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Charles Shipley

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MAJOR-GENERAL SIR CHARLES SHIPLEY.

MAJOR-GENERAL SIR CHARLES SHIPLEY was born on February 18th, 1755, and received his commission in the Engineers in 1769, at the age of 14. He served 35 years abroad, at Minorca and in the West Indies. He was captured, with his family, by the French in 1794, on the voyage to Guadaloupe and was released owing to the pluck and exertions of his wife. He took part in most of the fighting of that period in the West Indies and became a Brigadier-General. In 1809 he was knighted and received the thanks of Parliament for his conduct at the capture of Martinique. He was Second-in-Command to Sir James Leith at the attack on Guadaloupe. In 1813, Sir Charles Shipley was made Governor of Grenada, where he died on November 30th, 1815, universally regretted. He received the General Officer's Gold Medal in 1815, inscribed for "Martinique" and with clasp for "Guadaloupe." He was the only officer of the Corps to receive this large gold medal.

THE FAREWELL ADDRESS

OF

MAJOR-GENERAL G. WALKER, C.B., C.B.E., D.S.O.,

(Commandant S.M.E. and R.E. Depot).

13th February, 1931.

I HAVE asked you to meet me here to-day, gentlemen, as I want to say a few words to you regarding what I conceive to be the duties of a British officer generally and a British Engineer officer in particular.

2. Our responsibilities are, I think, twofold :

(*a*) In respect of our position as English gentlemen.

It is our duty to maintain before the world, wherever we go, by our conduct, demeanour and appearance, the prestige which has belonged for many centuries, and which, I trust, will remain for many more, to what is called a gentleman—a man who cannot be better described than one who does justice, loves mercy and walks humbly and in the fear of God. It is no question of rank.

(*b*) In respect of what is due to the Service.

Here the first essentials in our conduct are, loyalty and discipline and the avoidance of anything that savours of intrigue.

A good officer must obey orders with alacrity, a loyal officer must obey them in the spirit, if circumstances prevent obedience to the letter. Your duty is to carry out the work that is set you by your commander without hesitation, to the best of your ability and without obstruction or criticism.

Criticism, and destructive criticism especially, is only too prevalent with some people. It is a frame of mind that is absolutely unsoldierly. It is a golden rule never to criticize unless you have a better solution of the problem at issue to put forward. A soldier's first thought must be how can I possibly get this thing done, not how shall I be able to avoid doing it.

3. An officer's duty is to lead men, and the leadership of men in war must be his constant study. Leadership does not mean making people do unpleasant things, but teaching them to do these things because they have to be done, and to like doing them for that reason.

The power of leadership depends on the following, amongst other things:

(*a*) Personal control of oneself and of one's temper.
(*b*) Sound professional knowledge, as intelligent men will never follow an ignorant one.
(*c*) Personal sympathy for the troubles and shortcomings of one's subordinates.
(*d*) Personal integrity and the realization that there are some things which an officer cannot do.

4. I must now say a word as regards our responsibilities to our Corps. We have a great tradition and a long and honourable history. These have been built up, during a long period, by the zeal and industry of our officers and men. Our predecessors have always realized that the duty of a Royal Engineer is first and last to help other people, to apply his art in such a way as to make the work of other people less difficult in war. It is our duty to maintain this tradition to the best of our ability.

I would like to warn you against a horrible expression which I sometimes hear, viz., "That is not a Sapper's job." In my humble opinion it is a damnable thing to say or even think. Whatever will help the work of the Army along is a "Sapper's job" every time.

5. May I add a few words of more personal advice which may be of value to the younger members of my audience. Avoid unprofitable speculation as to the future either as regards yourselves or the Corps. Just do what comes to your hand zealously and ungrudgingly and give an honest opinion when you are asked for it.

Your personal future will depend upon your efficiency and nothing else.

An R.E. officer must have a broad general knowledge of the work of his Corps and an intimate knowledge as to how it provides for the needs of the Army. As he gets older he must try and be a master of one branch but must not fail to keep in touch with the others.

Versatility is what is required. He must not get into a rut by tying himself up to one line for too long.

