provided they were properly packed; the slightest blow will start a leak.

The places of supply of petrol were indicated on our route sheets, and we always carried enough to get us to the next filling point but one. From Jerusalem to Baghdad it is necessary to carry enough for the whole stretch of 1,000 miles, and we actually had 10 gallons in the tank and 52 gallons in tins.

The quality of the petrol varied a good deal, and chronic pinking was at times experienced.

Oil.

Always one sump-full spare (one gallon).

Repairs.

We did all repairs of a small nature ourselves, and usually found plenty of small jobs to do. It was generally advisable to mend our own bursts and punctures. Major repairs were fortunately confined to body and springs, so that no special equipment was necessary. Between Baghdad and Peshawar an adequate supply of spares does not exist, and it is almost impossible to get accurate work done. But every lorry-driver is an expert at patching up trouble.

Car Papers.

The international papers supplied by the A.A. cover every country except Afghanistan and India, for both of which no papers are needed.

The cost of insurance outside Europe was prohibitive, and the car was therefore only insured as far as Sicily.

Personal Papers.

All information is obtained from the Passport Office, and Thos. Cook and Son, Ltd., will, for a small fee, obtain all necessary *visas*. It pays to spend some time *en route* discovering the local regulations.

International driving licences are supplied by the A.A.

Languages.

The only languages known among the party were:—

French. A working knowledge.
German, Italian } "Restaurant and hotel" standard.

We knew not one word of Arabic, Persian, Pashtu or Urdu, but we found the language of signs most effective !

Extras and Spares.

1. Extras fitted, and found essential :—
   (1) Bunks.
   (2) Internal lighting.
   (3) Locks on all doors and on petrol tank.
   (4) Oil-bath air filter.
   (5) X.P.M. cover over petrol tank.
   (6) Ford Tractor spring instead of standard rear spring.
   (7) Two spare wheels complete.
   (8) Complete set of Parsons' chains.
   (9) Petrol filter funnel.

2. Extras not fitted, but desirable :—
   (1) A third spare wheel complete.
   (2) A wireless.
   (3) Auxiliary springs to relieve shock-absorbers.

3. Spares and tools taken, and found necessary :—
   (1) A rear spring.
   (2) Set of sparking plugs.
   (3) Complete set of tools.
   (4) Hammer and cold chisel.
   (5) Tyre repair outfit, and Dunlop gaiters.
   (6) Two jacks.
   (7) Set of gaskets.
   (8) Nuts, bolts, split-pins.
   (9) Spade and tow rope.
   (10) Hose connections.
   (11) Electrical—coil, condenser, contact-breaker arm, bulbs and fuses, wire.
   (12) For unditching, 2-ft. lengths of bamboo pole, 2 in. diameter.

4. Spares not taken, but desirable :—
   (1) Hydraulic jack.
   (2) Set of shock-absorbers.

FACTS AND FIGURES.

Total mileage, Fleet to Nowshera	7,000 miles.
Total petrol consumption	425 gallons.
Average petrol consumption	16.47 m.p.g.
Average cost of petrol	1s. 8½d. per gallon.
(Highest cost, 3s. 4d. p.g. in Italy.)	
(Lowest cost, 10½d. p.g. in Iran.)	

Total running expenses	£57 15s.
Average running expenses	1.98d. per mile.

The running expenses do not include the cost of spares before the start (between £25 and £30), but they do include everything bought *en route*, including three complete new tyres.

Longest day's run	332 miles, in France.
Number of punctures and burst tyres ..	20

Total cost of trip .. £194, or £48 10s. per head.

This figure includes the fitting out of the car, but not the actual purchase of it.

CONCLUSION.

The achievement of the trip at a cost of under £50 per head is, we consider, worthy of note, especially as reliable estimates before the start varied from £200 to £70 per head. We ourselves thought we were optimistic in hoping to do it for £50 each.

All along the route there were signs of new construction, and the provision of better roads and adequate bridges combined with the possibility of doing the trip so cheaply makes one look forward to the time, within ten years, when the overland route will be a rival to the sea route.

PROFESSIONAL NOTE.

PAINTING.

THE accompanying sketches show the construction of the notice boards and method of fixing them at Lydd, to which reference was made in the June, 1938, *R.E. Journal.*

Exposure tests of Dulux (Nobel Chemical Finishes, Ltd.), and other paints are being continued with the co-operation of the W.D. Chemist. The immediate object of the tests is to correlate long term exposure under the conditions of ordinary practice with short period exposures under controlled climatic conditions in the laboratory.

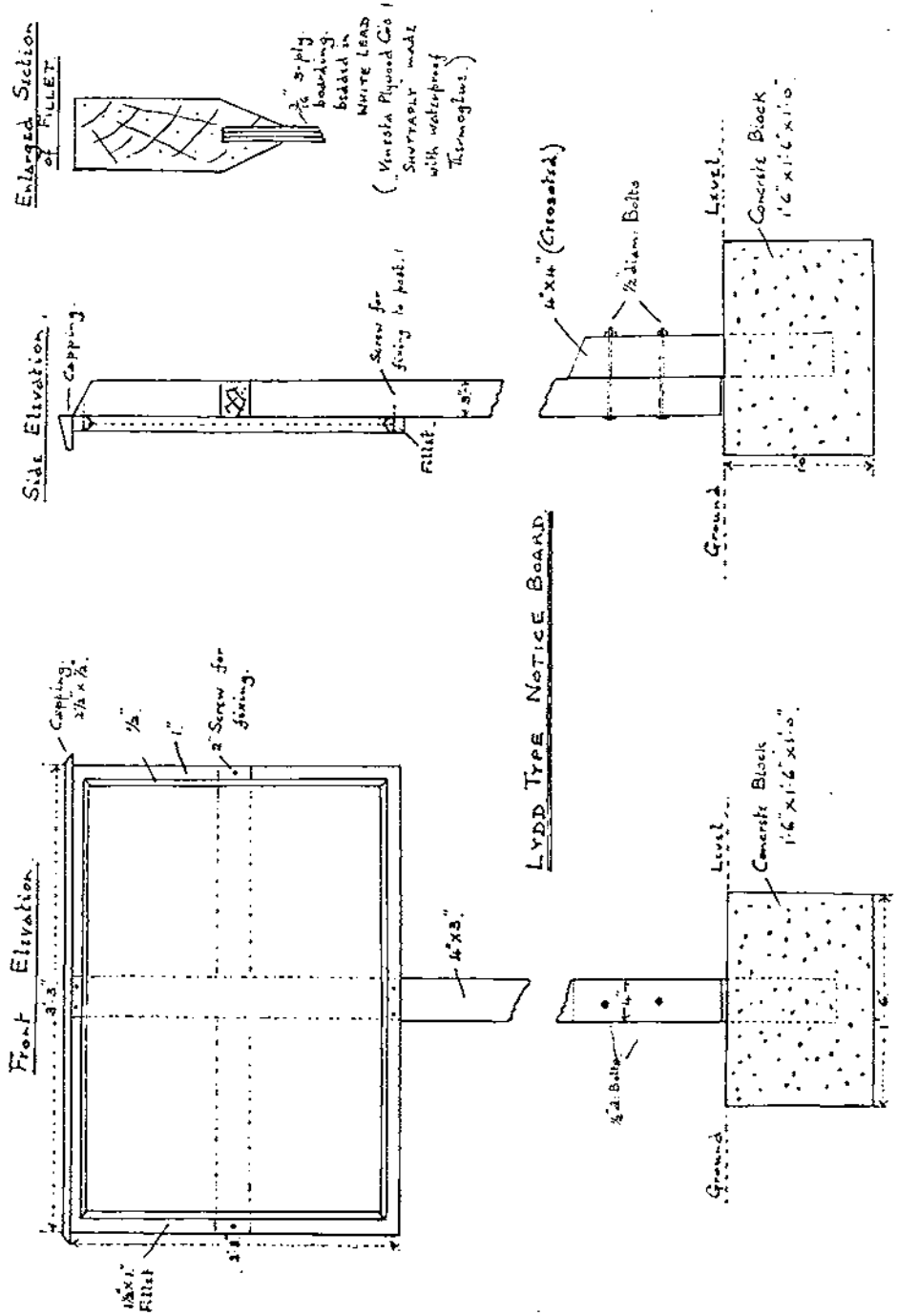
It has been suggested that as the hitherto inflexible periods laid down for "periodical painting" have been recently considerably relaxed, this might be the jumping-off point for a new effort to reduce the annual cost of W.D. painting by improving the efficiency of the protective coatings actually applied in ordinary practice.

It appears that the Woolwich efforts towards this desirable goal have hitherto been limited to the continued improvement of the specifications upon which W.D. (ordnance) paints are purchased in the cheapest market. But the protection afforded by the paint depends just as much, if not more, upon the manner of its application than on the quality of the material itself. Hitherto the absence of any effective specification to control the manner in which the paint must be applied and the compulsory acceptance of the lowest tender for the work have given us the paintwork to which we believe we have become accustomed since before living memory.

Few can have supposed, if for a moment thought did turn to doubt the efficacy of regulation, that in the end the system could be giving us the cheapest protection covering. It must have been noticed, for instance, that all but the very best paintwork is now usually done with the largest long haired brushes; this, in itself alone, is enough to make it impossible to apply the quality of coating required for good work.

No doubt better specifications will presently be devised than the following, which has been proposed to control the painters' application of the material.

Pre-supposing the condition that W.D. paint, ready mixed for use, shall be applied by the contractor without the addition of any


LYDD TYPE NOTICE BOARD
Front Elevation
Capping 1½"×½"
½"
1"
2" Screw for fixing.
4"×3"
1½"×1" Fillet
Side Elevation
Capping
Screw for fixing to post
Fillet
Enlarged Section of Fillet
¼" 3-ply boarding bedded in white lead
("Venesta Plywood Co.'s Shuttaple" mark with waterproof Thermoglues.)
4"×4" (Creosoted)
½" diam. Bolts
Level
Concrete Block 1'6"×1'6"×1'0"
Ground
½" Bolts
Level
Cement Block 1'6"×1'6"×1'0"
Ground

other ingredient, the efficiency of the coating will depend on the thoroughness of cleaning down and the proper working on of the paint in a thin coat. A thin coat thus applied dries quickly under normal conditions, *i.e.*, a dry clean surface and a not abnormally humid atmosphere.

This normal drying period could be used as a test of efficient application of standard W.D. paint: and in this case all that would be necessary to add to the special conditions of contract would be a clause to limit the number of men employed on a contract to such as it was calculated should complete the work during the dry season doing the work thoroughly. It would then be possible, by beginning the first coat at one end of the Barracks, to continue the coat slowly towards the other, setting another party to proceed with the second and following coats at a few days' interval. The proper inspection of the quality of this work would then be a very simple matter, and the life of the result at each particular site, being a matter of simple record, would be a reliable test of the real life of all W.D. paint.

T.T.B.

MEMOIRS.

LT.-GENERAL SIR WILLIAM T. SHONE, K.C.B., D.S.O.
Colonel Commandant R.E.

WILLIAM TERENCE SHONE was the youngest son of John Allen Shone of Monkstown, and was born on March 8th, 1850. He was commissioned in the Corps from the Royal Military Academy in January, 1871. After leaving the S.M.E. he served for a few months at Pembroke Dock, and then, in September, 1873, he went to India, where he was to pass the greater part of his service life. He spent the first year there at Roorkee, being attached to the Bengal Sappers and Miners and, later, on Irrigation work. At the beginning of 1875 he went to Calcutta and acted for a few months as Assistant Secretary to Government in the Public Works Department, but returned in September to the Punjab where, until 1878, he was Assistant Engineer in various stations. In 1879–80, he saw his first active service as Assistant Field Engineer in the second Afghan War, with the 2nd Division on the Khaibar Line (medal). At the end of this war, he returned to the Military Works in the Punjab, but in the middle of 1881, went again as Assistant Field Engineer in the Mahsud Waziri expedition of that year, receiving the Indian General Service Medal with Clasp and being mentioned in Dispatches. He spent most of 1882 and 1883 on leave, and on returning to India in 1884, served as Executive Engineer at Meerut and Saugor, and in the autumn of 1885, went on special duty to the office of the Inspector General, M.W.D., at Simla. From Simla, in November, 1885, he joined the Burmese expedition under Sir H. Prendergast as Field Engineer and, after the capture of Mandalay, remained in Burma during the subsequent clearing up of the country till 1887, when he was invalided home. For his services in this campaign he was mentioned in Dispatches, added two clasps to his I.G.S. medal and was awarded the D.S.O. After the expiration of his sick leave, he spent a year in England at the S.M.E., the I.G.F.'s office and the Artillery College at Woolwich. He went back to India in March, 1889, was placed in charge of the construction of the fortifications guarding Rawalpindi, and in the same year attained his majority. In the summer of 1891, and the subsequent cold weather he was C.R.E. in the two Miranzai expeditions, which resulted in the establishment of posts on the Samana Ridge. He was mentioned in Dispatches, obtained another clasp and was promoted Brevet Lieut.-Colonel. After this campaign he again took charge of per-

Lt Gen Sir William Terrence Shone KCB DSO

manent fortification work, this time at Attock, at what is perhaps strategically the most important river crossing in India. He left this work in March, 1894, to act as Deputy Director of Military Works at Simla, but in 1895 was again on active service as C.R.E., line of communications, with the Chitral Relief Force under Sir Robert Low. Here he was again mentioned in Dispatches and, besides obtaining the new Frontier Medal and clasp, was awarded the C.B. and (while still a Major in the Corps) a Brevet Colonelcy. He returned to his work at Simla, and in 1896 went to Quetta as Executive Engineer (later Superintending Engineer), M.W.D. He was promoted Lieut.-Colonel in August, 1896. He was on leave in 1897 and so missed the frontier campaigns of that year. In September, 1898, he went to Mian Mir (Lahore Cantonment) as Superintending Engineer, and in June, 1899, to Ootacamund as Chief Engineer of the Madras Command.

He was promoted Colonel in September, 1900, and in November of that year went for the last time on active service with the China Expeditionary Force, as Chief Engineer with the rank of Brigadier-General. He was again mentioned in Dispatches. He returned to India at the end of February, 1901, and in April, was appointed Director-General of Military Works in India with the temporary rank of Major-General. This rank was confirmed in April, 1902, but he only held the appointment for two years, as in April, 1903, he went to England to become Inspector-General of Fortifications. But this appointment again only lasted ten months. The report of the Esher Committee, signed in January, 1904, and adopted by the Government, recommended the abolition of the appointment of Inspector-General of Fortifications. With this office, which had been derived in 1802 from that of Chief Engineer of England, the Corps ceased to have an official head on the active list, and in February, 1904, General Shone went on the unemployed list. He was offered, but declined, the Governorship of Bermuda. He had been promoted Lieut.-General in December, 1903, and was awarded the K.C.B. in June, 1906. He retired in February, 1907.

During the period he held his appointment as I.G.F., he was Chairman of the Committee of the R.E. Institute.

He was appointed Colonel Commandant of the Corps in September, 1918.

After his retirement, Sir William Shone first lived at Goring. He moved to Bassett, Southampton, in 1912, where he stayed till 1924, and where he was military representative on the local tribunal during the early part of the war, and was for many years chairman of the Free Eye Hospital. His next home was in Cheyne Court in London for two years and then from 1927 to 1931 at Haslemere, where he was President of the Haslemere Branch of the British Legion. He then moved to Bournemouth. He was Vice-President of

the R.E. Old Comrades' Association for many years, and it was a great grief to him that during the latter years of his life his health did not allow him to take any active part in the duties of a Colonel Commandant or in helping the various R.E. charities and organizations in which he was interested.

He died at Bournemouth on July 11th, 1938.

Throughout his service, Sir William Shone was an unusually capable officer, with sound opinions of his own ; he disliked humbug or anything of an underhand nature ; and he was a reliable friend and a pleasant companion. He was essentially an engineer officer. He rose to high rank without any staff employment. He served in six campaigns as an engineer, always with credit, the last three in positions of great responsibility. He was in charge of important works in time of peace and he finally held in succession the two most important engineer appointments in the Army. His career was cut short by changes in organization and his removal from his last appointment reflected no discredit on him. The last holder of the office was indeed by no means unworthy of the long line of distinguished Inspectors-General of Fortification.

In 1893, when Major and Brevet Lieut.-Colonel, he married Janet, daughter of the Right Hon. Gerald Fitzgibbon, Lord Justice of Appeal for Ireland. Lady Shone survives him, as also a son, who is at present First Secretary to the British Legation in Belgrade ; they also had a daughter, who died at Haslemere in 1930.

MAJOR-GENERAL SIR FREDERIC MANLEY GLUBB, K.C.M.G., C.B., D.S.O.

MAJOR-GENERAL SIR FREDERIC GLUBB, K.C.M.G., C.B., D.S.O., who died in London on 31st July last, meant more to his generation than his career, distinguished though it was, is apt at first sight to suggest; much more than is realised, nineteen years after his retirement, by the Corps of to-day. It is no disparagement of his contemporaries to say that in the latter stages of the Great War, and particularly after Messines, his reputation as a military engineer stood second to none in the Army, and it was on account only of his age, as he was informed by the Commander-in-Chief, that he was not chosen to succeed General Rice as Engineer-in-Chief on the Western Front.

It was, however, the man himself, even more than his experience and ability, that gave him the implicit trust of his superiors, the affection and admiration of all who came in contact with him and a position something akin to that of the "elder statesman" in the Corps in France. With a great heart in a small body and the dignity of complete simplicity, he combined high principles with a mellow sympathy and a quiet humour which endeared him to the younger generation, whilst exacting from them the last ounce that they were able to give. He had that great gift for a commander that he could inspire wholesome respect together with affection. He was not a man with whom either chances or liberties were taken and it is not possible to improve on what his liaison officer in Italy, Signor Guilio Caetani (afterwards Italian Minister in Washington) said of him, after a comparatively short acquaintance—"I shall be sorry to leave the General—he is a man."

Frederic Manley Glubb came of an old Cornish family. The son of Orlando Manley Glubb, an officer in the 37th Bengal Infantry, he was born in India on 19th August, 1857, during the Mutiny. On the death of his father some six years later, he came home and was brought up at Shermanbury in Sussex, where his grandfather was vicar. He was educated at Wellington and the R.M.A., Woolwich, being gazetted Lieutenant R.E. on 25th January, 1877.

The earlier part of his career was generally uneventful, though moves were apparently as frequent then as now. Within fifteen months of leaving the S.M.E. in 1879, he had served in the 24th Coy. at Portsmouth, the 6th Coy. at the Curragh, had returned to Chatham and sailed for Bermuda, whence, after some three years, he accompanied the 15th Coy. to Malta.

He returned home in 1886 and joined the 12th Field Coy. at Chatham, moving with it to the Curragh the following year. On promotion to Captain in 1888, he was employed on works in Athlone

and in the following year he married Frances Laetitia, daughter of Bernard Bagot, Esquire, *J.P.*, of Auchrane, Co. Roscommon. He sailed for Hong Kong in the following September, where he commanded the Fortress Company for three years, which he filled happily with racing, polo and sailing.

For the six years between his return from Hong Kong and the outbreak of war in South Africa he was employed on works at Preston and Hilsea. He was promoted major in 1895.

After a few months in the 5th Field Coy. at Aldershot, Glubb sailed for South Africa in February, 1900. On 4th April, he took over command of the 17th Field Coy., which had lost its previous Commander, Major H. H. Massy, on Spion Kop. The company was in Clery's 2nd Division and was then at Sunday's River Bridge, north of Ladysmith. From then, until Buller resumed his advance on 2nd May, the company was employed on water supply, railway diversions, bridging and roads. The main impression that Glubb made at that time on the memory of one of his subalterns was the skill with which he handled his rather formidable divisional commander. The 17th Field Coy., took part in Buller's advance through Newcastle and Laing's Neck, employed on general R.E. work. In the attack on Botha's Pass on 8th June, Glubb commanded a small mixed detachment with Hamilton's 2nd Brigade, afterwards returning to the command of his Company and spending the next four months trekking about the country east of Standerton with Clery's mobile column. On 8th November, 1900, a broken leg, the result of his pony putting its foot in a rabbit hole, finished the war for him and he was invalided Home, reaching England in February, 1901. This war brought him a mention in dispatches and the D.S.O.