Most important of all, we are military engineers, and we must continue to study soldiering all our lives.

Lastly, never allow yourselves to think anything you have to do a rotten job. There is not a rotten job in the Army if it is done in the right spirit.

6. Those are the things which I have tried to do during my 42½ years' service. I have had a happy life and have enjoyed every minute of it. If I had to start again, even with my long experience to guide me, I should do what I did so many years ago, and become a Royal Engineer.

SIR CHARLES PASLEY.

II.

THE MANUFACTURE OF PORTLAND CEMENT.

By CAPTAIN A. D. CAMPBELL, M.C., R.E.

AMONGST the contributions of Sir Charles Pasley to science and industry, his experiments in the manufacture of Portland cement stand first. He recorded his results in a book, the full title of which is as follows :—

> "Observations on Limes, Calcareous Cements, Mortars, Stuccos and Concrete, and on Puzzolanas, natural and artificial; together with Rules deduced from numerous Experiments for making an Artificial Water Cement, equal in efficiency to the best Natural Cements of England, improperly termed Roman Cements; and an Abstract of the opinions of former Authors on the same Subjects."

That, one must admit, is a title which gives full value for its money, though possibly a little parsimonious as regards full stops.

It is backed up nobly by a table of contents occupying no less than 58 pages!

In the 411 pages which go to make up the first or 1838* edition, is given not only the story of the earliest successful attempts to make an artificial cement out of Medway mud and lime, but also an account of many interesting experiments in reinforced brickwork and mortar joints in general.

The condition of the cement industry in Great Britain at the time when Pasley started his researches (1826) can be gauged from the following extract from the *Encyclopædia Britannica* (14th Edition) :—

". . . in 1822 Frost brought out his 'British Cement' which was soon followed by Aspdin (1824) with 'Portland Cement.' Both of these, however, were hydraulic limes, in that the mixtures were only calcined and not clinkered. Aspdin was apparently the first to use the word 'Portland' to define a particular type of cement, though Smeaton, over half a century earlier, had said that cement

* *Note.*—It is characteristic of Pasley that a second edition, the first part of which was published in 1847, was never completed, his inherent versatility having apparently resulted in an absorption in other studies.

made from these materials would 'equal the best merchantable Portland stone in solidity and durability.' His 'Portland Cement' was, of course, quite different from modern Portland cement, but nevertheless the colour and properties of concrete made from this cement were somewhat similar to Portland stone.

"By this time (1820–30) works were springing up in various parts of the country where the raw materials were suitable; Parker's 'Roman cement' was manufactured at Northfleet, Kent, 'British cement' was made by Frost at Swanscombe, and the Aspdins were making 'Portland cement' at Wakefield and Gateshead. This Portland cement, as mentioned above, was more of the nature of hydraulic lime; but about 1845 Mr. I. C. Johnson, who was then manager of Messrs. White & Son's Works at Swanscombe, Kent, produced a cement of the modern Portland cement type, by burning the raw materials 'with unusually strong heat until the mass was nearly vitrified,' and this clinker when finely ground, made a cement which was far in advance of the ordinary type produced at that time."

It is of interest to contrast with this the preface written by Pasley to his second edition in 1847.

"A Second Edition of this Treatise has been required for several years past, but the Author could not spare time to revise it till now. The first Part of the work only is offered to the public at present; the second Part will follow in a few months, with the Table of Contents for the whole. In the meantime, he has been gratified to find that his labours have not been thrown away, inasmuch as the opinion he advanced—that artificial cements, equal or little inferior to the best cements of nature, might be made with profit to themselves and benefit to the public by any manufacturers, who might think proper to adopt the principles first developed and the rules laid down by him—has since been proved to be correct. When he first published his researches on the subject, all the previous attempts to make a good artificial cement in this country had so far failed, that only one sort, that prepared by Mr. Frost, had found its way into the market, which was of inferior quality, owing chiefly to certain defects of the mode of preparing the ingredients, pointed out in the First Edition of this work. At present there are three manufactories of artificial cement in England, which have all been used more or less extensively in works of importance, and have given satisfaction; viz., first, that of Messrs. John B. White and Sons, in the parish of Swanscombe, Kent, the present proprietors of Mr. Frost's works, who, after gradually relinquishing the objectionable parts of his process, have succeeded in making a good artificial cement, which they call their PORTLAND CEMENT, by a mixture of chalk found on their own premises with the blue clay of the Medway; secondly, that of Messrs. Evans and Nicholson, of Manchester, who make an