He was then employed on works in England until the spring of 1903, when he was promoted Lieut.-Colonel and spent two years as C.R.E. Mauritius, followed by three years at Aldershot as C.R.E. Woolmer and Lands. He was promoted brevet Colonel in 1906 and substantive Colonel in April, 1908. Six months later he went to York as Chief Engineer to General Plumer, with whom he was destined to have so long and successful a connection in later years. York must have suited him well, plenty of hunting and shooting and his then staff officer says of him : " He was a perfect man to work for —he always had his table clear of files."

In early 1912 he moved to Salisbury, as C.E. Southern Command, and was there when the war started. On 5th August, 1914, when the 3rd Corps was formed in France, Brigadier-General Glubb was appointed its Chief Engineer and remained with it until, on 12th May 1915, during the second Battle of Ypres, he was appointed Chief Engineer, Second Army, and as such directed the preparation of the Canal Line, round the eastern ramparts of the town. He had been promoted Major-General in the previous February. For the

Maj Gen Frederick Manley Glubb KCMG CB DSO

remaining three and a half years of the war, General Glubb was to remain with the second Army and it was there that he was to make his name. He came to it with a wide experience of all kinds of military engineering, untrammelled by any technical speciality, and he had the qualities of character and personality to make full use of his experience. It was a happy chance that put him with Plumer ; the two men were perfectly in tune ; the Chief Engineer had always a clear grasp of the Commander's intentions and of his part in giving effect to them. His abilities had, perhaps, their greatest scope in the preparations for the battle of Messines. It was a model of a perfectly prepared offensive, the product of the team work of a happy staff, and both above ground and below there was nothing lacking on the engineer side that experience and foresight could suggest. General Glubb always knew most clearly what he wanted and he always got it ; he never left anything to chance, having a firm grasp of detail, but for all that his table was still " clear of files." Above all, he had the same good hands with his subordinates that he had on a horse ; he knew when to drive and when to leave them alone, but he saw to it that they always got there. In the second Army the Gunner and Sapper Major-Generals ran a combined mess with their staffs and the Red Château at Cassel was very definitely an institution in that Army, the spirit of which persisted though the location might change. It was a happy institution of which the little general was very definitely the benevolent, if rather austere, patriarch. Even the Gunner Major-General was no more than the senior member of the family. The younger members became adept at devising " occasions " to justify a relaxation of the simplicity of the régime, which seldom deceived but were usually readily accepted by the General. No picture of him at this time would be complete without reference to the strength of his very rare antipathies. Once formed they were ineradicable. One of his officers he suspected of having smoked in his car (a definite offence, but forgivable) and of denying it—an unforgivable sin which made an early parting expedient. His staff got considerable amusement, and some embarrassment from the fact that all foreigners, especially of the Latin races, were *ipso facto* suspect ; an attitude due less to insularity than to the fact that their minds were incomprehensible to his own Spartan simplicity. No one, however, could be more generous in recognizing their merit when once they had gained his confidence and the fact that this attitude never complicated his dealings with the allied armies is sufficient testimony that he kept it to himself.

When the Italian Expeditionary Force was formed under Plumer at the end of 1917, he took his second Army staff with him and General Glubb became Engineer-in-Chief in Italy. The preparation of this force, with all the complications caused by the dependence of a British force on the administrative services of a foreign army, called

for rapid organization and the solution of many awkward problems against time. The initial task in Italy being the co-ordination and preparation of a defensive line to be occupied by the French, Italians and British, set a complicated problem to the Engineer-in-Chief, which he solved with his usual clarity of purpose and lack of fuss. By the time that General Plumer's H.Q. were recalled to France, as a result of the German spring offensive in 1918, the back of the task was broken.

General Glubb returned to his old post as C.E. 2nd Army in March, 1918, and remained with that Army through the harassing spring of 1918, when, drained of reserves and with skeleton divisions, it clung to the Ypres salient. He was still with it after its victorious advance through Flanders in the autumn, when the Armistice came. He was then sent ahead by General Plumer, who was given command of the Army of Occupation, to work out proposals for the initial occupation of the Rhine bridgehead. Taking with him a small staff, he went on some hundred miles in advance of the Army, in some doubt as to the nature of their reception, but all went well and he had the interest of a private view of the conditions behind the German line. He vacated his appointment as C.E. of the Army of Occupation in April, 1919 and retired in September of that year.

For his services in the war he was mentioned eight times and was created K.C.M.G. in 1918. He had previously been made C.B. in 1914.

From his retirement until his death he lived quietly but far from inactively at Pembury in Kent. It was not in him to spare himself and it was not only as a *J.P.*, as president of the local branch of the British Legion or in the business of the parish that he found a vent for his sense of public duty, but he was always available with help, sympathy and advice for the many who sought it.

His tastes were active and practical; literature, art, history and the like made no appeal to him. All his life he was a keen horseman, a light-weight and with exceptional hands on a horse, he played a good game of polo and rode a very good race in his younger days on his own and other people's ponies. He had plenty of scope for this in Malta and Hong Kong and, later, in Mauritius. He was always very keen to hounds and hunted regularly when in England until the war. He was fond of sailing and a good shot. After the war he took up golf and, though he no longer hunted, he was able to shoot regularly, until his last illness.

It is a difficult task to show a man to those who have not known him, and those who have not known Tony Glubb have missed a refreshing memory of quiet charm and intense underlying virility. Those who have known him, know how much they owe to contact with the strength, wisdom and straightforwardness of his personality. In his simple, self-effacing way he was a great man.

P. DE F.

CORRESPONDENCE.

TRAINING OF R.E. OFFICERS.

Roorkee.
26th October, 1938.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

May I draw attention to a notable contrast in *The R.E. Journal* for September, 1938. In one article, " The Engineers of the German Army," there is a description of military engineers training for their role in war, namely to help the other arms. They appear to have no doubts exactly what this role implies and they are freed from all duties, even including heavy bridging, that do not directly contribute to its fulfilment. In the next article to it is an account of " The Value of Works Service as Engineer Training " from which it appears that the British Army considers " the choice of bricks and tiles . . . and externals such as paths, grass, and bushes, etc." are suitable subjects for the training of its engineers.

In discussions of what the role of the Corps should be, great weight is always given to liaison with the civil profession. But civilian engineers are not without intelligence. They are accustomed to working with such bodies as municipalities, corporations of large institutions, and government departments who have no knowledge of engineering and of whose internal administration the engineers are probably ignorant. Surely the Army is not so peculiarly different that they will not be able to understand its requirements or methods ?

What we as a Corps should be doing for the Army in peace-time is to bring about a thorough practical working liaison with the various institutions of civilian engineering. We could then make sure that when, to meet the requirements of a national war, engineer units and services that exist only on paper in peace have to be raised, the various types of engineer get into the right places to carry out the various tasks that arise. This, after all, is only one small section of national registration which already appears to be on the way.

In civil life the necessary liaison is provided by consulting engineers, who form a relatively very small body. No one disputes that the Corps should contain some officers with specialist and practical engineering experience. These will take the place of the consulting

engineer but their numbers need only be very small if their quality is good.

What the Army expects from the Corps as a whole is not wide engineering knowledge. The actual real engineering required by an army in the field is a subject that the infantry, artillery, or tank officer rarely comes in contact with and therefore takes no interest in. What he expects of us is the organization of work on the army's defensive positions, a thorough mastery of the technique of river-crossings, or large scale demolitions.

These are subjects that no civilian engineer has studied and, when he joins the Army for a national emergency, it is these subjects that he will expect the Royal Engineers to be experts in and to teach him. If we expect to sit in high places and tell civilian experts what to do about railways, heavy bridges, roads, hutments, concrete, etc., we shall only create that friction which we are so anxious to avoid.

What we require for peace training, therefore, is an adequate peace establishment for our field units and ample ground on which to practise our special subjects of defences, rapid light bridging, demolitions, etc., with the fewest possible restrictions. The officers with these units must remain with them long enough to acquire that personal contact between all ranks which is so much better in all other arms of the British Army than in the Corps. Probably more than half the captains and subalterns in the Corps have never served in a British field unit.

In conclusion may I add my own experience of works service to reinforce Lieut. Innes' statement that " works service cannot be classed as training for war . . . work of this nature is the antithesis of military engineering." Though not continuous, my experience of works service has been varied both geographically and in type. It has all been post-war. And from the point of view, either of engineering or of training for war, it has been complete waste of time. Much discussion with other officers shows that I have not been unlucky—only quite average. If all Sappers would ask themselves " what is the problem ; what shall we be required to do in war ? " there would be much more agreement in the Corps on how we should be organized and how we ought to train.

Yours faithfully,

H. J. BOURNE, *Captain, R.E.*

SOIL STABILIZATION AT LYDD.

Rusthall Elms,
Tunbridge Wells, Kent.

15th September, 1938.

To the Editor, *The Royal Engineers Journal.*

DEAR SIR,

Brig.-Gen. Wace has asked for more information about the work on soil stabilization at Lydd. The work was not true stabilization, but was more in the nature of a re-tread or, as he suggests, a cold bituminous macadam mixed in place. Considering the fact that the sub-base was saturated clay, that the water level was in places touching the mixed mat, and that there were no means of draining off the surface water, the results obtained were astonishingly good. Provided the water had been able to dry out fully, there is no question that the results would have been better: the work done has been valuable in showing what can be achieved under the worst possible conditions.

The article was written on the engineering side with the object of showing R.E. officers what was being done and thus interesting them sufficiently to get further similar work tried out.

I am an engineer, not a chemist, and would suggest that for further information on the chemical and analytical side of the work, reference should be made to one of the firms who are specializing in the science of soil stabilization.

Yours faithfully,
T. T. BEHRENS, *Lt.-Colonel.*

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.)

THE NEXT WAR.

A series edited by CAPTAIN LIDDELL HART.

SEA POWER IN THE NEXT WAR, by COMMANDER RUSSELL GRENFELL, R.N.

AIR POWER IN THE NEXT WAR, by J. M. SPAIGHT, C.B., C.B.E.

PROPAGANDA IN THE NEXT WAR, by CAPTAIN SIDNEY ROGERSON.

TANKS IN THE NEXT WAR, by MAJOR E. W. SHEPPARD, O.B.E., M.C.

(Geoffrey Bles. Each Vol. 5s.)

The four volumes of this series which have just been published are to be followed by four more volumes dealing respectively with Infantry, Gas, the Territorials and the Civilian in the Next War. The primary object with which the series is being published is stated by the editor to be to enlighten the intelligent public as to the probabilities of a future war in its various spheres. He also hopes that the military reader may find some stimulus to thought about his problems. Elsewhere the purpose of the series is stated to be to give an idea of the nature of present-day armaments and of the way in which they are likely to be used under modern conditions.

It was hardly to be expected that the editor of a series of books dealing with so speculative a subject as the next war could induce all his team of authors to write with the objects of his series constantly in view. While Mr. Spaight handles his very controversial subject with balance and restraint and Captain Rogerson is always reasonable in his claims and practical in his proposals, so that both their books go far to meet the objects laid down, Commander Grenfell and Major Sheppard have not been so successful in fulfilling the purpose of the series. Carried away by his conviction that our present " big ship " policy is wrong, Commander Grenfell has forgotten that he was to write about the probabilities of the next war and how present-day armaments might be used under modern conditions. It would have been more consistent with his purpose if the editor had found a naval writer who would have dealt with our Navy as it must inevitably be for many years to come, instead of with our Navy as the author thinks it ought to have been. Major Sheppard, on the other hand, who is a historian rather than a prophet or an advocate of forlorn causes, has dealt very fully with the past and the present of tanks but has little to suggest about the future in which the next war lies.

SEA POWER.

Apart from his failure to be guided by the object of the series, Commander Grenfell has written an eminently readable, clear and stimulating book. As an exposition of the author's own ideas and as a challenge to official policy the book can be heartily recommended. But the reader can hardly fail to realize that the author is an extreme

advocate of the school which believes that the day of the big ship is past. Other naval writers, such as Captain Bernard Acworth, have proposed drastic reductions in the size of battleships; but Commander Grenfell surely reaches the *reductio ad absurdum* when he proposes that we should limit our largest warships to some 3,000 tons!

There is nevertheless a great deal in the arguments which Commander Grenfell puts forward so persuasively. The immense size and cost of the modern battleship and the comparatively small number available must inevitably create a tendency to great caution in their employment. Moreover, the fact that they take so long to build means that, in war-time, they are practically irreplaceable. It is therefore quite true that the naval commander-in-chief can "lose the war in an afternoon," whereas his famous forebears in the sailing era could not. Yet need we doubt that our Navy can still produce captains of the calibre of those who in the past have not hesitated to take heavy risks in an adequate cause? Lord Hawke, when warned by his master of the fleet that it would be dangerous to take his ships into Quiberon Bay in a gale, replied: "You have done your duty in pointing out the danger. Now lay me alongside the enemy flagship!"

Where Commander Grenfell throws doubt on the under-water protection of battleships and takes a pessimistic view of our defences against submarines and aircraft, it is difficult to avoid the belief that the wish to adduce further arguments against the big ship has begotten the thought that these dangers will prove fatal to it. Experience with anti-submarine devices and the events of the wars in Spain and China provide evidence which, to the majority of naval officers, does not support these fears.

The well-designed big ship can defy all-comers, and, taking all known factors into consideration, no responsible *person* could recommend such drastic alterations in our naval policy as are advocated in *Sea Power in the Next War*. To re-model our Navy on the lines advocated by Commander Grenfell would be a very long process which would have to be carried out in the face of many unknown factors and would consequently entail the blind acceptance of very great risks.

Chapter III on general developments since the war is one of the best in the book. The effects of naval disarmament and the difficulty of regaining the ground we have lost could hardly be made clearer. Other chapters, too, such as that on the merchant fleet, can be heartily endorsed. The book contains much that is stimulating and much that is good; it is well worth reading as a partisan view on what the Navy ought to be.

AIR POWER.

Mr. Spaight has to deal with the most speculative of the four aspects of the next war which these books cover—and each book in turn adds to our realization of how little can be written about the next war which is not speculation and guesswork. In his earlier chapters, in which he reviews the lessons to be drawn from air operations in 1914–18, he discusses the various post-war doctrines of aerial warfare and examines the available information about air operations in Abyssinia, Spain and China. Mr. Spaight is careful to present the evidence with scrupulous fairness. His manner is that of the judge summing up a case; rather than that of an advocate pleading the cause of air power against its detractors.

In the chapters in which he gives his views on the probable form which air power in action will take, he outlines the steps being taken towards rearmament and emphasizes the importance of building up large reserves. He shares the views of many others in the country to-day when he expresses the view that H.E. and incendiary bombs will be the projectiles to be chiefly used from the air and that gas will be used on a comparatively small scale.

Mr. Spaight's recognition that neither he nor anyone else can forecast with confidence what part air power will play in the next war is epitomized in his sentences "air action will be a factor of vital importance, perhaps the vital factor, in the next

"war" . . . but . . . "it will not be the only factor. The day of armies and fleets "is not past."

PROPAGANDA.

Captain Rogerson's book may well be found to be the most interesting of the four, if only because our literature on propaganda in war is so very scanty. The subject is certainly one upon which anyone who may ever be concerned, even in a humble capacity, with the co-ordination of the national effort in war should be informed. Appreciation of the dangers of the weapon if badly handled is no less important than appreciation of its powers; and Captain Rogerson shows how easily propaganda may recoil on the head of its user.

He deals with his subject in an eminently practical manner. The principles which he lays down, of which the most important is that propaganda must be based on truth, are presented very clearly. So also are the conditions necessary before offensive propaganda can achieve real success. As in 1914–18, offensive propaganda alone can never achieve big results until events have created conditions which render an enemy people receptive. The difficulties with which we would be faced in war in carrying offensive propaganda successfully into various possible enemy countries are frankly discussed and we are left with the impression that it would be unlikely that propaganda would prove fully effective as a means of breaking enemy resistance until war had continued for a considerable time.

Propaganda at home and among neutral countries is dealt with equally adequately, and the potential value of the numerous means which science now provides for the distribution of propaganda provides another aspect of the subject which is of intense interest.

It is common knowledge that this country does not to-day possess an organization for national propaganda comparable with that of certain foreign powers. Captain Rogerson finds in this yet another aspect of our unreadiness for war. The suggestions which he outlines for rectifying this position form a fitting culmination to a first-rate book. The obvious difficulties to be encountered in devising any such organization in a democratic country will certainly leave the reader thinking.

R.H.D.

TANKS.

It has been said that the best prophet of the future is the past. Major Sheppard evidently thinks so, too, since more than three-quarters of his book is concerned with past history.

The growing pains of the tank make depressing reading, particularly, one imagines, to anyone inclined to be wise after the event. But against the drab background of the story, two figures stand out clearly—the two Sappers to whom the tank owes so much; to the one for his imagination and to the other for his leadership. Major Sheppard does justice to them both, while to *Ole Luk-Oie* he pays the further compliment of using a dreamer (as in *Duffer's Drift*) to illustrate the modern tactical doctrines, British and foreign, of tank employment. Consequently, what might have been dry as dust becomes readable—though "potted," inevitably. Up to this point the book constitutes a clear and useful preliminary survey.

We now come to the case for the defence. Here the author adopts the only helpful course and gives the arguments for and against the suggestion "that the anti-tank "defence now has the measure of tank attack." Is there an answer to this proposal? No; not even in *Tanks in the Next War*, for the simple reason that the equation contains too many variables. In other words, circumstances alter cases.

But this is not to say that no conclusions can be drawn from the facts as they exist, and the author, with the utmost restraint, gives us his own. Briefly, they are that post-war progress in the means of anti-tank defence has outstripped that of tank design and construction, so that in future the odds will often be against the tank. But even so, the tank is at present the attacker's most powerful weapon and as such

increases his chances of success. Therefore he cannot afford to be without it, while in the hands of the defender it may be even more potent. In short, the tank, if no longer the ace of trumps in the general's hand, is still in Major Sheppard's opinion, a trump card, while the editor of "The Next War" series writes in his preface: "If the later stages of the World War saw a striking vindication of the tank "pioneers, the more fragmentary evidence obtainable from the latest wars has "provided their opponents with some ground for renewed resistance, and even in "more impartial judgment has raised a doubt whether the wider prospects of mobile "warfare that seemed to be opening are not already being closed by the development "of antidotes to the tank." With which cautious observation there can be little disagreement, for

"There lives more faith in honest doubt,
Believe me, than in half the creeds."

This, then, is as far as the book takes us—to the threshold, perhaps, of the next war. What lies beyond? Has the well of inventiveness dried up? Will the tank stand still while its antidotes improve? Will it learn to swim (*solvitur nando!*) and to negotiate minefields without loss of fighting power? Will it and its weapons be controlled from afar like a "Queen Bee" aeroplane? Will it ever be transported by air? Will it fly?

What absurd suggestions! But so, thought many people who mattered, was the idea of a tank.

I.S.O.P.

MARLBOROUGH.

HIS LIFE AND TIMES.

Vol. IV.

By RT. HON. WINSTON S. CHURCHILL, *P.C., C.H., M.P.*

(*Harrap.* Price 25s.)

This is the fourth and last volume of the classic biography of Marlborough, dealing with the unhappiest period of the astoundingly varied career of this great soldier. It is a story of political intrigues and personal animosities surpassing even those recounted in the previous volumes.