artificial cement, which has been called the PATENT LITHIC CEMENT, with the very same ingredients, and in the same proportions nearly, that were used in the Author's experiments, but the most important of which is obtained in a round-about manner from the residual matters or waste of certain chemical works, instead of working with natural substances; thirdly, that of Mr. Richard Greaves, of Stratford-upon-Avon, who makes a powerful water cement, which he calls BLUE LIAS CEMENT, by mixing a proportion of indurated clay or shale with the excellent blue lias lime of that neighbourhood, both of which are found in the same quarries; the former being previously broken and ground, and the latter burned and slaked, which is absolutely necessary in making an artificial cement from any of the hard lime stones.

"The success of this process, as a commercial undertaking, though the most expensive of all that were suggested in the First Edition of this work, is therefore peculiarly satisfactory, considering the great importance of good water cement, and the probability of the natural cement stones of this country, which are only found in certain localities, becoming unequal to the demand, or scarcer than they are at present."

There is an obvious inference to be drawn from a comparison of the above extracts, that Pasley's book was largely instrumental in bringing to birth a material which has since become of such world-wide importance that it is not uncommon to hear the present era referred to as the Concrete Age.

This suggestion is supported by the *Dictionary of National Biography*, which states:—

"In May, 1836, he [Pasley] commenced a work on 'Limes, Calcareous Cements. . . .' [The labyrinth provided by the full title having already been explored, the reader is excused a second venture.] . . . The first edition was published in September, 1838. It contains several discoveries, the result of experiments at Chatham, and led at once to the manufacture in large quantities of artificial cements, such as Portland, Patent Lithic and Blue Lias. . . ."

That Pasley was in close touch with Mr. Frost and subsequently with Messrs. White & Sons is shown by the fact that some ten pages of the Appendix to the 1838 edition are devoted to the methods and experiments of these manufacturers.

It is, indeed, definitely stated that Mr. Frost forsook the brown clay of Upnor for the blue Medway clay on seeing the excellent results of Pasley's experiments, and later on, that Mr. White referred to the latter for his opinion before purchasing Mr. Frost's works, maintaining thereafter a correspondence with Pasley in which the latter was apparently extremely outspoken in his criticisms and recommendations regarding the methods employed in the Swanscombe works.

From the foregoing evidence, it is therefore clear that :—

(1) The origin of modern Portland cement is traced to the works of Messrs. White & Sons at Swanscombe.
(2) The methods of manufacture resulting in this production were revolutionized at these works about 1845.
(3) Pasley's book appeared in 1838, and had a wide influence on cement manufacturing methods.
(4) Pasley was in close touch during the critical period with the Swanscombe firm and was apparently periodically consulted by them.
(5) Pasley was undoubtedly the first manufacturer of cement to spot the valuable properties of the blue Medway clay from which the modern Portland cement admittedly sprang.

In connection with the last point there is a pregnant little anecdote in the telling of which Pasley's first few pages cannot be beaten.

"In 1826, in consequence of having received an order the year before, from his Grace the Duke of Wellington, then Master-General of the Ordnance, that Practical Architecture was, in future, to form part of the Course of Instruction for the Junior Officers of the Corps of Royal Engineers, attending the Establishment at Chatham, under my direction ; I was induced to investigate the properties of water cements and limes, and adopted a very simple and expeditious mode of testing them ; and afterwards I tried a great number of experiments, in hopes of obtaining an artificial cement from a mixture of chalk and clay. The clay experimented upon was an excellent brick-loam from Darland, in that neighbourhood, which I was induced to use in preference to any other, in consequence of the celebrated Smeaton, in his researches into the qualities of lime stones, having declared that those adapted for building under water were all composed of a mixture of lime and of a clay suited for brick-making ; so much so, that after dissolving the lime out of several of those stones by an acid, he found the residue to be clay of such a quality, that on being burned, it was converted into a sound red brick, which experiment of Smeaton I had myself also verified. But after the efforts of several months, all my experiments with chalk and brick-loam having completely failed, I gave up the pursuit, under the impression, however, that the thing was practicable, and that it would or might be done hereafter by a person more skilful in chemistry than myself.