This book opens in the summer of 1708, when the war appeared to be almost at an end. France seemed on the verge of collapse and was prepared for very hard terms. Marlborough was already in correspondence with his nephew, Berwick, and the author clearly exposes the somewhat strange moral code of the times, when Marlborough was prepared to accept an enormous sum of money from the French after a fair peace had been effected. But it is also made clear that, contrary to what many of Marlborough's detractors have often maintained, he was not to be bought: the money was offered as a reward, not as a purchase price. Marlborough undoubtedly desired a peace at this time, but the final ultimatum was worded in such a way to make it almost impossible for Louis XIV to accept, and war went on.

Marlborough was soon manœuvring with all his previous skill, but there is little doubt that he underestimated the moral effect produced on the French by the ultimatum of the Allies and also by the personality of his adversary, Villars. In 1709, they met in the terrible head-on collision of Malplaquet, which is described in a passage of singular brilliance. The Allies were successful, but the moral victory rested with the French, and Marlborough was a changed man. "It disturbed his "mind: it affected his health: it changed his sense of values. . . . Marlborough, "like his army, was morally and physically exhausted by the battle. He had fought "it with all the skill and vehemence he had shown at Blenheim. His plans had "proved successful. He had won at every point. The enemy had been beaten out

" of all their defences and driven from the field as a result of the heart-shaking " struggle. But they had not been routed : they had not been destroyed. They had " got off as an army, and, indeed, as a proud army. They retreated, but they cheered. " They were beaten, but they boasted."

Marlborough's political adversaries immediately seized their chance, and it became clear that his political influence was on the wane. Harley was working with all his back-stair skill and power of propaganda against the Duke to effect the fall of the Whigs : the Queen was obsessed with her desire for a Tory success. Yet Marlborough, ageing and knowing that his whole position was being rapidly undermined, still rose superior to events and, in 1711, in probably the most brilliant of all his manœuvres, pierced the " Ne Plus Ultra " Lines and seized Bouchain in the very face of the French Army. That was the end of him. The Tories were in full cry, and in December he was dismissed by the Queen. The shrewdest comment was that of Louis himself : " The affair of displacing the Duke of Marlborough will do all for us as we desire."

Not content with this, Harley and St. John, while betraying Eugene to Villars, proceeded with charges against the Duke of peculation and corruption, none of which could be upheld, and Marlborough went into exile. It is an unpleasant story.

Meanwhile the Treaty of Utrecht, of which most men in this country spoke with shame for many years afterwards, was negotiated. The author deals drastically with the shameful aspects of this treaty, but, looking back dispassionately to-day, it did provide a reasonable foundation for the subsequent reconstruction of the peace of Europe, although it brought the good name of England low at the time.

In 1716 the Queen died, and the Duke returned to England and to the fickle favour of the populace. He was restored to all his offices, and he spent the greater part of the rest of his life building Blenheim.

One almost feels sad that there are no more volumes of this biography to appear. The author has the exceptional power of writing as vividly and clearly on the intricate political intrigues as on the more colourful details of Marlborough's battles.

This biography is a classic on the political history of the times, as well as on the character of one whom he shows to be possibly the greatest military commander of all time.

THROUGH THE FOG OF WAR.

By LIDDELL HART.

(Faber & Faber, London. 1938. Price 12s. 6d.)

This book by a Military Correspondent of *The Times* is timely because of the last chapter—" Epilogue "—in which the author discusses some lessons from history, and warns us to look ahead in view of what has happened recently in Manchuria, Abyssinia, Spain and Central Europe, where the development of the new technique of " camouflaged war " seems to show that it is identical with what is usually known as " manœuvring for position before the main stroke is delivered." In plain words—We are not yet out of the wood and the sooner we make up our minds as to what we are going to do about it the better. Before we can make up our minds—the author stresses the point—some hard thinking is required if history is not to repeat itself.

He continues : " History shows—to take one instance only, Turkey—that the " counter-pull of Britain's moral impulses and material interests produced an " amazing series of somersaults in British relations with Turkey. We repeatedly " sought to cultivate the Sultan as a counterpoise to French and Russian ambitions " in the Near East, and as often were driven to take action against him, because his " behaviour to his subjects shocked our sense of justice as well as our sentiments. " In the light of a hundred years of history and their sequel the use of our national " gift for compromise may not seem altogether happy. . . . The Englishman is not " Machiavellian. He can never rid himself of moral scruples sufficiently to play the

"part. . . . While we complacently counted on Turkey's gratitude, she did not "forget our unreliability. And by throwing the weight of our influence on the side "of the Sultan and his effete palace clique, against the movement of the Young "Turks towards reform, we not only forfeited our influence in restraining their "excesses, but cold-shouldered them into the embrace of Germany."

The above was written certainly before the recent crisis in Central Europe over Czechoslovakia, but probably since May 21st, 1938.

He continues: "If we learned to look a few moves ahead we should realize the "dangers of condoning evil. . . . Our opportunism is valuable, so far as it means "adaptability, but harmful so far as it only means short-sight."

And concludes: "That we in this country have failed to see this 'war in progress' "may be due to the fact that we are thinking politically, whereas the dictatorship "States are thinking militarily. The situation in this new 'great war,' as it stands "now, is that the attacker has been allowed to come within reach of gaining the "decisive points without a battle; and in the most vital direction we have made "no serious attempt to prevent him. Armament programmes merely belong to the "grand tactics of this modern kind of war; they are vain if you are beaten "strategically. We have been courting this risk."

Time is short—for the attackers. By 1940 we hope that our rearmament may be completed. Germany did not hesitate to fight in 1914, a year before she expected to complete the reorganization of her army and her shipbuilding programme.

The book must not be read backwards, though we are tempted by some of the later chapter headings.

The author has perhaps wisely dropped his military title before venturing to go large on the title of his book, *Through the Fog of War*. The title sounds intriguing and makes one hope for wise words on how to see through the fog. But the fog he deals with is of quite another sort—that encountered by historians of war (or does he mean critics of soldiers?)—the smoke screen—which he alleges the great leaders and the great military historians, of all nationalities, have created to conceal the truth as to what really happened in war, with particular reference to 1914–18.

Taking the last category first, one wonders what was the reaction on the mind of the distinguished Sapper to whom he dedicates (by permission?) this book. If it was intended to warn him that life is short, the writer may rest assured that the object of his concern needs no warning. Years ago, on the death of Sir Julian Corbett, he told the reviewer that he had taken steps to secure an understudy. If it was to lure the unsuspecting victim to read his damnation (see Chapter XXIV, pp. 269–275, and Chapter XXV, p. 281), it was, to say the least, unkind.

We must leave the reader to form his own opinion of the treatment of the victims of the author's "studies." Most are dead; among them, his close friend Lawrence of Arabia alone, in his opinion, had any genius for war.

Marshal Foch and his friend Field-Marshal Sir Henry Wilson he holds jointly responsible for committing Britain to a Continental war, and causing her to depart from her traditional role in war with the command of the sea in her hands. Captain Liddell Hart's dictum invites careful study of the alternatives.

Despite three-quarters of a million casualties at Caporetto, the author absolves Marshal Cadorna and congratulates him on receiving the Field-Marshal's baton as a mark of recognition of "the responsibility he had borne in making possible Italy's "war effort." On the other hand, he cannot forgive Field-Marshals Earl Haig and Sir William Robertson for the losses in the Somme and Passchendaele offensives, and later he questions the validity of the reasons put forward for them and ignores the assistance they gave to France. Moreover, he attributes on more than one occasion motives to Sir Douglas Haig which no one who knew him can allow to go unchallenged.

Field-Marshal Lord Allenby and General Sir Ian Hamilton are more fortunate; and the latter can have little fault to find with pp. 103 to 109. "Sir John Monash,"

he considers, "had probably the greatest capacity for command in modern war "among all who held command in the last war."

Of the French commanders, Joffre, Berthelot (one of Joffre's assistant chief staff officers in 1914) and Sarrail, he tells us nothing new. Berthelot he compares with Sir Henry Wilson: "Each had an amazing capacity for wrong judgment. Wilson "may have been more consistently wrong, but Berthelot was more often wrong."

Captain Liddell Hart seems to have adopted a novel test for his "studies": "Can I find anything that this man has written which will convict him out of his "own mouth?" "Wilson's diary," he writes," contains one instance of how Berthelot "and he competed in error. On 12th September, 1914, the two discussed the probable "date when the Allied armies would cross the German frontier. Wilson modestly "estimated it at four weeks' hence; Berthelot deemed this estimate too conservative "and put it a week earlier!"

Three German generals are included in the list, Bernhardi, Kluck and Ludendorff, but the author tells us nothing new about them. In speaking of Hindenburg he introduces the triple combination Hindenburg-Ludendorff-Hoffmann in preference to the usual bracket. His judgment on Ludendorff is: "Ludendorff is an outstanding "lesson in the dangers of the expert who has so concentrated on his own department "that he is unable to see the part in relation to the whole. He proclaimed the doctrine "of national war while regarding it as merely a super-size soldiers' war. If Germany's "collapse began on the home front it was due above all to the unwisdom of the man "who controlled the battle front." This sounds a profound judgment, but it is not possible to explain it without quoting half a page of the letterpress leading up to it.

The second portion of the book is devoted to the "Views" of Lloyd George, Henry Wilson, Foch, Joffre and Pershing on the Great War. It begins: "History "is a catalogue of mistakes"—the reader, it is hoped, will profit by reading what the author has compressed into these chapters. A cursory glance at "Pershing's View" would indicate that it should have been included in Part I of the book, "Studies." Pershing is still alive, but probably too sick a man to answer Captain Liddell Hart.

Chapter XVII is headed "Peyton March's View (of the War and Pershing)," based on the former's war memoirs, *The Nation at War*, published in 1932—a rare find for our author as an example of the unpleasant things one General can say about another.

Chapter XVIII, "Behind the German Front," commences with a dissertation on the difficulties of the historian and leads up to the value of such books as Rudolph Binding's *The Case of Sergeant Geisha*. Binding was a poet as well as a trained cavalry troop leader and later a staff officer, and, like all Germans, less reticent than the Englishman, he unburdened his soul to his diary. He served on both fronts, first the Western and then the Eastern, where he came in contact with many of the leaders and chief staff officers. Captain Liddell Hart devotes his chapter solely to his comments. The chapter is interesting.

Chapters XIX to XXII are studies of battles from Mons and the Marne to the Somme. Then follows "Two Appreciations"—comments on that made by Haig in October, 1917, for Robertson, and the other by Wetzell in December, 1917, for Ludendorff. Haig's is described as "full of optimistic assumptions which," Captain Liddell Hart says, "were belied by events"; for Wetzell's he has no words too good.

This was the memorandum referred to by General Edmonds when he wrote: "Fortunately for us, Lieut.-Colonel Wetzell's proposals were not accepted, although, "in the end, after the first offensive had come to a standstill, Ludendorff bearing "them in mind, did order the second act—too late."

Chapter XXIV, "The March Breakdown," gives Captain Liddell Hart a chance to pillory both Haig and the British Official Historian, the latter of whom he accuses of trying to cover up the main lessons.

In Chapter XXV, Captain Liddell Hart claims to convict the Official Historian out of his own mouth, asserts that a prophecy of his as to what would happen in the

next war has not occurred in Spain, and finally charges him with being biased in Haig's favour. "It is asking more still," he writes, "to expect that a senior member of "Haig's staff should be capable of unbiased judgment. It is certainly too much to "expect that he could do this when he was also one of Haig's closest friends for forty "years—the future C.-in-C. and the future Official Historian had been fellow-students "at the Staff College. In consequence, there is no cause for surprise that the volume "should fail to keep the balance fairly."

Captain Liddell Hart may excuse himself with the plea that the nation ought to know the truth. But is this the only way that it can be done?

H.B-W.

TO-MORROW'S WAR.

Its Planning, Management and Cost.

By Stephen Possony.

(William Hodge & Co. Price 8s. 6d.)

This book is a translation from the German; but the author's nationality is not stated. He is evidently an economist who has formed his ideas about the future nature and conduct of warfare from extensive reading of military literature—futuristic and historic—without the guidance of practical experience.

The conclusion he arrives at is that "total" war—that is, war waged between great powers, or groups of powers, of approximately equal strength and preparedness—would now entail expenditure of lives and resources far exceeding that of the Great War. That the war machine has grown to such a size and complexity that it can no longer be fed for any length of time by the available economic resources; while at the same time the increased power of defence makes rapid decisive results unattainable. Total war must therefore end, without a decision, in general bankruptcy.

Few would quarrel with that conclusion, but one cannot so easily accept the statistics which Mr. Possony has compiled as a basis for his argument. To arrive at his figures he assumes a war fought, apparently with uniform intensity, on a thousand-kilometre front for a year. He uses that as a multiplier for figures, taken from various sources, of the requirements of armies standing on the defensive or in offensive action respectively on selected occasions.

He ignores the possibilities implied by the principle of economy of force and concentration of effort. Nor does he appear to recognize the improbability of war occurring unless sufficient inequality of strength, preparedness or morale exists to encourage an aggressor to resort to war. Moreover, as he is discussing total war, he refers in passing only to the probability of future wars being waged with a limited objective—wars in which an aggressor pursues a limited object, while relying on the power of the defensive and the general dread of total war to hold intervention at arm's-length.

As a forecast of "To-morrow's War," the book has little value; but when, in the second part of the book, the author deals with the "Problems of Organizing the Economy for War," his views are better worth study, though they clearly are not accepted by all economists. As I understand him, he opposes the idea of developing self-sufficiency as a preparation for war. Accumulation of stocks he holds to be the first essential and this can only be done by expanding foreign trade and credit. Self-sufficiency could never produce the necessary stocks or stand the strain of war wastage. This supports his contention that "the advantages will be with the defen-"sive and blockade must be considered the chief weapon."

On the whole, though we may consider Mr. Possony's statistics exaggerated and unreliable and his military conceptions amateurish, his economic theories, whether sound or not, are at least suggestive. They certainly tend to support the view that no nation is likely to provoke war on a maximum scale deliberately, unless an element

of great disparity exists; that, therefore, war can be averted, and the threat of war resisted, by adequate preparedness. That argument, however, cuts both ways and affords little comfort to small nations, whose elimination may constitute the limited objective of an aggressor.

Incidentally, Mr. Possony is not a believer in the moral effect of air attack producing rapid decisive results.

C.W.G.

LEE, GRANT AND SHERMAN.

By LIEUT.-COLONEL A. H. BURNE, D.S.O.

(Gale & Polden, Ltd. Price 10s. 6d.)

Military histories can obviously be written from two points of view. One object may be to produce as complete and authentic a record of events as is humanly possible. The other may be to effect a study of past events with a view to military instruction and to influencing serving soldiers in their future action. So many military histories unfortunately belong to the first class, partly because so few historians are capable of up-to-date military discussion. Colonel Burne's *Lee, Grant and Sherman* definitely is one of the second variety and as such is greatly to be welcomed.

The second great fault with military histories, for any serious student of war, is their length and abundance of unimportant detail. Colonel Burne has cut down the descriptions of events to the absolute minimum needed to present the problems. Each engagement is followed by comments, searching, fair and instructive, of the type that invite reflection on the part of the reader. This book is a model of how a student should tackle the study of any campaign. The twenty-three simple sketch maps are also ideal for the purpose of presenting the features of a battle quickly and concisely.

The American Civil War must for a variety of reasons always offer a fascinating story to the student of war. The immense size of the theatre of war in relation to the forces available, the consequential problems of time and space, the effects of the changing conditions of war of that period and the peculiar difficulties arising out of the use of "new" as opposed to conscript armies, all contribute to the interest. Utilizing this vast background, the author in this book has brought out how true of all times are the principles of war. Coming on top of our experiences in the Great War, distinguished in the main neither by leadership nor by the general observance of the principles of war, this publication is a valuable correction, for it bubbles over with examples of leadership and of the application of the principles.

Colonel Burne shows very effectively how the personalities of the various commanders affected the results of the war. He traces the consequences of the proper use of interior and exterior lines, of the correct choice of objectives and of the development of the principles of the offensive. To the professional soldier it is interesting to note how often the author has occasion to refer to the importance of staff work, training, intelligence and proper military procedure.

At the close of his description of the Wilderness campaign, the author discusses how far modern weapons and conditions would have affected results. If a criticism may be offered of this book, it is that the writer did not more often insert comments from this angle. Of the Wilderness campaign Colonel Burne writes: "In short, we "are led to the rather surprising conclusion that, if another war were fought in "Virginia, the conditions and method would not be so very different from what "obtained in 1864." With this the reviewer does not quite agree, for, while the vast forests and obstacles would have reduced the value of air forces and mechanization to a humiliating degree, demolitions might well have made operations entirely impossible. Further, the author has overlooked that the important effects of bad intelligence and

bad intercommunication in that campaign would have been largely eliminated by the use of modern means of communication and reconnaissance.

From the engineer's point of view, we, who see so little equipment that our perspective is obscured, ought to read more about the 2,000-ft. pontoon bridge thrown in eight hours over the River James by Grant's engineers in 1864. It is interesting, too, to read that many of the features of trench warfare as evolved, as we thought, in 1914–18, were practised in the nine months of trench warfare outside Richmond fifty years before.

To perfect a book of this nature, the reviewer would like to see a thread of discussion throughout on the assumption that the antagonists possessed the modern equipment and facilities that they reasonably might be expected to have to-morrow. Such a discussion would tend to teach how to use modern instruments in the future, which is the real object of military study. Thus, comments upon the dependence upon railways and upon the possibilities of armies breaking off contact and disappearing in the period under discussion, as compared with similar problems to-day, would be most instructive.

This book is certainly to be recommended to all serious students of war.

If there is any one impression above another of this book left upon the mind of the reviewer, it is the emphasis laid on the fact that the defensive and the avoidance of risk lead nowhere and that only by legitimate risks can big results be obtained.

B.C.D.

DER KAMPFWAGENKRIEG.

(Tank Warfare.)

By General der Artillerie i. R. Ludwig Ritter von Eimannsberger.

(J. F. Lehmann, Munich and Berlin, 1938. Price 6.75 marks.)

When the Armistice was signed in 1918, the tank, although still in its infancy, had already proved itself a weapon of vast potentialities. In this book, which is typical of most German military writings, the author has set out to investigate the probable employment of tanks in a modern European war.

The first part of the book deals with the big tank battles of 1917 and 1918—Cambrai, Soissons and Amiens. In all these battles, tanks and infantry attacked together and had little difficulty in advancing as long as their own artillery could keep up a covering barrage; as soon as the advance reached the limit of this barrage, the attack had to pause until the guns could be brought forward. The defender thus gained precious time to re-organize himself and further attacks did not usually meet with much success. The cavalry, waiting on each occasion to exploit the breakthrough, were not at all effective.

The author points out some of the lessons learnt from these battles. The tank offers a method of overcoming the stalemate of trench warfare, if its initial success can be exploited. Cavalry is of no use for this exploitation; in fact there is no place for horsed cavalry on a modern European battlefield. Tank attacks can succeed without weeks of artillery preparation. The employment of tanks produces cheap victories; the attacker suffers fewer casualties, and saves more money in artillery ammunition than he loses in tanks. Secrecy in preparing for the attack is essential.

The writer then goes on to discuss developments since 1918 and to give details of British and French tanks. He compares the various tanks with ships of war, saying for instance, that our present medium tank is a "battle cruiser" among tanks. Facts are given about certain special types, among which it is interesting to note that Italy has developed a flame-thrower tank, which projects a jet of fire 75 yards long.

The writer next points out that it is purposeless to consider modern tank attacks without knowing what methods of defence are likely to be employed against tanks.

To prevent the infantry from being overrun they must have their own anti-tank weapon, and for this purpose he suggests a 47 mm. gun, which is capable of being used against ground targets as well; against tanks an explosive tracer shell is fired. The gun is to have a total traverse of 150 degrees and is effective against all A.F.V's up to a range of 500 yards. Each infantry battalion should be equipped with six of these guns instead of heavy machine guns. In addition, there should be a divisional anti-tank battalion, giving in all 72 anti-tank guns in the division. The infantry platoon should be provided with the 20 mm. anti-tank rifle, firing an explosive shell. These numbers are worked out on the assumption that each anti-tank gun will account for three tanks before it is itself knocked out, and that in a defensive position there should therefore be not less than eight such guns per kilometre of front.