"In 1828, my Friend and Brother Officer Major Reid having come to reside at Chatham for a few months, chiefly from the interest he took in the Architectural Course, then in progress, requested me to show him not only the mode I had adopted of testing the natural cement and lime stones, which had proved perfectly satisfactory, but also in what manner I had attempted to form an artificial cement. I

was at first reluctant to repeat any of those experiments, which I told him could only lead to certain failure, but on his expressing a strong wish to see them notwithstanding, I complied with his request; and as my stock of brick-loam from Darland was at this time expended, and that place was nearly two miles distant, a different clay was used in lieu of it, which to our mutual surprise and satisfaction formed an excellent artificial water cement. This unexpected success was owing to my having given directions to a soldier, whom I employed in such experiments, to mix two parts of pulverized chalk and one part of clay together, without specifying what kind of clay, and he fortunately selected the blue clay of the Medway as being the nearest to the spot, and which on this account had been used by the Corps, to secure the powder-hoses of our experimental military mines, when prepared for explosion.*

"Mere accident having thus led me to resume under more favourable circumstances an investigation, that I had entirely abandoned as hopeless, and having soon after discovered what I supposed to be the cause of the failure of the brown and the success of the blue clay, I proceeded to try many hundred experiments of a satisfactory nature; and have succeeded in rivalling the most powerful natural water cements by a great number of artificial compounds, which appear to possess the same properties, but are generally of a much lighter colour. I was engaged in this pursuit for more than three years; in which the winter months were chiefly devoted to experiments on a small scale, tried generally in crucibles in a common fireplace, whilst the summer months were employed in burning my artificial cement in sufficient quantities for the practical purposes of building. My first efforts to make good cement on a great scale in the summer of 1829 failed, in consequence of some very extraordinary and unforeseen difficulties, that had not come to light in working on a smaller scale; but in the summer of 1830, these difficulties were surmounted, and my artificial cement has since been applied with success to all the practical purposes for which the natural cements have as yet been used, of which conspicuous and satisfactory specimens may be seen at or near Brompton Barracks, Chatham. Two small brick tanks or reservoirs have been lined with it, both perfectly watertight, one in a garden attached to the Barracks, another at a little distance from them, near some cottages occupied by married Soldiers of the Corps. It has been applied as stucco to the brickwork of all the gateways of the Barracks, and to the coating of two brick sentry boxes at the principal entrance. It has been run in moulds into the form of ornamental vases and chimney pots. It has stood the severest frosts; and in tenacity it was found rather

* *Note.*—Tacticians will note that although mobility was apparently lacking in this episode, yet the employment of two other principles, Co-operation on the part of Major Reid and Economy of Force on that of the soldier, led to a happy issue.

superior to Harwich cement of good quality, as was proved by experiments that will hereafter be noticed."

Pasley's unexpected good fortune in his preliminary trials was not, therefore, in any way climactic; it was, as is obvious from the foregoing, merely the starting point of a long, carefully recorded series of experiments, wherein many different raw materials were mixed, pounded, moulded, burnt, ground, gauged and set in varying proportions.

Eventually a table was produced detailing in order of merit the materials and mixes which appeared to be worthy of further experiment on a large scale.

Having gone so far, the next point to be decided was the most judicious method to employ in the process of manufacture, and here again many and varied were the experiments to be carried out.