Regarding other methods of defence, the writer admits that mines are a problem for the tank; he says that tanks will have to recognize them, and avoid or remove them, but he does not make it clear how they are to be recognized. He considers tanks are likely to be used in future European wars only in large numbers, and that the tank itself is of little use as an anti-tank weapon, since the few at the disposal of a surprised defender would be quickly destroyed. Defence against tanks must, therefore, be purely passive, and the author works out a suggested system, which is similar to the trench system of the Great War.

Finally, the book discusses a possible method of breaking through a defensive system by means of a massed tank attack; as a basis for the discussion, the tank battle of Amiens is re-fought under modern conditions. The defender is assumed to hold two main positions, roughly twenty kilometres apart. The writer considers that a complete break-through could be effected in two days by a force of 19 armoured divisions and ten motor divisions, supported by strong air forces. There would be no preliminary concentration or artillery bombardment, so the defender should be completely surprised. The attack on the first enemy position would be made purely by tanks supported by long range howitzers, the infantry following at their own pace, to consolidate the ground won in co-operation with the rear tanks. Meanwhile, strong air attacks on the second position prevent the enemy from organizing his defence there, and this second position is taken before nightfall by a second wave of armoured divisions. Motor divisions hold the front during the night and on the second day a further force of fresh armoured divisions passes right through the gap and starts to roll up the defenders' position.

Since there have been no tank battles of any importance during the fighting in Spain and China, the whole of this book is based on theory; it is, however, a most interesting work, which provides ample food for thought.

D.E.H.

HEIGL'S TASCHENBUCH DER TANKS. PART III. ARMOURED WARFARE.

By CAPTAIN G. P. VON ZEZSCHWITZ.

(J. F. Lehmann, Munich and Berlin, 1938. Price 10 marks.)

Parts I and II of this work have been reviewed in *The R.E. Journal* for March and December, 1935, respectively.

The first portion of Part III is devoted to a description of the main tank attacks during the World War. The writer picks out the mistakes made in each attack and deduces the lessons to be learnt from it.

The Battle of the Somme in 1916 gave the British tanks their baptism of fire; the first tank attack being delivered on the 15th September. Forty-nine Mark I tanks were employed. As a new method of warfare, the attack was a complete surprise for the Germans, and tanks proved their value, especially in bitterly defended localities such as Flers and Gueudecourt. The main defects that came to light were indifferent steering, slow speed and unreliability of drive.

Subsequent tank attacks taught the following lessons :—Tanks should only be employed in masses and on suitable ground ; the German (S.m.K.) armour-piercing bullet penetrated the tank armour, which required thickening ; tanks must be camouflaged ; infantry should be trained to co-operate with them ; artillery preparation should be dispensed with, so as to make a tank attack a surprise.

Whippet tanks were first used towards the end of March, 1918. Their mobility made them very useful, particularly in mobile warfare.

After the turning-point in the war in the midsummer of 1918, mistakes were still made in splitting up tank units in the attack, especially when the element of surprise was lacking and the enemy was fully prepared. There was a lack of collaboration between British and French. They did not profit by each other's experience in the early days of tank warfare.

The Germans delivered their first tank attack in March, 1918, in their onslaught on the British Fifth Army, but the number employed was small. The fighting at Villers-Bretoneux on the 24th April, saw the first tank versus tank engagements. Only 13 German tanks took part, but the writer is of opinion that if 100 had been available, they would have broken through to the gates of Amiens and ensured a decisive German victory.

After a short chapter on the employment of armoured cars between 1914 and 1918, the writer turns to the experiences of tanks since the World War.

During the Allied intervention in Russia in 1918–19, a large number of British and French tanks were lent to the White-Russians, who made all the mistakes in handling them that the British and French had made when tanks were first introduced. In the end, most of the tanks fell into the hands of the Soviet, and formed the ground-work for the modern Russian tank corps.

Tanks were employed in the Russo-Polish War of 1919–20, in the campaign against the Riffs in Morocco, in the Sino-Japanese War since 1932, in the Italo-Abyssinian campaign of 1935–36, and in the Spanish Civil War of 1936–38. In no case have they been employed on a large scale, and there is little to be learnt so far from their use.

The next chapter deals with anti-tank defence since 1916. When the first tank attacks were made on the Germans in September, 1916, the infantry were practically helpless. S.m.K. ammunition, intended for use against gun-shields, was issued to all the infantry, but the main reliance for anti-tank defence was placed in the artillery. The construction of treble ditches was considered to afford an impenetrable obstacle, and mines were extensively used.

The Germans were under the impression that they had overcome the danger of tank attacks, when, on the 20th November, 1917, the Allies surprised them with a mass attack driven home under cover of fog, between Ribecourt and Banteux. After further fighting, the German G.H.Q. recognized that S.m.K. ammunition did not offer sufficient protection against tanks, and they introduced a 13 mm. machine-gun. This was superseded before long by a 2 cm. anti-tank gun, and later by a 3·7 cm. gun. In the final retirement the German infantry suffered severely from tank attacks ; the vast supply of anti-tank ordnance, that was being got ready for the spring of 1919, was too late to be of any use.

In the British and French Armies the development of anti-tank defence went hand in hand with the improvements in tank design. The French adopted a 3·7 cm. quick-firing gun as early as 1916. The British principle was to utilize tanks for defence against tanks, and, when a tank attack was expected, tanks were rushed up to the threatened point.

One of the main lessons learnt from the war was the necessity for keeping one's knowledge of the enemy's progress in tank design up to date. Artillery is extremely useful in fighting tanks before an attack, but during an attack the most efficient weapons are small-bore quick-firing guns, anti-aircraft guns, and special field-guns.

Various types of post-war anti-tank guns are illustrated : the German 3·7 cm. gun,

the Swiss (Oerlikon) 2 cm. gun, the French 2·5 cm. gun, the Russian 4·7 cm. and 7·5 cm. guns and the Austrian 4 cm. gun.

In discussing the tactical and constructional lessons learnt during the war, the writer points out that Britain, France and Germany worked on different lines. After the successful employment of tanks on the Somme in September, 1916, when the tank corps proved its value as a deciding arm, both France and Britain went in for mass-production, but France out-distanced her ally by building 800 to Britain's 250. Germany held back, partly from doubt as to the real efficiency of the tank, and partly from shortage of materials.

The British missed their opportunity in the great spring offensive of 1918. The division of tank brigades between armies and corps, their subdivision into battalions and companies for individual divisional sectors, led to a complete splitting up of their forces. The incorrect employment of tanks in the British retirement is as instructive as the subsequent massed attacks at the turning point of the war. The British defensive handling of this arm stands out in contrast to the correct use made by the French.

Further chapters deal with the organization of tank troops during the war, and with the various principles that should be followed both in the construction and handling of tanks. To attempt to design and await the coming of the perfect tank would mean waiting for eternity.

Among the many illustrations in the book, those of special interest to R.E. are one of a British light bridge—span 45 feet—to carry 10-ton loads, and one of a British heavy bridge—spans up to 150 feet—to carry 20-ton loads.

In the course of the book, the writer quotes, amongst others, the following authorities :—

Williams-Ellis : *The Tank Corps.*
Fuller : *Tanks in the Great War.*
Fuller : *Memoirs of an Unconventional Soldier.*
Raray-Icks : *The Fighting Tanks since* 1916.
R.T.C. : *A Short History of the Tank Corps.*
Churchill : *The World Crisis,* 1914–1918.

A.S.H.

GIBRALTAR UNDER MOOR, SPANIARD AND BRITON.

By the late MAJOR-GENERAL E. R. KENYON, C.B., C.M.G.

(Third Edition. Edited by Lt.-Col. H. A. Sansom, R.A.O.C. and published for the Gibraltar Society by Messrs. Methuen & Co. Price 8s. 6d.)

The Corps of Royal Engineers was born at Gibraltar in March, 1772, and, therefore, owes much to that delightful colony, which, in turn owes a very great deal to the Corps. It must, therefore, be a matter of great satisfaction that this book, written by a sapper and first published by the Institution of Royal Engineers, has been selected as an official historical record by the comparatively young Gibraltar Society. In its new form, it now appears very ably edited and brought up-to-date by Lt.-Col. Sansom, who until recently has been president of the society.

The book will be of great interest to all who are stationed in, or who may visit, Gibraltar, and in its 130 pages it deals clearly with the military history and antiquities of The Rock. There are very interesting details of many of the special features of Gibraltar : the Moorish bath in Bomb House Lane which " except in the Alhambra " there is nothing in Spain to compare with " ; the Dragon Tree in the garden of Government House, believed by experts to be the oldest known tree of its species in the world and now over one thousand years old ; and many other excellent descriptions will also be found of the famous caves and of the Rock Apes.

The account of the various sieges and a very great deal of interest in the military and civil history of Gibraltar is given in a clear and direct style, in which the author has recaptured the spirit of romance from the first days of the Moorish occupation down to modern times. Full details are also given of the interesting historical buildings still in existence and of those which have disappeared.

All important recent changes are dealt with in an Appendix by the present editor, who also there describes the steps taken to safeguard the various historical monuments of The Rock. A very full Bibliography, a really excellent Index, and first-class photographic illustrations, together with maps showing Gibraltar in 1627 and at the present day, all help to make this work a valuable, and in fact, indispensable, one to all those who may have connection with the colony.

In these days when all countries are endeavouring to encourage tourist traffic, it seems a pity that the publication of this book was not subsidised by the colony, to enable it to be sold at a price more attractive to temporary visitors and the humblest households of the officers and other ranks stationed at Gibraltar.

R.R.K.

A.R.P. AND HIGH EXPLOSIVE.

By Maj.-Gen. H. L. Pritchard, C.B., C.M.G., D.S.O., Colonel Commandant R.E.

(Duckworth, 3, Henrietta St., W.C.2. Price, 1s.)

The Government has hitherto somewhat stressed the danger of gas, and, as the author says, quite rightly so. Gas to most people is an unknown terror and therefore the more to be feared, but it is one that can be comparatively easily guarded against, and, when this has been done, the danger is reduced to such a degree that it may well happen that the use of gas would not be worth while. This book therefore fulfils a useful purpose in saying something that had to be said—and it says it clearly and simply—on the necessity for being prepared for the arrival in this country of large quantities of high explosive in its most unpleasant form.

The author starts off with a description of the nature of an attack, its objects and targets, and the types of bombs with their probable effects. This is all well brought out, and could hardly be improved upon, as a most convincing argument for the vital necessity for Air Raid Precautions, if the country is to remain in existence as a power in the world.

He next proceeds step by step to discuss the possibilities of protection, and clearly brings out the various dangers that may result from the use of high explosives and the means that may be taken to guard against them. He tells us that the Home Secretary has informed Parliament that we must expect 300 tons of bombs to be brought to this country every 24 hours, and that this scale of attack may continue for some months, and he bases his recommendations on this statement.

The statement of the Home Secretary cannot, and need not, be questioned, but it does not appear to follow that the whole of this unpleasant quantity of bombs will fall in, or near, any one place or indeed on any useful target. Our defences may surely be relied upon to see that a proportion of it, at any rate, is wasted. In actual practice, therefore, it would seem to be possible and expedient to take perhaps a less gloomy view of the dangers to which we may be exposed. Even then, the danger is so great that it could hardly be stressed too much, to awaken the country to the vital need for preparation.

The figures given by the author for bomb-proof protection against a 1,000-lb. bomb appear to be on the optimistic side. It may be open to question whether 18 in. of reinforced concrete is sufficient as the detonating slab, while 7 ft. is perhaps more than is necessary for the roof of the shelter itself. It is suggested that a redistribution of the concrete might be considered with advantage and possibly with resulting economy. In any case, it is for consideration whether it is an economic proposition,

except in very special cases not generally applicable to the public, to legislate for anything larger than a 500-lb. bomb. For this size it is understood that 2 ft. 6 in. of reinforced concrete is required in the detonating slab and 3 in. for the roof, with 3 in. of sand in between.

The term "Blast" and its effects is believed to be a subject under investigation by the Government experts, and it is not known whether any final conclusions have yet been arrived at. The author has therefore confined his consideration of blast to its effect in causing the collapse of buildings. It is perhaps probable that consideration from this point of view only is quite sufficient and that other forms of protection necessary in any shelter would suffice to deaden the force of concussion, enough at least to prevent casualties.

As protection against debris the author writes that, with a very low ceiling, say 7 ft. 6 in., it may be worth while shoring up the ceiling itself, but otherwise a structure with an internal height of, say, 3 ft. 6 in., or even 3 ft., should suffice, and will be much stronger, take up less room, and be easier to fix and strut. This may be true but there are disadvantages. Such a form of shelter would take up just as much floor space, and would moreover put the room out of action for any other purpose. The ceiling of the room in which such a shelter is built would collapse with the building and the debris would be likely to block the means of escape. Such a shelter would not do for persons suffering from claustrophobia. It is suggested therefore that, even in the case of ceilings up to, say, 12 ft. in height, it might be better worth while to shore up the ceiling and to continue to use the room for its normal purposes.

Apart from the above criticisms the book leaves little to be desired. It is clear and concise, and contains most valuable information and recommendations on all the many points that have to be taken into consideration. A complete set of useful drawings is included, which make all the measures of protection clear and easy to understand. The book can be confidently recommended and will be found helpful in its application to any particular case that may have to be considered. The author is to be congratulated on his contribution to our knowledge and to be thanked for his public service in placing this knowledge before the people, especially at so low a cost.

L.N.M.

GEOLOGY FOR ENGINEERS.

By BRIG.-GEN. R. F. SORSBIE, C.B., C.S.I., C.I.E., late R.E.

(G. Bell and Sons, Ltd. Price 12s. 6d.)

The many sappers, who have derived benefit from the earlier edition of this work (1910), will welcome the appearance of the second; so great is the amount of new material that the book may well be described as almost completely rewritten. There is no need to stress the importance of the subject to engineers of all sorts, but, in their training, it is apt to be treated as of minor importance. General Sorsbie brings a vast amount of study, as well as long and valuable experience, to the compilation of the book, which deserves and will repay careful study.

The chapter on Indoor Work in the first edition has been omitted, as it is considered that the subject is one for the chemist rather than for the engineer; while the Part on Historical Geology has been left out for want of space. It would have been desirable to include at least a summary of this aspect of the subject, as there are many references in the text of the new edition to the various geological periods.

The sections on Minerals and Rocks go into great detail, and there are some terms which only a trained geologist is likely to understand, *e.g.* "pneumatolytic" on p. 62 and "poikilitic" on p. 116. But such abstruseness is compensated by a

valuable and comprehensible table "The Easily Distinguishable Characteristics of Rocks," from which it should be possible to discover the correct name of almost any chance specimen.

Water-supply naturally comes into prominence in a work of this description, and the chapter on that subject is particularly useful; adequate recognition is given to the work of dowsers. The value of the geological maps of the Ordnance Survey is mentioned, but it is added that they do not give sufficient information as regards the nature of the surface when covered with drift, etc.; there are, however, special "drift" maps.

In the next chapter "Building Stones," an important omission is any reference to the Government Building Research Station at Watford (see *The R.E. Journal* for March 1928), where in a few days stones can be put through the weathering tests which Nature would take years to do. There is a curious error on p. 177, where the crushing strength of limestone is said to be from 400 to 1,400 tons to the *square inch*. In the case of granite, the resistance to pressure is given as between 800 and 2,740 tons, but neither in this case nor in that of slate (20,000 to 25,000 lb.) is the unit of area mentioned. In another place the crushing strength is given for granite, 13,000 to 28,000; for limestone, 4,500 to 12,000; for slate, 10,000 to 15,000, all in lb. per square inch; but the author disarms criticism by saying that the importance of crushing strength has been over-estimated, for the pressure on stone used in building seldom, if ever, approaches the actual crushing strength.

A useful chapter on Bricks and Clays follows, to which the only exception that can be taken is that the deleterious effects on the finished brick of the saltpetre and other chemicals, found in the soil of Northern India and of other places, is not referred to.

The bibliography of the chapter on Roads and Canals refers to a work on the former subject by an eminent R.E. officer, which, though very valuable when first written nearly thirty years ago, has long since been superseded by successive editions of *Military Engineering, Vol. V.* The chapter is a useful one, although it would have been better to refer to canals for irrigation purposes, as well as to those for navigation. One would hardly say to-day that "*moorum* is the chief material "used in road-making in the Bombay Presidency" (p. 252). Another curious error has crept into p. 256 "In Europe, the purest bitumen is found in the Dead Sea." The list of places whence bitumen is obtainable needs revision; there is no mention of the deposits in Iraq; Persia is now known as "Iran," and the Indian Territory in the U.S.A. has long since changed its name to "Oklahoma."

Chapters on Rivers, Coast-Erosion, Drainage and Reclamation of Land, and Soils and Sites for Buildings conclude what must be regarded as a most valuable text-book on the subject, and great praise is due to the author for its careful compilation. The book is well got up, there are few misprints, and there is an excellent index.

F.C.M.

DISRUPTED STRATA.

By M. H. HADDOCK, F.G.S., A.M.I.M.E.,

Principal of the Coalville Mining and Technical Institute.

100 pp. (Technical Press, London. Price 16s.)

After a short introductory chapter on Continental Drift, the subject is dealt with from the standpoint of the mine surveyor and stratigraphist; such questions as the location by bore holes, the dip and strike of planes, striking angles, etc., and drifting being dealt with mathematically and with numerous illustrations. A very full bibliography is appended, drawn from many sources, Great Britain, France, Germany, America, etc.

H.B.

SURVEY OF INDIA.

GEODETIC REPORT, 1937.

(Price Rs. 3.)

Primary triangulation was carried out during the year in the Naga Hills and a connection was satisfactorily made between the Mandalay Meridional and the Upper Irrawaddy Series. Eleven stations were occupied. The average triangular error was 0·56". The country is not easy. Mules and elephants were used for transport as well as the waterways of the area. Observations were with the Wild precision theodolite on 20 zeros, three separate measures being made on each zero, a total of 60 measures for each angle. The position of the foot screws on the stand was changed 120° after each third of the zeros had been observed. The longest ray was over 60 miles. Argand lamps with 16-inch parabolic reflectors were employed for night working, and heliotropes up to 15-inch for day observations. It is proposed to introduce electric beacons in the near future.

Some interesting re-levelling of a line, undertaken 26 years ago between Sukkur and Chaman, was carried out by precise methods to ascertain changes due to the Mach and Quetta earthquakes of 1931 and 1935. "Considerable changes were found " and an elevation of over one foot in about 10 miles at the lower end of the Bolan " Pass appears to be real. At Mach and Quetta changes were small, but two rock-cut " benchmarks near Quetta have undergone a relative movement of nearly a foot." One appears to have sunk while the other has risen with reference to the Sukkur standard bench-mark.

Gravity was observed at 47 stations in Assam and Bengal. Extremely rapid variations take place in the Assam area, notably greater than hitherto found in India. "These results are not surprising in view of the obvious instability "of this region." An interesting chart is given showing crustal structure lines in India derived from gravity observations. Magnetic observations were extended in Bihar, in continuation of those of the previous year, with a view to elucidating underground features which may have been responsible for the occurrence of the great earthquake in that region. It does not, however, appear possible to relate these observations to any marked irregularity in the underlying crust which would account for the earthquake.

An observatory has been built at Agra, for determining variations of latitude, where work was started on 1st January, 1937. It is presumed Agra may prove a better situation for this purpose than Dehra Dun, where the proximity of the hills causes variations of refraction tending to vitiate the results. Thirty-six earthquakes were registered at Dehra Dun during the year, mostly at a considerable distance. Four were within 900 miles and two slight shocks were recorded as "local."

H.L.C.

PLANNING, 1938.

AN ANNUAL NOTEBOOK BY E. & O.E.

(*The Architect and Building News*. Price 5s. 9d. post free.)

The 1938 edition of *Planning* has now been published. When the 1937 edition, the first in book form, was reviewed in these columns a year ago, it was suggested that the book would be of great value to many R.E. officers, particularly when they are engaged with buildings not entirely typical of Army life.

In the new edition some sections have been revised, and new sections added. The latter, which include among others, notes on the design of fire stations and crematoria, are not likely to be required frequently, but nevertheless there is no doubt that a complete and up-to-date book on designing buildings is of great value.

R.G.V.W.

AUTOMOBILE ELECTRICAL MAINTENANCE.

By A. W. JUDGE, A.R.C.SC., WH.SC., A.M.I.A.E.

(Publisher: Pitman. Price 4s. 6d.)

This is a small, practical book dealing with modern automobile electrical difficulties. It gives simple explanations of all the well-known modern systems and is up to date.

It covers ignition systems, sparking plugs, dynamos, starters, batteries, lamps, accessories, and is generally suitable for budding motor mechanics and engine artificers.

There are a few fault-analysis charts which are useful to help students think.

The Lucas equipment is frequently dealt with in great detail from the practical side.

Electrical theory is not treated owing to lack of space.

In general, it is a practical book which non-technical readers have a reasonable chance of understanding.

A book recently issued on this same subject is *The Working Principles of Motor Vehicle Lighting and Starting*, by W. C. Stoddard, M.I.M.T. In general, the difference between these two books is one of degree. The book on "Working Principles" goes deeply into its subject. It includes extremely fine maintenance charts, together with a great deal of theory; and is suitable for *reference* in any workshop or garage. The book on *Automobile Electrical Maintenance* is better suited to the keen mechanic.

W.G.F.

AUTOMOBILE ENGINE OVERHAUL.

By A. W. JUDGE.

(Pitman. Price 4s. 6d.)

This little book covers in a fairly comprehensive manner the whole practical side of petrol-engine overhaul and repair. Many useful workshop devices and special tools for executing awkward jobs are described, as well as most modern types of engine overhaul equipment. The author does not lay sufficient stress on the importance of using high-quality spanners and similar tools for this class of work, and certain important warnings have been omitted, *e.g.*, guarding against piston distortion by packing between the gudgeon-pin bosses when removing gudgeon-pins from a split-skirt piston, and the importance of renewing connecting-rod bolts with manufacturers' replacements or other bolts of the correct material. The book should be useful in instructional establishments and in unit libraries.

H.L.M.

AUTOMOBILE BRAKES AND BRAKE TESTING.

By MAURICE PLATT, M.ENG., M.I.A.E., M.S.A.E.

(Pitman. Price 3s. 6d.)

This book explains in non-technical language everything that anyone but a designer needs to know about brakes, braking, adjustment and testing. Four proprietary systems in common use on English cars are described in detail, viz., the Bendix, Bendix-Cowdrey, Lockheed and Girling. The book would be found useful by anyone responsible for the efficiency of M.T. vehicles.

H.L.M.

HISTORY OF THE TWELFTH ENGINEERS, U.S. ARMY.

By COLONEL J. A. LAIRD, D.S.O.

This book, which has been presented to the Institution by the author, is a war history of the 12th Engineers, U.S. Army. The 12th were railway engineers and consisted of Headquarters and two battalions, each of three companies. Its recruitment began on May 7th, 1917, and the unit was actually first assembled in June

on river boats moored to the bank of the Missouri River, near St. Louis. The officers and men were drawn from the railways serving St. Louis, and were, of course, fully proficient in railway work, and after less than two months' military training embarked for Europe at New York on July 27th, and, after a week in England, during which they took part in the march through London, landed at Boulogne on August 18th. The regiment shortly afterwards took over the maintenance and operation of the light railways on the front of the British Third Army. They performed an immense amount of work in the preparations for Cambrai, and, during the German counter-attack, they came into action—the first American troops to do so in the Great War. They again did yeoman service in the March retreat and when on July 25th, 1918, they moved from the British front to that taken over by the American Army beyond Verdun, their departure was deeply regretted, both by their Allies and by themselves. On the American front they again found plenty of work, both in maintenance and operation during normal trench warfare, and in pushing forward to connect with the German system (which they found quite good) when the Americans overran the St. Mihiel Salient. At the time of the Armistice they were preparing to repeat this operation towards Metz for the projected offensive of the Second Army. The Armistice, needless to say, did not bring their work to an end, and they continued to operate the light railways till they moved off for embarkation on March 4th, 1919. The regiment was finally mustered out on May 16th, 1919.

The above brief summary shows that there was plenty to record and it has been very well recorded. In the spring of 1918, the War Department ordered the appointment of regimental historians. Colonel J. A. Laird took on the work, and the material for a regimental history was thus systematically collected. The book is most interesting both from the historical and technical side. Two points seem to stand out—firstly, the natural efficiency with which an engineer unit, composed entirely of men trained in civil life, settles down, after a very short military training, to the same work under war conditions; and secondly, the excellent relations they maintained with the British Army. The references to the latter are all kindly and appreciative, and the R.E. officers who were in contact with them during the year they served with the British Army will reciprocate this feeling. They used to be referred to by the British troops as the American Royal Engineers. The fact that they were so-called and seem to have liked the name is in itself significant.

It only remains to be added that the wealth of illustrations will make writers of British regimental war histories green with envy.

E.V.B.

LES DÉBUTS DE L'ÉDUCATION TECHNIQUE EN FRANCE (1500–1700).
By FREDERICK B. ARTZ, Overlin, Ohio, U.S.A.
(Librairie Félix Alcan, Paris.)

This book is of importance in showing how diverse were the factors which brought about the development of technical education in France. As the structure of modern society is so largely the result of technical discoveries, the history of technical education is of considerable interest. The writings of various philosophers (such as More's *Utopia*), economic theories, the economic policy of the French government in the development of State industries, and the need for technically-trained officers in the army, navy and mercantile marine, all played their part in developing technical education.

It is to-day difficult to realize to what an extent education in the Middle Ages was dominated by mere book learning. The universities were hostile to science. This attitude was partly overcome by philosophers who advocated an education having some connection with everyday life, both for its cultural value and its economic utility. The creation of government industries caused a demand for technicians, for whom a systematic technical education was gradually evolved.

The stress of almost continuous war during the seventeenth century produced a demand for technical education for officers. At times the training was somewhat primitive. In 1684, some four thousand "gentleman cadets" were under training in nine special companies. Many were on entry unable to read or write and their ages varied from fourteen to forty-five!

It is interesting to note that the French artillery and engineers were originally the same, a separate corps of engineers, the famous "Corps du Génie," being founded in 1676. Vauban's Corps of Engineers, formed from a group of the most capable officers in the Corps du Génie, soon acquired a European reputation. No school of military engineering was opened in France before the eighteenth century; prior to that date, officers learnt their profession in the service and by reading treatises on engineering which had been published or which circulated in manuscript form.

Many difficulties had to be overcome, but the author considers the French remained until 1850 the pioneers of technical education for the army, the navy and mercantile marine, and for industry.

J.H.D.

A GUIDE TO THE OLD TESTAMENT.

By Lt.-Col. E. N. Mozley, D.S.O.

(S.C.M. Press. Price 3s. 6d.)

As headmaster of a preparatory school, Col. Mozley has felt the difficulty of explaining parts of the Old Testament to his pupils, and the work under review is intended as a guide to those who have to do likewise—admittedly a difficult task.

The greater part of the work consists of an analysis of each book of the Old Testament, chapter by chapter, showing in condensed form what the author recommends to be read, what omitted, and what passages are deserving of special notice.

The selection of these seems to be based on the present views of the Higher Criticism (summarized in the earlier part of the work) which the author regards as proved facts, not even mentioning any of the numerous occasions on which the critics have been found to be in error.

There is little or no reference in the work to the recorded views of Our Lord and of the New Testament writers on the Old Testament. The New Testament is surely the best Guide to the Old.

F.C.M.

GERMANY AND A LIGHTNING WAR.

By Fritz Sternberg.

(Faber and Faber. Price 12s. 6d.)

This is an important book, less because it tells us much that is new than because of the way in which it presents its facts and arguments. It deals with a subject of considerable gravity.

The author is a German opposed to the Nazi régime but the book is not excessively biased and unbalanced on that account. It was written just before the Czechoslovak crisis but suffers little from that. The author has based most of his conclusions upon statistics and reports of an unimpeachable nature and wherever possible used the German official publications to support his thesis.

In a nutshell, Herr Sternberg contends that there must be a world war, that Germany must fight Russia, Britain and France and that she has no chance of success. The certainty of a world war is placed at the door of an outworn world capitalist system, from which has emerged an intolerable urge for markets, a permanency of unemployment due to rationalization and over-production and a false prosperity which cannot be indefinitely bolstered up by armaments. That the world war has not yet burst upon us is due, the writer says, to the internal social tensions, which have held Governments back from strong action abroad.

Most of the book is taken up with comparing the war potential of Germany and her possible Allies, with that of her probable enemies. This part of the book is the most convincing. Starting in each case with a comparison with 1914, Herr Sternberg shows how ill-equipped Germany, Italy and Japan are relatively to Britain, France and Russia, to meet a long war. Compared to Hohenzollern days, the Germany of to-day has little foreign credit or gold, a poor export trade, and equal or greater dependence upon food imports, less iron and a great shortage of oil. Iron, steel and coal are the decisive factors in modern war In these Germany's resources are far behind those of her opponents, supported by the U.S.A., while Italy and Japan are weaker still. The author considers that the immense strength of Russia is continually overlooked. He remarks that, compared to Czarist Russia, the U.S.S.R. is a very formidable military power by herself, quite the equal of Germany in most respects, though he does not overlook Russia's present weaknesses. (These are her dependence upon a poor railway system, an unreliable agriculture and an oil supply lying too near her southern borders.)

Owing to the 15 years in which Germany had to drop conscription, her trained reserves for many years yet will be very inferior to those of France and many pages are devoted, rightly, to the influence of a first-class industry upon war. The geographical location of these, in view of air attacks, is discussed and Germany is shown to be not so invunerable as is supposed, for her heavy industries are tied by the coal basin of the Ruhr, whereas those at least of Russia are far removed.

Only in her extensive industrial mobilisation plans is the author prepared to give Germany any real superiority over her enemies. This advantage is shown to be a very real one. Herr Sternberg takes aircraft production as an example. In the last war, to keep 2,500 aircraft in action, an annual production of 15,000, he says, was necessary, implying that the losses were 600 per cent. per annum. In the next war losses may be far heavier. If Germany wishes to use 5,000 aircraft she must possess an annual output of 30,000. These figures, which are confirmed by our *Official History of the War in the Air*, are important. Since technical progress in aircraft is still rapid, no nation can afford to keep many aircraft in peace. The essential is an apparatus for rapid and colossal war production. In view of the lag between placing an order and delivery, any fully-prepared nation possesses a very real advantage. However, the difficulties of such production in face of raw material problems and enemy interference, are somewhat overlooked, which in the case of aircraft tend to reduce the likelihood of air attacks on the scales envisaged by certain trench diggers in remote country districts. The author is not impressed by the menace from the air in this coming war, except perhaps as a disturber of industry.

The writer repeatedly stresses the utter interdependence between military operations and economics in a big war. He warns us that Germany has a Great Economic General Staff, that her objectives will be economic ones, that her shortage of iron, food and gold may tempt her to overrun neutrals such as Sweden, Denmark, Holland and Rumania to obtain these necessities. What she did to Belgium in 1914 she may be prepared to repeat.

Herr Sternberg ends his book with a discussion of moral factors. He believes that there is very great latent dissatisfaction in the German working-classes and little real enthusiasm for war, feelings which will have a crippling effect in any prolonged war. He comes to the conclusion that only in a lightning war has Germany any chance of success and, owing to the strength of Russia and France, he sees little chance of such success.

The author does not touch much on the British Empire. If anything, he has underestimated the strength of the British peoples and the forces holding them together, as so many Germans do.

Perhaps the most important, if most gloomy chapters, are those dealing with the drift of world economic forces towards war. This book should be widely read.

B.C.D.

MAGAZINES.

CIVIL ENGINEERING MAGAZINES.

The following articles which have recently appeared are recommended as being of special interest to Royal Engineers.

Publication.	*Date of Issue.*	*Article.*
Journal of the Institution of Electrical Engineers.	1st Sept., 1938.	Regulations for controlling the earthing of Electrical Installations to metal water pipes and water mains.
Journal of the Institution of Petroleum Technologists.	Sept., 1938.	"Properties of Asphaltic Bitumen in Relation to the Road." A general summary of the present situation.
The Engineer.	22nd July, 1938.	Pole Setting Equipment.

RASSEGNA DI CULTURA MILITARE.

(*July–August*, 1938.)—*La battaglia del solstizio.*

A short account of the battle of the Piave fought in June, 1918.

L'esercito dell'Italia fascista. By General Pariani.

An account of the formation and organization of the Fascist Army.

La battaglia del giugno, 1918, nella relazione ufficiale austriaca. By General Boliati.

The first instalment of a description of the battle of the Piave, taken from *Austro-Hungary's Last War.* Part VII. (Reviewed in *The R.E. Journal* for September, 1938.)

L'importanza della fronte interna nella guerra avvenire. By General Bronzuoli.

A plea for better progress in Air Raid Precautions, if panic and disaster are to be avoided when war breaks out.

Chi si ferma è perduto.

Colonel Reisoli dwells on the necessity for keeping our ideas on warfare up to date.

La guerra cino-giapponese.

Colonel Oxilia concludes his account of the Sino-Japanese War. The various phases described are: (1) the investment of Nanking in December, 1937; (2) the development of the operations after the fall of Nanking in January, 1938; (3) the aerial bombardment of Canton and of the Canton-Hankow railway.

In criticizing the conduct of the military operations, the writer points out that the Chinese might have been able to counter the concentric Japanese attacks by the Napoleonic manœuvre of action on interior lines, but their armies had neither the manœvring power nor the means to take advantage of their position. All they did was to prepare a series of defensive lines. These delayed the enemy's advance, but never prevented the development of his manœuvre.

La conquista della regione dei laghi equatoriali.

Lieut.-Colonel Terragni concludes his article on the conquest of the region of the equatorial lakes.

The final stage of the advance had to be timed to start as soon as the rainy season was over. Little information was available as to the climatic conditions of the country. Advantage was taken of the long compulsory halt at Agheremariam to organize the large area of country that had been conquered. The local tribes gave trouble on the lines of communication by attacking convoys, but they achieved no marked result except by exhausting the troops and causing a waste of motor spirit.

In the middle of October an attack was made in three columns on the Abyssinian force that had collected on Mount Giabassire, and it was dispersed with heavy loss. This Italian victory completed the conquest of the Borana country.

Impiego di un reparto artieri nel combattimento d'arresto durante l'organizzazione dell'attacco e l'attacco.

Lieut.-Colonel Vanelli explains the duties of an engineer unit employed in laying mines in a defensive position. The unit employed for the defence of a sector is the platoon; for that of a zone of several sectors it is the company.

A platoon, commanded by a subaltern, is made up of three sections. The equipment of a platoon consists of 714 trip-mines and 64 pressure-mines. The supply of trip-mines is sufficient to cover a front of about 1 km., with four to six rows of mines; that of pressure-mines will cover a line of about 120 metres. It takes from 10 to 12 hours to put down the whole supply.

Each section commander will prepare a sketch of the position of each mine laid down, starting from a known point; the platoon commander will co-ordinate the sketches sent in by the platoons and submit them to the commanding engineer.

The procedure for taking up mines, or for making gaps through a mine-field, varies according to the nature of the mines in question. Trip-mines offer no special difficulty; if available, tanks may be used for the purpose. Pressure-mines, on the other hand, present a much more difficult problem. It is suggested that tanks might be used, pushing ahead of them at a distance of about ten metres, small rollers, which would detonate the mines by their own weight.

Trip-mines are intended for use against men and animals, and weigh about 4 lb. apiece. They are fixed to pickets or shrubs at height of 8 to 12 inches from the ground, and carefully concealed. A pull on the cord to which they are attached releases the striker and fires the mine.

Pressure-mines are employed for blocking roads or places that vehicles or tanks are likely to go over. They should be so arranged that at least one wheel of a car or one track must pass over a mine in the course of a vehicle's progress. A pressure of 250 lb. is required to cause a detonation, so that a man of normal weight can walk over a mine safely. The mines are buried in the ground and are covered with 1 to 1½ inches of earth.

The article concludes with a defence scheme worked out in detail.

Le teleferiche militari con funi ancorate ad entrambe le estremità.

Lieut.-General Bellusci's study of wire ropeways anchored at both terminals is continued, with an example of a ropeway for the transport of minerals downhill with hand-brake control.

(*September*, 1938.)—*La battaglia del giugno* 1918 *nella relazione ufficiale austriaca.*

General Bollati concludes the description of the battle of the Piave taken from the Official Austrian account. While criticizing a few minor points in the latter, the writer agrees that the Austrian troops were in no way to blame for the defeat.

There were two lessons to be learnt from this battle: (1) not to undervalue the possibilities of an adversary, even after a great defeat (*i.e.*, the Caporetto disaster); (2) not to rely on others for the supply of food and war material. Great expectations from the occupation of Ukraine and Rumania were not realized, nor was Germany able to provide the assistance that Austria hoped for.

Ludendorff.

Professor Folchi gives us the first instalment of an account of the part taken by Field-Marshal Ludendorff in the World War.

When, at the outset of the war, things were not going too well for Germany on the eastern front—two Russian Armies had crossed the border of East Prussia and were threatening Silesia—the Supreme Command sent for Ludendorff to save the situation. Ludendorff accepted the appointment of Chief of the Staff to Hindenburg in the Eastern Army.

The criticism, that the victory of Tannenberg over the Russian Army of the Narew would not have been won but for the mistakes of the Russian generals, does not diminish the credit due to Ludendorff for his strategy, in spite of the risks taken.

The campaign in Poland followed, and it is said to have been one of his best strategic conceptions, even if the coup on Warsaw failed owing to the insufficiency of Austrian troops. Shortly afterwards, Ludendorff won another great victory over the Russian forces on the Masurian lakes.

In the spring of 1915, Falkenhayn succeeded Moltke in the direction of operations, and he initiated the great eastern offensive. There was disagreement between his views and those of Hindenberg and Ludendorff, and it is stated that if Ludendorff had had his way, Russia's collapse would have taken place two years sooner than it actually did.

In 1916, Hindenburg succeeded Falkenhayn as Chief of the General Staff of the armies in the field, with Ludendorff as Quartermaster-General. Ludendorff planned the campaign against Rumania, the most brilliant in the European war.

From the time that Ludendorff became Quartermaster-General, his will was imposed on every problem, great or small; the responsibility of the Imperial Chancellor, the vote of the parliamentary majority, even the wishes of the Emperor, were practically subordinate to the Supreme Command.

Outside the sphere of his military competence, Ludendorff had the defects of his professional mentality; he remained a pure technician, a man of the laboratory, master of every element in it, but incapable of seeing the aspect of other problems outside. During the war he was the sharp flashing sword of Germany, and yet not its *Führer*. He was born a quarter of a century too soon.

L'impiego del quarzo piezoelettrico nelle stazioni radio campali. By Lieut.-Colonel Gatta.

After defining *radio-spectrum*, the writer points out that, in a field station, its range should be approximately the same as that of a commercial transmitting station, *i.e.*, not less than 6,000 hertz.

There are several methods available for stabilizing radio-frequencies. The most practical method, especially for field stations, is that which makes use of piezo-electric quartz stabilizers, also known as " pilot " quartzes.

The working of quartz stabilizers is fully described. They gave good results in the Ethiopian campaign, and a considerable economy is effected by their use.

Sopra gli attuali mezzi di scoperta di aerei non visibili. By Prof. Fernandes.

If aviation has made enormous strides since the days of the war, ground defence against aircraft has not only kept pace with the progress of aviation, but has out-distanced it. During the World War, for every aeroplane brought down by artillery, there were five brought down by chaser planes. During the present war in Spain, out of every six aeroplanes brought down, five have been shot down by artillery to one by other aeroplanes.

The writer explains the principles of sound-ranging, and the advances made in that branch of science. It is interesting to note that blind persons make the best aerophonists, not because their sense of hearing is better than that of other people, but because it is more highly trained.

La rigenerazione degli olii lubrificanti usati. By Major Tatti.

Lubricating oils used in internal-combustion engines lose their characteristic properties more or less rapidly. They are found to contain mineral particles (*e.g.*, silicates), metallic and carbon particles, and asphaltic substances. They also contain

—partly in solution, and partly in a colloidal state—water of condensation, incompletely burnt products of combustion, and organic acids.

Various processes are adopted to remove these impurities :—

Physical: decanting, centrifugal action, filtration and distillation.
Chemical: neutralizing the acids with an alkaline solution.
Physico-chemical: treating the oil with certain earths, which fix the water and the acid and asphaltic impurities in the oil.

The writer describes the "Triploil" apparatus and other methods for the regeneration of oil. In Germany, the saving of used lubricating oil is now compulsory for certain firms.

A.S.H.

REVUE DU GÉNIE MILITAIRE.

(July–August, 1938.)—Études sur les lignes téléphoniques fixes en montagne. By Captain Daubigny. The upkeep of aerial lines in mountainous regions, especially where the snowfall is heavy, is a serious difficulty in many regions of the French frontier. Avalanches frequently carry away the lines, or bury them completely, and the repair gangs have to face many dangers in their recovery. Subterranean cables avoid many of these difficulties, but their installation is very costly; their substitution for the aerial lines is therefore a matter of particular consideration. This article describes the work of the French telegraph service in the mountainous regions, their methods and equipment. It also gives, in concise form, some of the principles governing the erection of aerial lines.

Le Colonel Drecq (1890–1938). An obituary article on the late Director of Studies at the School of Military Engineering. Colonel Drecq's career began with the Great War, in which he distinguished himself as a company officer. His energy and enthusiasm carried him on to rapid promotion, and after the war he became a teacher of remarkable power. He died in May last, at 48 years of age.

Méthodes de construction des ponts de pilots légers. By Lieut.-Colonel Cueff. Describes a new method of building light pile bridges, by means of a foot-bridge put in underneath the proposed structure. The foot-bridge acts as a staging for the construction of the larger bridge, and enables the working party to work simultaneously along the whole length. It is not a particularly advantageous method, and does not commend itself to the editor of the review, who appends a note. Comparisons of time and labour between the method and the regulation way of building-out, with or without a raft, are given. These show that for a given bridge (60 m. long), a gain of time amounting to 33 per cent. was achieved by the new method, but with an increase of personnel of about 45 per cent. The time factor is usually the important one, but the larger party required for erection includes three times as many N.C.O's and, since lack of trained N.C.O's and men is chronic during a campaign, the new method could not often be employed.

La motorisation et la mécanisation des unités du génie dans l'armée Allemande. By Captain X. An account of the state of mechanization now reached in the German engineer units. The German organization consists of Sapper and Miner units of an almost uniform composition, instead of a number of specialist units. The Signal Service is a separate organization, as with us. The Corps and Divisional Engineers are formed into battalions, partially motorized. Each battalion has a headquarters staff, a signal section, "for internal communication," 2 foot companies partially motorized, 1 company completely motorized, 1 bridging detachment (motorized), 1 stores detachment and 1 light column for engineer material. The last two detachments do not exist in peace-time.

The tendency is towards complete mechanization, for the Germans recognize that the less time and physical energy expended on getting the Sappers on to their job,

the better progress on the work itself. The adoption of mechanical tools has made great headway, and illustrations are given of compact little electric generating sets on two-wheeled trailers. A motor-driven band-saw for tree-felling is shown, operated by two men. Automobile canoes and boats for crossing rivers are also described.

Much attention is paid to the " transmission " or signal service within the engineer unit. The section belonging to each battalion consists of 2 light telephone lorries carrying 20 kilometres of heavy and 3 of light cable, and 8 crews, 2 smaller cars for maintenance and supplies, 2 cars for reconnaissance and liaison, and 4 radio sets. This allows for a complete system of inter-communication between what we should call the divisional C.R.E., his field company commanders, his reconnaissance officers, his bridging train and any considerable working party.

Book Reviews. Among the notices of foreign books, there is a short review of Lieut.-Colonel Sandes' *The Royal Engineers in Egypt and the Sudan*, referring especially to the chapter on the Fashoda incident, which would naturally interest French readers.

W.H.K.

REVUE MILITAIRE GÉNÉRALE.

(*July*, 1938.)—*Théorèmes de Défense Nationale.* By Colonel Bernard. Contains some profound views on the problems of modern war, complicated by all the multifarious influences on modern life. As whole nations are now involved, the effects of military policy and of the conduct of war disturb the whole national life. In countries like Germany, Italy and Russia, this development is now accepted, and the peace-time form of government is moulded on military lines. Mobilization for them would be but a tuning-up of existing forms.

A depressing outlook; as if all life must now be turned towards arrangements for its disturbance by war.

Le Général Rennenkampf et la bataille de Tannenberg. By General Niessel. A contribution to the discussion as to the value of General Rennenkampf's operations in East Prussia in August, 1914. Could he have prevented Samsonoff's disaster at Tannenberg?

It has been the habit of Russian writers since the war to blame France for the Tannenberg catastrophe. France, they say, had insisted on a premature offensive by Russia before she could be ready. France had bribed the Czarist Government to precipitate that offensive. But these are merely the excuses. General Niessel shows that the disaster was due to several causes, all under the control of the Russian authorities: favouritism, which placed inefficient and idle officers in command; lack of preparation, which sent the fighting troops forward with incomplete supplies; faulty communications, which gave the Russians poor road facilities as against the good railway system of the Germans; and lack of proper code arrangements, which exposed the Russian messages to the German Staff.

Rennenkampf was accused of treachery, but he was in fact a very loyal and energetic soldier. His operations began with successful actions at Stallupinen on August 19th, and at Gumbinnen on August 20th. Von Prittwitz was obliged to fall back, and the Germans relieved him of his command, and sent von Hindenburg and Ludendorff to conduct the defence of East Prussia. They also drew the Guard Reserve Corps, the XI Corps and the 8th Cavalry Division from France at the critical moment to reinforce their army on the Eastern frontier.

Instead of following up his success, Rennenkampf was directed by Jilinski to turn his attention to the investment of Konigsberg, and the Germans slipped away to oppose Samsonoff, who was invading East Prussia from the south. Hindenburg's bold strategy gained a deserved success; but the ill-prepared troops of Samsonoff were heavily handicapped. Jilinski deliberately concealed the disaster from Rennenkampf, told him, too late, to lend help from his left wing, and left him afterwards to

be defeated in turn by Hindenburg, who was now able to bring very superior forces against him. Rennenkampf was able to withdraw the bulk of his forces, which he did in good order. Jilinski reported to the Grand Duke Nicholas that Rennenkampf had lost his head and was no longer fit to command, but fortunately the Commander-in-Chief sent a staff officer to investigate, and it was Jilinski who was removed.

A very great opportunity of hastening the decisive issue of the war was lost on the East Prussian front.

Quelques réflexions sur les problèmes d'armament. By "Currus." An anonymous writer, himself not a technician, but closely connected with armaments, gives some reflections on the present urgency of the armament problems. "The evolution of armament is governed by two factors—tactical requirements, and technical possibilities—and the reconciliation between the two is not always easy." The tactician requires things quickly; he does not appreciate how long it takes industry to adjust itself to meet his new demands. Better liaison between the two is needed.

Aide et conseils aux anciens militaires Nord-Africains en France. By Mohammed Soualah. The large number of North African native troops employed in France has necessitated the formation of an association to look after their well-being when they leave the service, and settle down in France or return to Africa. The author describes the work of this association.

Emploi et orientation des anciens militaires Nord-Africains. By General Azan. The editor of the *Revue* discusses the problem of the North African native soldier who seeks employment in France after his service is completed. The danger which arises from these natives absorbing revolutionary ideas and trying to mix with the local population is a real one, and General Azan thinks it unwise to permit it. There is plenty of room in Africa for the exploitation of native labour.

La défense des Colonies. By General Abadie. The recent creation of a new post —Chief of Staff for the Colonies—has added a further step in the co-ordination of the three French War Ministries. Colonial defence is now assured of a stronger interest. The French system of colonies has suffered in the past from a lack of co-ordination. Scattered naval stations have been fortified, but each colony has been dealt with in a piecemeal fashion.

The author, who has a wide colonial experience, and is at present commanding a division in Tunis, describes the evolution of the Colonial defence organization.

(*August*, 1938.)—*Le Maréchal Fayolle.* By Georges Lecomte. An address on the occasion of the unveiling of a plaque fixed to the house where Marshal Fayolle died in August, 1928.

Forces et faiblesses de l'Empire Britannique. By Commandant Villatte. The vast extent of our Empire, says the author, is at once its strength and its weakness. Politically the links are fragile, but morally the bonds are strong. The rise of Italy and the menace of Japan have greatly increased the military dangers of the Empire. Although the loyalty of the Dominions and Colonies can be counted on, as in 1914, Great Britain must find allies, as well as maintain her forces by sea, on land and in the air.

Que peut-on attendre d'un D.C.A. moderne? By Commandant Courbis. The efficacy of anti-aircraft artillery during the Great War was not conspicuous, but quite a different state of affairs has been brought about in the interval. Commandant Courbis, in an article of thirty pages, points out the many directions in which anti-aircraft weapons and instruments have reached a very high standard of accuracy. The greatly-increased speed of aircraft has been met by a corresponding improvement in methods of picking up targets. The twenty years' interval has produced an all-round advance; with the result, in the author's opinion, that modern anti-aircraft artillery may confidently be expected to give much better results than in 1914–18.

La securité de la France. By Edouard Boutry. An article on the moral factors in the war-like spirit of the French people.

Le problème Japonais. By Captain Henry. A short sketch of the rise of Japan, emphasizing her remarkable powers of choosing for her assimilation the features of Western evolution which suit her best, and biding her time until she is prepared for her next step. Her progress towards dominion in Asia seems inevitable unless, as the author says, the white races consolidate in reality.

(*September*, 1938.)—*La bataille de Juin*, 1918, *en Italie.* By General Bollati. The Second Battle of the Piave was fought while the last of the German attacks on the Western Front was being met by the French and British armies. The battle is little known to us, although the British XIV Corps took part in it. Unfortunately, the whole article is spoilt by the omission of six pages, not consecutive, which are blank.

L'Organisation défensive de l'Empire Français d'outre-mer. By Lieut.-Colonel Sarrat. This article is also spoilt by the omission of the first two pages. The author gives a *résumé* of the evolution of the defensive organization of the French colonial empire, and discusses the effect which is expected from the recent decrees of May last, which established, among other improvements, a Chief of Staff for the Colonies, and the inclusion of the Minister for the Colonies in the Committee of National Defence. Many anomalies are removed by these measures.

L'Infanterie dans la guerre d'Espagne. By Commandant Andriot. A timely warning that mechanical devices and weapons cannot *displace* infantry; they can only assist them. The conclusions to be drawn from the Spanish battles must be studied with caution and not be too hastily formed. Infantry still remain the principal arm. The lack of trained infantry in Spain, the paucity of artillery, and the disproportion of material are factors which can hardly be described as normal. Tanks have been subjected to severe damage; they have proved, especially the faster German and Italian machines, to be vulnerable to anti-tank guns.

Resort to lorry transport, instead of marching, has often been punished by disastrous air attacks on the convoys. Low-flying attack by machine-guns has taken heavy toll of the unskilled infantry, whose anti-aircraft guns have found it almost impossible to lower their fire to cope with the fast-flying air machines, and whose want of training in machine-gunnery prevents them from dealing immediately with this danger.

L'Inconnue Japonaise. By Lieut. Dalstein. A reminder of the fact that Japan is very little known to the general European public. Her earlier inaccessibility, her aloofness, and her secrecy have combined to ward off the curious, and her rapid rise to power has therefore surprised the uninformed. The author calls attention to the rapid growth of the Japanese population, the poverty of the masses, the concentration of wealth in the hands of a small class, and thence the necessity for territorial expansion, for exploitation of the mineral wealth of China.

The war with China may exhaust Japan, or it may induce China to throw in her lot with Japan, and unite the yellow races against the white. If the latter continue to let affairs drift, and fail to present a united front—and how often they have failed in this respect—then the yellow domination over Asia will become a reality.

Réseau routier et besoins militaires. By Lieut.-Colonel Montigny. The author suggests the execution of tunnels under waterways, instead of bridges, for all main roads likely to be included in an area of operations. Such tunnels would be easy to fortify, and their outlets could emerge within a fortified locality. The enemy's attacks against them could be circumvented; one method proposed is to have tunnels filled with water on either side of the main one, to prevent mining. The cost of such tunnels, the author says, would not much exceed that of bridges. This seems doubtful and, moreover, in the case of a withdrawal of the army with a view to subsequent advance, such tunnels would be completely destroyed by the retreating enemy.

W.H.K.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*July*, 1938.)—*Inauguration du Mémorial Colonial à l'École Royale Militaire.* An account of the unveiling of the memorial to the Belgian officers and men who gave their lives during the Great War in the Belgian Congo. The ceremony was performed by the King of the Belgians on May 27th, 1938.

Pages d'histoire de l'Armée Belge: Les débuts de l'Aviation Militaire Belge. (*Continued.*) By General Mathieu. This instalment covers the first period of active operations from 1st to 26th August, 1914, and gives a detailed account of practically every reconnaissance flight made during those three weeks. Considering the primitive state of aviation at the time, some of the flights made were of remarkable duration. Three of the four squadrons were based on Antwerp, and most of the flights were reconnaissances connected with the defence of that fortress.

Détermination des Coefficients d' " Infranchissabilité." By Major Simon. A purely theoretical study of the casualties likely to occur among personnel and tanks in a modern barrage. How such a mathematical exercise can have any practical value in the study of war, it is very difficult to see. Moral condition, intensity of fire, accuracy of weapons, state of the ground and of the weather, fatigue of the combatants, are all factors which defy calculation; and it would be a sorry state of affairs if a commander, having worked out his formula, decided not to attack!

Les éléments directeurs de la Géomorphologie de la Belgique. By Major Stevens. A lecture to the Royal Military School by the Professor of Geology.

(*August*, 1938.)—*Pages d'histoire de l'Armée Belge: Les débuts de l'Aviation Militaire Belge.* (*Continued.*) By General Mathieu. The operations during the period 26th August to 7th October, 1914, are described. They were principally confined to the defence of Antwerp. Bad weather conditions hampered the reconnaissances, and storms did considerable damage, for the machines were either in the open or in tent hangars which did not withstand the weather; but in spite of these handicaps, the airmen did great service.

The names of both pilot and observer are given in all cases in which the flights are described.

L'Artillerie Belge et la motorisation. By Lieut. Crahay. The Belgian Army in 1914 had no heavy artillery, and all its guns were horse-drawn. When the German and Austrian heavy mortars appeared in the field, the Belgians had to be equipped by France with 155-mm. and 220-mm. guns, drawn by Latil tractors. By the end of the war all the heavy artillery, the anti-aircraft artillery and one group of field artillery were motorized. The pros and cons of motorizing the artillery are enumerated, and the conclusion is in favour of a continuation of the process until the whole army is complete. There are difficulties in the way.

Les éléments directeurs de la Géomorphologie de la Belgique. By Major Stevens. (*Conclusion.*)

L'Hôpital Royal Militaire de Mons. By Colonel de Block. An account of the institution for old soldiers established at Mons by Louis XIV in 1702. It began its career as a hospital for wounded soldiers in the wars of Marlborough, and had many vicissitudes.

(*September*, 1938.)—*Pages d'histoire de l'Armée Belge: La première de mes deux missions en Russie pendant la Guerre.* By Lieut.-General Semet. Belgium sent a military mission to Russia in September, 1914, headed by General de Ryckel, assisted by the author. They travelled *via* England and Archangel, and on arrival were very warmly received. The author describes the peace-time luxury of life in Petrograd, as if war did not exist. It was not until the Mission joined the Commander-in-Chief's headquarters that they found earnest purpose and efficiency. The Tannenberg disaster was concealed from the foreign attachés, and everything was done to minimize the effect. The precautions taken when the Czar visited the Grand Duke Nicholas were of the utmost elaboration. The Emperor was virtually a prisoner.

The author returned to Belgium with General Pau, who had conducted a French mission to Russia and Bulgaria.

Pages d'histoire de l'Armée Belge: Les débuts de l'Aviation Militaire Belge. (*Continued.*) By General Mathieu. This instalment covers the periods October 7th to 13th, 1914, and the retreat of the Belgian Army to the Yser, and October 13th, 1914, to March 20th, 1915—the Battle of the Yser and the stabilization of the front. As soon as the fall of Antwerp was imminent, the aviation depot was transferred first to Ostend, and then to Dunkerque. There it remained throughout the period covered. Bad weather during the winter months took a heavy toll of the machines, and replacements from France were numerous.

The flights during October to December were maintained as far as the dwindling resources permitted, and the progress of the inundations was closely observed—information which could hardly have been obtained otherwise, as regards the enemy's side. Observation for artillery was developed, but the paucity of pilots and machines made it impossible to keep pace with the increasing demands. In March, 1915, the Company of Aviators was disbanded, and the Air Service reorganized on a wider basis.

The narrative tells of a gallant company of pioneers.

Les 2e et 5e Regiments de Chasseurs à pied à la première sortie d'Anvers (*25 et 26 Août*, 1914). By Lieut.-Colonel Couvreur. An account of the action of these two regiments, which formed part of the advanced guard of the 1st and 5th Belgian Divisions in their sortie from Antwerp. The operations of the Belgian Army were still of an open character, and were carried out with the principal object of harassing the communications of the Germans of von Kluck's army. The account is principally concerned with the gallant exploit of Corporal Tresignies of the 2nd Chasseurs, who swam the Willebrock Canal under heavy fire to lower a drawbridge from the enemy's side. He was killed while turning the wheel of the lowering apparatus, in full view of his comrades lining the opposite bank.

L'Autogire. By Colonel Desmet. The autogiro, as distinct from the helicopter, relies on the current of air caused by its horizontal motion to actuate its horizontal propeller. The development of this type of machine, which makes a spasmodic appearance and is hailed with enthusiasm each time, only to sink again into obscurity, lags behind aviation generally. Its advantages and disadvantages are enumerated. The chief advantages lie in the greater facilities for observation, for taking off and landing in small spaces, and for dropping messages at low heights. The principal disadvantage, placed last, is its vulnerability as a slow-moving target for small arms, when flying at low altitudes. For this reason, its value for artillery observing is much reduced.

W.H.K.

REVUE MILITAIRE SUISSE.

(*July*, 1938.)—*La Guerre et l'Armée.* By General Clément-Grandcourt. A review of General Debeney's book of reflections on the Great War; and a sketch of his military career. The Battle of Montdidier on August 8th, 1918, gained by Debeney, is claimed as the origin of Ludendorff's remark, "The 8th August was the black day of the German Army."

The reflections contain some sober advice on innovations; "material does not economize personnel"; "speed is not everything"; "horses cannot be entirely abolished," and "infantry is the crux of the battle." So experienced a soldier as General Debeney must be read with deep attention.

Opinions du Major-General Fuller sur l'armée motorisée. By Captain Bauer. The author met General J. F. C. Fuller at an hotel in Saragossa last spring and interviewed him on the subject of motorized armament. The well-known views of this authority are epitomized. He was in Spain as an independent observer; and he found that

the Spaniards on both sides were not making full use of their tanks. They have been too light for their tasks or have been used in driblets. Rapidity can be overdone. As regards anti-tank defence, the infantry guns cannot be too mobile. Tank attacks will nearly always come as a surprise from unexpected directions. In short, the general impression that the tanks have not proved a success in Spain must not be accepted as conclusive, since they have not been properly used, nor have they been of the right dimensions.

De l'emploi des lance-mines. By Lieut. Godet. A short article on the advantages of the trench-mortar type of weapon over others for infantry equipment. Mobility —or perhaps transportability—over any type of ground is an essential feature. No special type of mortar is described.

(*August*, 1938.)—*A propos de la vitesse du fantassin au combat.* By General Clément-Grandcourt. Contains some very interesting observations on the qualities of the present-day infantryman. The French found in 1914 that their Reserve Divisions, composed of men who had done their three years' active service but who were still under 34 years of age, were quite unequal to the tasks required of them in the rapidly-moving warfare of the first month. Their losses were very heavy in consequence. The benefits of the initial training disappear after about three years of civil life. Hence the necessity of continuing the training of reservists after they leave the colours, or at least of maintaining the standard of fitness. The infantryman of to-day requires to be a nimble animal, not a luggage-porter or an automaton. Constant drill makes the men slow and stiff.

Armée offensive ou défensive? By Colonel Lecomte. The author discusses the problem, more particularly of the Swiss Army, as to whether an army should be prepared for the offensive or the defensive. For many years, the offensive at all costs has been upheld as the only policy likely to lead to success, and certainly the French school was strongly in favour of this action. To-day, however, the defensive has gained so much in strength that there is a reaction. Of course, the adoption of a defensive policy does not preclude a counter-offensive as an answer to invasion, nor does it preclude the conversion of a defensive into an offensive when the assailant has been checked or repulsed. A country like Switzerland, surrounded by powerful neighbours, can only prepare for defence; it would be ridiculous to form her army for aggression. Equally unsound would it be to ignore preparations for manœuvre in retreat. Hitherto, in training and manœuvre it has been the attack which has received most attention. Colonel Lecomte, himself a former professor of fortification, is by no means in total agreement with those who are preaching the defensive and the defensive alone; but with a very short period of training, such as the Swiss are compelled to adopt, it is impossible to exercise the troops in all three forms of war—attack, defence and retreat. One of these forms must be selected and prepared for at the expense of the others.

Instruction et Education. By Lieut.-Colonel Mayer. The training of the Swiss soldier, like that of the English, requires different treatment from that of the French and German. The Swiss and English recruits are citizens first and soldiers afterwards; the French and German are in the reverse order. There are further differences in the method of military training. The French officers and N.C.O's are required to be the complete instructors of their men. But all are not equally suited to this. The time spent by the recruits with the colours is not long enough to enable the officers to act as parents, schoolmasters and military instructors, and the results are very variable. The author says: "Let each stick to his own job. That of the parents and teachers is to form men. That of the officers is to form soldiers, and then to command them."

In our own army, the time taken up by subalterns having to teach the elements, which the school teachers ought to have taught, is so much time taken from military instruction.

(*September*, 1938.)—*Le commandement moderne.* By General Rouquerol. The author remarks that all the profound changes in the conduct of modern war have not had

any appreciable influence on the qualities required in a commander. The telephone has made it possible to conduct operations on the widest scale from a centre far removed from the turmoil, but it has not absolved the commander from the imperative duty of personal observation of the ground over which he expects his troops to move. The better his acquaintance with the real conditions at the front, the better will be the commander's interpretation of the information collected at his headquarters, and the better will be his orders.

Du combat offensif. By Lieut.-Colonel Montfort. Offensive operations by the Swiss Army are recognized in the official training regulations to be confined to surprise attacks on an enemy greatly superior in numbers and equipment. The author propounds no tactical theory, but he takes the principles of the present regulations and enlarges on the three successive phases of offensive tactics—approach, attack, pursuit—showing how the limited scope open to the Swiss can be exploited by a skilful application of the principles laid down. The article, which is to be continued, is a pithy summary of these principles.

À propos de nos materiels d'artillerie. By Lieut.-Colonel Montmollin. On January 1st, 1938, the new Swiss organization came into force, and the changes introduced are now being tested. As regards the artillery, the changes are not regarded as ideal by any means; they have been effected more with an eye to the economical point of view than to efficiency. For want of funds, existing resources have been redistributed. A division now has one regiment of field artillery (three groups each of three batteries) and one group of two batteries of 105-mm. guns. The former howitzer batteries of a division are now grouped into two regiments allotted to Army Corps. The author remarks that it is early yet to form conclusions about the new arrangements, but he makes some observations on the salient points. He points out the remarkable disproportion between guns of flat trajectory and howitzers. For a mountainous country, this is a striking reversal of the natural order. The Germans, he points out, are substituting 105-mm. howitzers for their 77-mm. field guns.

Other matters in the new organization are disturbing the Swiss artillerist.

W.H.K.

MILITÄRWISSENSCHAFTLICHE MITTEILUNGEN.

(*July*, 1938.)—*Anti-Aircraft Defence in the Interior of the Country.*

Major-General Rieder investigates the trajectories and ranges of the three types of anti-aircraft weapons.

Machine-guns of 8 to 13 mm. calibre are effective to a height of 1,000 metres, small-bore A.A. guns of 20 to 40 mm. calibre to a height of 3,000 metres, large-bore A.A. guns to a height of 4,000 metres.

Political and Military Review during the Second Quarter of 1938. By Major-General Paschek.

The main items recorded in the period under review are: (1) the success of British politics, the agreement with Italy, the defensive alliance with France and the weakening of the League of Nations; (2) the strengthening of the Berlin-Rome axis and the tension between France and Italy on account of Spain; (3) the Czechoslovakian crisis.

The Civil War in Spain.

In his sixth article Major-General von Lerch deals with the operations that took place between the 15th December, 1937, and the 15th May, 1938. These are described under the following heads:—(1) the operations round Teruel; (2) the encirclement on the Palmera front; (3) the reconquest of Teruel by the Nationalists; (4) the Aragon campaign; (5) the march to the coast; (6) the surrounding of the 43rd Division and their retreat across the Pyrenean border.

(*August*, 1938.)—*In Remembrance of the Campaign of* 1878, *for the Occupation of Bosnia and Herzegovina.*

Major-General Kerchnawe describes the operations of the Austrian Army entrusted with the occupation of Bosnia and Herzegovina in 1878. Four columns under General Philippovic operated from the line of the Save in a south-easterly direction through Bosnia, concentrating on Serajevo. A fifth column, under General Jovanovic, advanced from the Adriatic on Mostar. The total force consisted of 11 divisions—150,000 men. After a two-months campaign the two countries were occupied by the Austrian forces. They were annexed by Austria in 1908.

The Bombardment of the Railway Viaduct at Sablici, East of Monfalcone, on the 9th January, 1916.

The Austrian Landsturm Battalion III/I was guarding the railway viaduct at Sablici, on the Italian front. An officer who was present describes the gallant behaviour of his battalion under a heavy Italian bombardment.

National Boundaries.

Colonel von Hubka describes the various kinds of boundaries between States. A river with a shifting bed is perhaps the least satisfactory. Referring to the new boundaries of States laid down after the Great War, he points out that boundaries that are economically satisfactory are the only ones that can have any degree of permanency.

The Conflict in East Asia.

Major-General von Lerch continues his account of the operations in the Sino-Japanese War up to the 20th July, 1938, under the following main headings: (1) *Operations in Shantung.* The Japanese Army in Shantung found itself in a critical situation early in April, and the Chinese won their first victory at Taerchwang. On the 19th April, the Japanese delivered their counter-offensive at Hsuchow, on the Imperial Canal, and surrounded the Chinese Army, who lost heavily. (2) *The Japanese advance against the Pekin-Hankow railway.* On the 2nd June, the Japanese attacked the Yangtse gorge at Matang. (3) *Guerilla Warfare in Back Areas.* (4) *Fleet Action.* (5) *War in the Air.*

At the end of the first year of the war Chinese losses are estimated at 1,000,000, Japanese losses at 300,000. Civil losses amongst the Chinese cannot be computed. One thousand and seventy Chinese planes are said to have been shot down, as against 89 Japanese.

(*September*, 1938.)—*River-Crossings at Belgrade from North to South during the past* 250 *Years.* By Colonel Kiszling.

On the 6th September, 1688, Max Emanuel, Elector of Bavaria, crossed the Save near Belgrade and captured that fortress from the Turks. Belgrade, however, was recaptured by the Turks soon afterwards. An attempt was made by the Imperial Army, under the Duke of Croy, to retake Belgrade in 1693, but it failed.

In 1717, Prince Eugene recaptured Belgrade from the Turks. On this occasion he crossed the Danube east of the fortress, and attacked it from the east. After Prince Eugene's death, the Austrians suffered defeat at the hands of the Turks, and in 1739, Belgrade became a Turkish frontier fortress.

In 1789, Field-Marshal Loudon crossed the Danube north-west of Belgrade, and the Save south-west of it. The Turkish garrison capitulated. In 1791, Belgrade again reverted to the Turks by the peace of Sistova. It remained in Turkish hands until 1867, when, in consequence of the war between Serbia and Turkey, it became the capital of Serbia.

In 1914, Belgrade surrendered to the Austrians, but was recaptured by the Serbs. It was eventually taken a second time by an Austro-German force under Field-Marshal Mackensen.

A Criticism of Technical Services in Wartime. By Major-General von Aarenau.

This is a retrospect of the work done by Austro-Hungarian technical troops in the World War.

If Greater Germany were to be involved in a European war, the decision would not be sought in the Austrian Alps, but on more important fronts. The old Alpine borders of the Ostmark will only be a secondary theatre of war.

In the World War nearly three-quarters of a million men were employed on engineer work on the Austro-Hungarian fronts: this number included workmen employed on field railways and field telegraphs. Some 200,000 men worked on fortifications and bridge-heads. The fate of the Belgian forts shows what may happen if such work is neglected for want of time or for any other reason. Time played a less important part in those days than it will in future; it was then possible to make up the shortage of technical troops as time went on.

Three years used to be considered necessary to turn out a trained sapper; the writer does not think it can be done in less, even with the higher standard of education prevailing in modern times.

The Danube no longer forms the boundary of the Ostmark; it is not likely that there will be the same demand for bridging engineers in a future war. But specialists, such as mechanics, electricians, miners, etc., will be needed more than ever.

Wireless Extension of the Telephone System.

Dr. Staeger mentions a French invention, known as the "télémobile," which consists of two parts. One of these is fixed and is connected with an existing telephone system. The other is portable, and can be carried about in a motor-car or aeroplane. Ultra-short waves are used. The operator in the car or aeroplane can use the instrument as an ordinary telephone.

The Supply of the Austro-Hungarian Balkan Forces during the Autumn Offensives of 1914, in Serbia.

Colonel Schoenauer explains the difficulties that were experienced in supplying the Fifth and Sixth Austro-Hungarian Armies with food and necessaries during the autumn of 1914. The two armies occupied a front of 120 km., the country was mountainous, with very few roads, and no railways. The weather was inclement, and the troops suffered from dysentry and typhus.

The Civil War in Spain. By Major-General von Lerch.

An account of the operations in Spain between the 20th June and the 20th August.

General Franco continued his offensive against Sagunto, and, at the same time, General Queipo de Llano carried out an attack on the Estremadura front. While in the south, in Andalusia, the fighting took its course, the great militia offensive of the Catalonian Army over the Ebro brought the advance against Sagunto to a standstill.

A.S.H.

WEHRTECHNISCHE MONATSHEFTE.

(*July*, 1938.)—*New Armament Industry Problems Abroad.*

Dr. Friedensburg discusses the question of industry for peace and war purposes in the leading countries of the world, together with that of raw materials. The problems of food and liquid fuel supplies in the event of war are among the most important.

Not much is to be learnt on this subject from the Spanish civil war, but, on the other hand, Japan's experiences from her war in China are instructive. It is doubtful if Japan is capable of keeping up a prolonged war. But this is the first instance since 1918, of a country being engaged in a totalitarian war, and the results will be interesting to watch.

The Ownership of Materials of Importance for War Purposes by Greater Germany's Neighbours. By Dr. Ruprecht.

The experience of the World War shows that, by the closing of the North Sea, Germany's supply of raw materials can be restricted to the products of the country

itself and those of its immediate neighbours. In this article the writer does not consider whether these neighbours may be hostile, friendly, or neutral.

The most important minerals for war purposes are coal, iron ore and oil. Others of considerable value are copper, lead, aluminium, manganese, nickel, chromium, wolfram, molybdenum, antimony and tin.

The only mineral of which Germany possesses enough for her requirements is coal. Of the remaining minerals, Germany's immediate neighbours can help to supplement, but not entirely to complete, her wartime requirements. The writer gives details of what each country can supply. It is interesting to note that Yugo-Slavia is, next to Russia, the biggest producer of copper in Europe.

Field-Gun and Light Field-Howitzer.

Lieut.-General Marx compares the German field-gun with the light field-howitzer. Out of eleven points of comparison, the howitzer is superior in four and inferior in three (not very important) points. With regard to the three remaining points, there is little to choose between them.

From the "Bomb Cannon" to the Infantry Gun.

Captain Westphal traces the gradual development of infantry ordnance from the smooth-bore bomb-thrower turned out by Krupp in 1906, to the heavy, medium and light trench mortars used in the World War. After the war, the heavy mortars came under the ban of the Versailles Treaty, the medium mortar became an artillery weapon, and the light mortar an infantry weapon. At the present time infantry have been provided with an anti-tank gun with a flat trajectory, and with heavy and light trench mortars.

Wireless Control for Navigation by Sea and by Air.

Colonel von Dufais describes the principles on which ships and aeroplanes can be controlled by radio.

The Diesel Motor for Aeroplanes and its Future Importance for Military Aviation.

The firm of *Junkers* is the only one that has succeeded in turning out a satisfactory Diesel engine for use with aeroplanes. Since the first successful flight, in 1929, from Dessau to Cologne, repeated improvements have been made, and the latest type, the "Jumo 205," is fully equal to a petrol motor. With a weight of 530 kg. it will give an output of 700 h.p. at 2,400 revolutions per minute.

Economy and safety from fire make the Diesel aeroplane engine invaluable for civil flying, and the same qualities give the bomber a maximum load capacity and effective range.

After describing long test flights made with Diesel-engined aeroplanes, the writer discusses constructional difficulties, and shows how they have been overcome. The long-distance flying boat is of special value for colonial powers (of which Germany hopes to be one again at some future date).

Reviews.

This number contains a review of a translation of Major-General J. F. C. Fuller's book: *The First of the League Wars*. This book is being read in Germany with great interest.

(*August*, 1938.)—*The Armament Industry Abroad.*

Captain Stark deals with the problems of armament industry as they affect countries outside Germany. In this first instalment he considers the conditions obtaining in France and Britain.

The country in which Government interferes least with armament industry is the U.S.A. At the opposite extreme—outside the dictator States—is, strangely enough, liberal France. Here a number of the leading armament firms, such as Hotchkiss, and Schneider-Creusot, have been nationalised. In Britain three interesting points have arisen in connection with armaments: Industrial preparations by the organization of so-called "shadow" factories and the general expansion of industry during the past four years; the food problem; and the preparations made to maintain

both in case of war. Britain has—until recently, at any rate—been extraordinarily happy-go-lucky in her arrangements. But if war were to break out with Germany she would at once resort to the convoy system, and, if she lost half her ships through submarine action, she would still be able to feed her population.

Renewals of Plant in Armament Industry.

Dr. Leonhardt discusses the problems of maintaining machinery and keeping it up to date in armament factories. The shadow factory system adopted in Britain is so costly that even a rich country like the United States has fought shy of copying it.

Russia's Supply of Mineral Raw Materials useful for War Purposes. By Dr. Ruprecht.

Russia possesses an enormous mineral wealth, but is so handicapped by a lack of communications that she would have to face a shortage in the event of war. Many of her coal-mines and oil-fields are in the Ural mountains, fairly safe from air attack, but the long lines of railway leading to her frontiers are a source of weakness. The only important raw material of which Russia is deficient is rubber. She is rich in copper, lead, zinc and bauxite, and she shares with British India the position of one of the leading manganese producers in the world.

The Position of Coast Defence To-day.

Captain Rehder discusses the following points in connection with coast defence: Artillery (heavy, medium, light, anti-aircraft), co-operation with army artillery, dummy guns; fire control and observation; range-finders; sound ranging; search-lights; mine-fields; booms; and torpedo batteries; use of smoke screens and gas; co-operation with the navy.

In the autumn of 1914, when the Germans occupied the coast of Flanders, they found it completely undefended, and the British fleet could have kept the right wing of the German Army under fire. The Germans, however, gradually strengthened their coast defences, which were able to assert their superiority over the British fleet. The final British reply, in the shape of 18-inch guns, mounted on monitors, was not ready until after the armistice. These guns are now at Singapore.

The writer maintains that coast fortresses will, in future, hold their own against ships.

Inland Water Transport and its Value in Wartime.

Navigable rivers and canals proved of considerable value during the World War both on the eastern, on the south-eastern, and on the western front. They helped to supplement the railways, to relieve the strain on the latter, and to supply the civil population. They were found specially useful for bulk stores.

Waterways are, of course, liable to interruption through frost, floods, and fog, and they are as vulnerable as railways to air attack.

(*September*, 1938.)—*The Armament Industry Abroad. A Comparison.*

Dr. Stark concludes his article in this number.

Sweden has taken active steps in recent years to control her industries in the event of war. The supreme commands of the army, navy and air force have been co-ordinated under a general staff for defence.

After a brief reference to Latvia, Argentine, and South Africa, the writer turns to Australia and the United States. Australia is determined to be independent of the home country as regards her armament in the event of war. She will shortly be in a position to manufacture shells for the 8-inch guns of the cruisers *Canberra* and *Australia*, and for her 9·2-inch coast-defence guns. The first tank has been manufactured in the country, a cordite factory has been begun, and the manufacturing rights of the Bren gun have been acquired from the Czechoslovak Government.

The United States have profited by their experience in the World War. Since 1936, great progress has been made with the Industrial Mobilization Plan. The writer discusses the reasons for the greater activity in American war industry, and considers that the organization of her armament manufacture is well worth study.

The Reserves of Foodstuffs, Raw Materials and Sources of Power in the Conduct of War.

Dr. Holzhauer dwells on the importance of holding large reserves of foodstuffs, raw materials and sources of power. Formerly the accumulation of reserves was not so essential in warfare as it has become since the beginning of the Industrial Age. It is now of paramount importance, if a nation is to survive a drawn-out conflict.

Will Material Win? By General Ludwig.

Opinions differ as to the form that a future war will take: one extreme view being that a rapid decision may be reached by an overwhelming use of tanks and aeroplanes, the other extreme being that improvements in armament may again lead to position warfare. In the latter case the victory of materials would be assured, and a decision would have to be sought in industrial and air warfare and in starving out the adversary.

The wars of the nineteenth century were wars of movement, with the exception of the American Civil War, which was won by the north by a superiority of material, in spite of the superior generalship of the south. The writer sees an analogy between this war and the World War.

In the latter both sides missed their opportunity. Had the Germans, after their success at Ypres, made a gas attack on a large scale, they could have broken through the Allied front. Similarly, had the Allies made their first tank attack on a sufficiently large scale, they might have broken through the German line.

In 1918, the shortage of men in the German Army necessitated the calling up of a large body of men employed in armament work. This led to a slowing down of the material supplies, and the ultimate defeat of the German Army.

In a future war a superiority of material, properly used, will give a better chance of victory than superiority of numbers.

A.S.H.

VIERTELJAHRESHEFTE FÜR PIONIERE.

(*August*, 1938.)—*Scharnhorst. The 125th Anniversary of his Death: 13th June*, 1813. By Major-General Klingbeil.

Scharnhorst, who came from a Saxon family, served in the Hanoverian Army for 20 years before being appointed to the Hanoverian General Staff. In 1801, he entered the Prussian service. In the war of 1806, as Chief of the General Staff to the Duke of Brunswick, he was unable to prevent the break-up of the old Prussian Army at Jena and Auerstedt. After the peace of Tilsit he was placed at the head of a reform commission for the reorganization of the army. In 1813, when Chief of Staff to Blücher, he was wounded in the battle of Lützen, and died from the effects of his wounds. He had been Chief of the Engineer Corps from 1810 to 1813.

History of the Saxon Engineer Corps. By Lieut.-Colonel Sinz.

The Saxon Miner and Pontonier Corps was founded in 1698 as a branch of the artillery. The writer traces its history during the 240 years of its existence. In 1812, there was an engineer corps, as well as a sapper and pontonier company and a bridging train, all of which took part in the Russian campaign on the French side. After the battle of Leipzig, Saxony sided with the Prussians against the French. The Corps took part in the war of 1866 on the Austrian side, and in the Franco-German war on the Prussian side. It distinguished itself in the World War. At the end of the war the various units were disbanded or incorporated in German infantry regiments.

125 Years of the Bavarian Pioneers.

Lieut. Spoerl traces the history of the Bavarian Pioneers, who were originally raised in 1813, as a pontonier company. They served with distinction in all campaigns during the 125 years of their existence. In the World War they consisted of 98 companies. With the subsequent reduction of the German Army their strength was reduced to three companies.

125 *Years Ago. Engineers and Fortresses during the Napoleonic Era.* By Major-General Klingbeil.

In a first instalment the writer gives an account of some of the work carried out by engineers during the campaign of the Elbe in 1813. In March, 1813, Eugene Beauharnais, Napoleon's stepson, had taken up a position east of Magdeburg for the defence of the middle Elbe. The two allied armies opposing him, under Wittgenstein and Blücher respectively, were able to unite near Leipzig, thanks to an extemporized bridge constructed over the Elbe at Rossiau by the Prussian sappers. Napoleon's dearly-won victory at Lützen on the 2nd May, compelled the allies to evacuate the left bank of the Rhine. In the pursuit of the allied armies, the French sappers repaired the demolished stone bridge at Dresden with timber framing in 16 hours. Both sides made use of the armistice that lasted from the 1st June to the 16th August to strengthen their positions. Napoleon fortified Hamburg, partly to prevent the British from helping the allies, and constructed a line of blockhouses along the line of the Elbe.

Unwanted Fortresses.

Colonel Dittmar discusses the value of fortresses in modern warfare.

In the Middle Ages, towns were fortified to assert their freedom and independence. Fortification gradually became part of the defence scheme of a country. In the campaign of 1806–07, the surrender of a number of Prussian fortresses led to the belief that fortresses were, on the whole, of little value.

Field-Marshal Count Moltke expressed the opinion that a railway is of greater value than a fortress; and this saying might well be modernized: "Build no fortresses; make roads or landing-grounds." The general gist of the article is that fortresses may hamper the movements of an army in the field, but that they have their uses. The modern tendency in Germany has been to avoid an extensive use of them. But, as the writer points out, the great battle of Tannenberg in 1914 could not have been won by the Germans if the southern boundary of East Prussia had not been strongly fortified.

Examples in Military History of Battles for Rivers.

Major-General Tiemann gives a number of instances of battles fought to effect river crossings, illustrating the correct principles to be followed, and the mistakes made on different occasions.

In the Austrian War of Succession, in 1744, Prince Charles of Lorraine, the Austrian commander-in-chief, had his army concentrated south-west of Heidelberg, in the angle between the Rhine and the Neckar. His object was to reconquer Lorraine from the French and Bavarians, and to do this he decided to cross the Rhine between Speyer and Germersheim (to the south). He proceeded to build a bridge over the Neckar, and another bridge to the north of it over the Rhine, and sent a force northwards. Having deceived the enemy as to his intentions, and drawn the enemy forces away to the north, he marched southwards and succeeded in crossing the Rhine with little opposition.

This example is quoted by Frederic the Great in the *General Principles of War*. A somewhat similar ruse was employed by Duke Ferdinand of Brunswick, one of Frederic the Great's generals in 1758, during the Seven Years' War, in his operations against the French.

In opening his Russian campaign of 1812, Napoleon adopted a similar stratagem. His intention being to cross the Niemen at Kovno, he gave out that his headquarters would be retained at Warsaw, some 230 miles away. He used political as well as military measures to deceive the enemy. Shortly before the passage was effected he reconnoitred the site personally, disguised as a Polish peasant. The operation was a complete surprise for the Russians, and the crossing was carried out successfully.

In contrast to the method of surprise advocated by Frederic the Great, other commanders, before and after his time, have forced a passage against a prepared enemy.

In 1632, Gustavus Adolphus forced the passage of the Lech against Tilly's army in a frontal attack. He took advantage of a re-entering bend to enable his guns to obtain a cross-fire on the enemy's position. With the help of a smoke screen he was able to conceal his bridging operations and establish a bridge-head on the opposite bank.

Massena's crossing of the Limmat in the face of a Russian and Austrian force, in 1799, is another example. He had collected a number of river boats, which were transported across country on ox-wagons. They were intended to take the infantry across the river, while a pontoon bridge was to be built later on. A feint was made of crossing at a point farther downstream. A force of 2,000 men was ferried across the river before daybreak, and secured a sufficient foothold on the opposite bank to allow of the construction of a bridge. 15,000 men were thus able to cross the river by 9 a.m.

In the war between Prussia and Denmark in 1864, the Danes were entrenched on the western bank of the island of Alsen. The Prussians succeeded in crossing the Alsen sound in four different places, with the support of a strong force of artillery.

We next come to four river-crossings carried out during the World War.

The first one mentioned is that of Garnier's Cavalry Division and the 34th Infantry Brigade over the Meuse early in August, 1914. The task set to the cavalry was to cross the Belgian frontier on the 4th August, to secure the crossings of the Meuse and of the canal north of Visé, and to clear the country north of Liége.

The 34th Infantry Brigade, which was to have taken part in a *coup-de-main* on Liége, found itself held up at Visé. The bridge over the Meuse had been destroyed. The engineers attached to the brigade and the two divisional bridging trains had not yet left Cologne.

The troops commenced crossing on the 5th, but, owing to the shortage of ferrying and bridging material, the cavalry had not completed crossing the river till the 8th.

The width of the river at Visé was 150 metres. This should have been known from peace-time reconnaissances. Two bridging trains could only furnish 120 metres of bridge for infantry in file or cavalry in single file, or 70 metres of bridge for vehicular traffic. Not only was the bridging material late in arriving, but it was quite insufficient in quantity.

Owing to the mistakes made, the 3rd Belgian Division was able to get away safely from Liége to Tirlemont.

The next river passage referred to is the attempted crossing of the Meuse by the 33rd Infantry Division on the 30th August, 1914.

The French were in occupation of the left bank of the river near Sivry. The XVIth Corps, with the 33rd Division leading, had reached Damvillers, some 4 km. from the right bank of the Meuse, on the 29th. The bridge at Sivry had been destroyed. In the order of march, two engineer companies had been allotted to the advanced guard; but the corps bridging train had been placed in the rear of the division, behind the ammunition columns.

In those days there was no divisional commanding engineer: the chief engineer of the corps (a lieut.-colonel) commanded the engineer battalion of three companies.

The services of the chief engineer were placed at the disposal of the division. Divisional orders directed him to get the advance guard across the river during the night of the 29th/30th, while a general attack was to be opened at daybreak.

Various blunders were made, owing to the inexperience of the divisional staff. The orders were issued too late (at 22.15 on the 29th). Various infantry units were placed under the chief engineer's orders, and he was directed to carry out the attack on a defended river, for the division. He was not given the necessary staff nor the means of communication for such a task. In his capacity of commander of the engineers he had quite enough to do, without being entrusted with the command of a mixed force in attack.

The result of the divisional orders was that all roads leading to the river were

blocked with vehicles, mainly artillery. Neither infantry, engineers, nor bridging train could get through. When at daybreak on the 30th none of the troops under his orders had put in an appearance, the chief engineer, on his own responsibility, cancelled the orders for the passage, a decision that received the approval of the corps commander.

The passage of the Third Army across the Meuse on the 23rd and 24th August, 1914, is another instance in which several mistakes were made. On the 17th August the Third Army was concentrated around and west of the Eifel. The line of the Meuse was held by the enemy. The bridges over that river had been prepared for demolition by the French, but were still intact. The Third Army received orders to cross the Meuse and attack the French Fifth Army, which was marching northwards west of the Meuse towards the Sambre. After various delays, the Army Commander ordered the crossing to take place on the 23rd August.

It is not possible to follow the operations in detail, but the main mistakes made were the following. No attempt was made to interfere with the preparation of the bridges for demolition. The commencement of the attack on the 23rd was postponed for several hours on account of fog. Advantage should have been taken of the fog to ferry the troops across. The attack was fixed for too late a date: it should have been ordered for the 22nd. In spite of all the efforts of the chief engineer of the army, the bridging train of the XIXth Corps did not reach the Meuse till the 24th. A mistake was made in concentrating the attack on villages and bridges, the very points where the maximum enemy resistance might be expected.

The result of the mistakes made was that the German artillery was not able to get across the river till the 24th, and the Fifth French Army succeeded in drawing clear. The battle of the Sambre, which might have been an overwhelming victory for the Germans, was just an " ordinary " victory.

Increased experience and the realization that battles for rivers require intensive preparation and the smooth co-operation of all arms taught the Germans how to carry out forced river passages, which can serve as examples for the future.

One of these is the crossing of the Dvina by the Eighth Army on the 1st September, 1917.

The Eighth Army was ordered to capture the town of Riga, on the right bank of the Dvina estuary. The Russian position ran along the right bank of the Dvina, but round Riga itself it formed an extensive bridgehead on the left bank, 70 km. long and 20 km. deep.

The sketch accompanying the article shows the point selected for the crossing, a place named Uxkull, upstream of the bridgehead, where the river was from 250 to 350 metres wide. It offered numerous advantages: a railway leading up to it, forests giving cover from view, a re-entering angle towards the attacker. The approximate position could not be concealed from the enemy, but he was not aware of the exact place at which the attack would be made. Careful measures were taken to prevent contact between the troops and the civil population; no telephone messages relating to the plans were allowed; the troops did not take up their positions till the day before the attack, all preparations were camouflaged, sham obstacles were put up and artillery preparation was carried out in various places along the whole line.

The attack was launched by three divisions on the 1st September on a 7-km. front. On the cessation of the artillery bombardment, at 9 a.m., the infantry began to cross the river. Seventy-five pontoons were allotted to each division. Three bridges were built; the first was completed at 1 p.m., the other two at 2.30 p.m. A boom to keep off mines was begun at the same time. (It took three days to complete.)

The attack was carried out with comparatively small loss and it led to the capture of Riga.

The Demolition of Reinforced-Concrete Beam Bridges. By Lieut. Kolb.

This article is limited to the consideration of slab and beam bridges: arch bridges are not taken into account.

The writer commences by discussing the elementary principles of a reinforced-

concrete beam or slab, and the stresses to which the reinforcement is subjected in the lower flange of a beam, in stirrups and in columns.

In demolishing a beam the best point to attack is the centre third, where there are no stirrups In a set of continuous spans, fractures should not be made equidistant from supports, or the beams may retain their equilibrium, particularly if some of the steel rods still hold together.

The best position for the explosive charge in columns and thin retaining walls is half-way up, to encourage an outward thrust. The damaged portion must extend over such a distance that the columns cannot be supported on the broken stumps.

The steel reinforcement can only be destroyed with certainty if the charge is in immediate contact with it. Even a thin layer of concrete that may lie between the two, reduces the damage to a mere bending of the reinforcement. In demolishing the tension flange of a beam, a hole should be bored through immediately over the tension rods and the charge placed in contact with them.

In the case of slabs, compression flanges of beams, and columns, charges should be placed on both sides (or, better still, inserted in bore-holes). The charges should be staggered in relation to one another, so as to produce a maximum shearing effect.

When the spans exceed ten metres, the destruction of light intermediate supports is specially effective and may cause the collapse of the roadway without the demolition of the main beams. On the other hand, if the piers are thick and if they are not effectually damaged, the result may only be a sag in the roadway.

If time, personnel, or explosives are short, it is better to concentrate on the demolition of suitable supports and the tension flanges of the beams, and to leave the compression flanges alone. If for any reason the demolition of the tension flange is not feasible, the destruction of a width of slab equal to 1½ times its depth may lead to the collapse of the bridge.

In demolishing a tension flange, the charge should be placed above the steel rods. If placed below, the rods will merely be bent. To place the charge, a hole will have to be made with a rock drill. If a drill is not available, a preliminary charge can be fired to loosen the concrete, and the reinforcement can be laid bare by means of a pickaxe or chisel. Tamping may be done with earth or sandbags. Holes bored in beams do not greatly affect their strength, and, subject to suitable precautions being taken, traffic can continue over the bridge until the time comes for firing the charges.

To destroy the compression flange, the charges may either be laid on the surface, or placed in special bore-holes. Any surfacing material, such as asphalt, macadam, protective concrete, etc., must first be removed, and the surface of the reinforced concrete must be laid bare.

In calculating a continuous charge across the whole roadway, it must be borne in mind that the beams offer a much higher resistance than the slab between them. It is not advisable specially to demolish main beams unless they are more than 1·50 metres deep. In such cases it will be sufficient to break up the upper third.

If charges are inserted, bore-holes should be drilled vertically downwards in the middle of the beam to a depth of at least one-third of its height, subject to a minimum of 20 cm. (8 in.) below the bottom of the slab.

Bore-holes drilled in a slab should not be farther apart than twice its depth. There should be a 5-cm. (2-in.) thickness below the bottom of the holes for tamping purposes.

While preparations for demolition are being made, traffic should be restricted to half the bridge at a time.

The article concludes with the method of calculating charges for demolitions. The formula laid down in the German engineer text-book is: for an untamped charge laid on the surface of reinforced concrete :—L (charge in grammes) = 50 F (area of cross-section in square cm.). If the charge is tamped, the charge can be reduced by an amount varying from 20 per cent. to 50 per cent., according to the efficacy of the tamping.

Other formulæ and tables are given for special conditions, and an example is given, working out details for the demolition of a bridge of three spans.

The Construction of a Military Bridge Across the Kaiser-Wilhelm Canal.

Lieut.-Colonel Selle describes the construction of a pontoon bridge—to carry 16-ton loads—across the Kaiser-Wilhelm Canal, by the 50th Pioneer Battalion.

There is no current or tide in the canal, so that it was only necessary to provide anchorage against the effect of the wind. Local conditions made it necessary to align the bridge slightly skew to the canal. Eighty-four pontoons (*i.e.* 21 four-pontoon rafts) were used.

A peculiarity about the bridge was the provision of a cut—65 metres wide (10 rafts)—to allow the passage of the largest ships. A sketch shows the method adopted of forming cut. This took only a few minutes but, for want of practice, re-forming bridge took longer (20 minutes). It was found that the wash of passing ships, even that of ocean liners, gave no particular trouble.

Obstacles in Mountainous Country.

Lieut.-Colonel Geiger lays down some general principles for the erection of obstacles and the laying down of land-mines in mountainous country.

A force operating in mountainous country is tied down to tracks and roads far more than it would be in the plains. In densely wooded country, pack transport is entirely restricted to paths, and even scouts can only make slow progress off the beaten track. During retirements, a system of roads is essential for the movement of mechanical transport, and the destruction of a few bridges may hold up the progress of a force for a considerable time.

Obstacles in hilly districts are much the same as those in the plains, but they must be used on a smaller scale. Tank traps will be unnecessary. Local material should be used as far as possible, in order to economize transport. Mines and trip-wires form effective obstacles.

It will probably be impossible to block all paths and tracks, but the provision of obstacles should not be neglected on that account. Mines should be laid down in depth, and so arranged that they will not all go off when the first enemy scouts pass over them. The best arrangement will be to conceal them, and design them in such a way that they will not go off until heavy guns pass over them.

The Strengthening of the Wooden Bridge over the Mur at Frohnleiten. By Lieut. Triebig.

In connection with the events that occurred in Austria on the 10th and 11th March, 1938, when German troops marched into the country, a motorized unit, comprising heavy artillery, advanced through the upper Enns and Mur valleys to Graz. It had to cross a number of bridges that were either not designed to carry such heavy loads or were in a doubtful condition.

The 47th Pioneer Battalion was entrusted with the strengthening of the bridges to enable them to carry 12-ton loads. Lieut. Triebig describes the method adopted to strengthen the bridge at Frohnleiten, a wooden structure with seven spans of 12 to 13 metres and a total length of 90 metres.

Each span was underpinned by means of two trusses, each consisting of two struts bearing against the piers at their lower ends, and connected by a distance piece at the top. No beam was longer than 6 metres. The work was completed in three days. It was complicated by the fact that the bridge was on the skew, and that the current was very swift.

A.S.H.

THE INDIAN FORESTER.

(*July*, 1938.)—Mr. Kapur contributes *Notes on some wood-working industries in the Punjab*. Most of those described are home employments, carried out without the aid of any but the most simple appliances. The cost of out-turn compares

favourably with that of machine-made articles. The author instances wooden heels for ladies' shoes, gramophone and radio cabinets, bobbins, shuttles, picture mouldings and electrical casings, simple drawing instruments, bed legs, and folding chairs. The writer is an expert on seasoning methods, and notes that the Forest Research Institute is trying to evolve a simple type of furnace kiln, at a total cost of under Rs. 1,000. Various timbers are used, including a great many which are seldom heard of in engineering circles, as they do not grow to scantling sizes.

The *Forest Stand of the British Empire* gives statistics as regards the ratio of forest to total area ; that of the U.K. and Ireland is 4·3 per cent. only, a figure very much less than the average, and one which exceeds only Kenya (2·1 per cent.) and South Africa (0·5 per cent.). Even Australia, which we are inclined to look on as an arid continent, has a higher percentage of forested area than this country. The average annual cut per acre (13·6 per cent.) is higher than in any other dominion, except South Africa, where it is 43·6 per cent. The total area under forest in the Empire works out at 2,430,000 square miles, or 21 per cent. of the world's timber acreage.

(*August, 1938.*)—*Wood for Sports Goods*, details the long list of Indian timbers, used in India, or exported to the United Kingdom, for the manufacture of such articles. Mulberry grown in the irrigated lands of the Punjab is used for hockey sticks and tennis rackets, and most officers who have used either will give the Sialkot manufacturers a *chit* for their excellence. When a laminated instead of a solid rim is used, *nim*, *chinar*, ash and many other indigenous woods are successfully employed. Bamboo has lately been introduced, with successful results, for the same purpose. The ' cricket bat willow ' is grown in Kashmir. Stumps are made of *shisham*. *Babul* is used for polo sticks and golf club heads. The list could be extended almost indefinitely.

A statement of wild animals shot in India and Burma, less certain provinces and Indian states, during 1935–36, ranges from 398 tigers and tigresses to one rhinoceros. The list is most carefully compiled—witness the fact that one hare is reported as having been shot in Ajmer—Merwara. But does every sportsman send in a return of all animals killed ?

A short article on ornamental and flowering shrubs refers to a pamphlet on the same subject, which might often be of use to sappers in charge of roads.

Finally, an extract from the *Quarterly Journal of Forestry* deals with the advantages of some sort of State control of privately-owned forests and woodlands. Most owners have to be convinced that forests will pay if sufficient attention is given to them, and the article proposes, as an alternative to legislation, that the technical advice of experts should always be available.

F.C.M.