At last, in 1830, with the assistance of Private James Menzies,

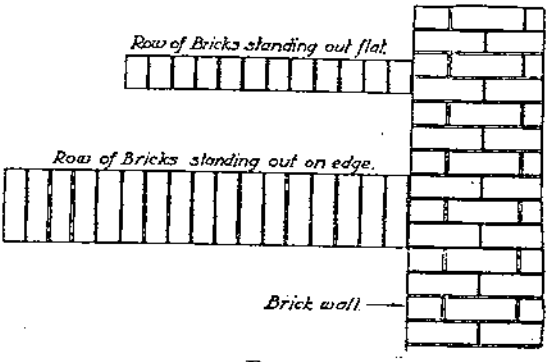


FIG. 1.

"an intelligent soldier," work was successfully started on a large scale and the phenomenal quantity of 140 cubic feet (*sic*) was burnt during the year in a kiln, generously provided by Mr. Nash, a Gillingham coal merchant, who was also an enthusiastic experimenter in cement manufacture.

The proportions of the raw materials were fixed at five measures of chalk, two measures of Medway clay and a half-measure of coal dust, and the resultant product was utilized in the rendering of a brick water tank in the garden of the Field Officer's quarter, where it apparently afforded the utmost satisfaction in the fulfilment of its task.

Experiments were next carried out to test the possibilities of using artificial cement in mortar joints, and this, perhaps more than anything else, gives us an illuminating sidelight on the state of knowledge (or ignorance) general during this period.

One of the tests was as follows :—

Bricks were attached to each other, as shown in Fig. 1, at specified intervals with ordinary mortar joints until the mass broke down.

From an account of these experiments, which were carried out by what now corresponds to the D.C.R.E., it appears that Pasley's cement was on the whole superior to the Harwich brand, which was generally looked upon as the standard product of the country.

Attempts were also made to manufacture artificial stone or concrete, but it is evident that Pasley's interest, due to some unexplained but obvious bias, was not really aroused in this connection. He does, however, give an interesting account of what he regards as the origin of this product :—

" In excavating for one of the piers of Waterloo bridge, the workmen had a good deal of difficulty, owing to the very compact state of the gravel forming the bed of the river, which everywhere else they had found perfectly loose. This effect had been produced by the accidental sinking of a barge load of lime over that spot some time before, which had cemented the loose gravel into a solid mass, resembling the calcareous conglomerates of nature, which are gradually formed by a similar process. Mr. Rennie, having mentioned this circumstance to Sir Robert (then Mr.) Smirke, the latter, with great judgment, availed himself of the hint and subsequently used it in all his foundations, none of which have ever been known to fail. . . . The superior efficiency of concrete was also proved in a remarkable manner at the new Custom House, where the floor of the large apartment called the long room actually fell in, and the whole building was in danger, owing to the insufficient manner in which the piling had been originally executed in a very difficult situation. At this period Sir Robert Smirke was consulted, who found it necessary to pull down a small part of the building, but saved the rest of it by undersetting all the walls with concrete, to the average width of 12 feet, and to the depth of from 12 to 15 feet, that is, until he found a natural bed of gravel, including one course of Yorkshire landing stones, and twelve courses of bricks laid in cement, having three or four offsets or footings between the Yorkshire landings resting on the concrete, and the base of the original walls. No other expedient could possibly have saved this fine edifice from entire demolition. It must be allowed that not only the ancient Romans, and after them the Moors, but even the Norman Barons of England in their feudal castles, used concrete, of which Kendal Castle is one of the most striking examples; and more recently, Belidor, in his 'Architecture Hydraulique,' treats of Beton mortar, which is much the same; so that it is not absolutely new. In fact, according to the old proverb, there is scarcely anything new under the sun; but the merit of introducing this immense improvement systematically and generally into the modern practice of Architecture, is undoubtedly due to Sir Robert Smirke."

In 1836, the Medway played what can be described as a thoroughly dirty trick on Pasley.

It would appear that for two or three years his experiments had been at a standstill, when he again became interested in the application of mechanical methods to replace hand labour.

Using, therefore, his former proportions, he once more set to work, only to meet with an inexplicable series of failures, which forced him to start right from scratch and recalculate the optimum ratios of his raw materials.

Apparently the intervening years had watched a tremendous increase in the number of lime works sited on the river bank between Rochester and Aylesford, with the result that the calcareous matter in the Medway clay had been substantially increased and the

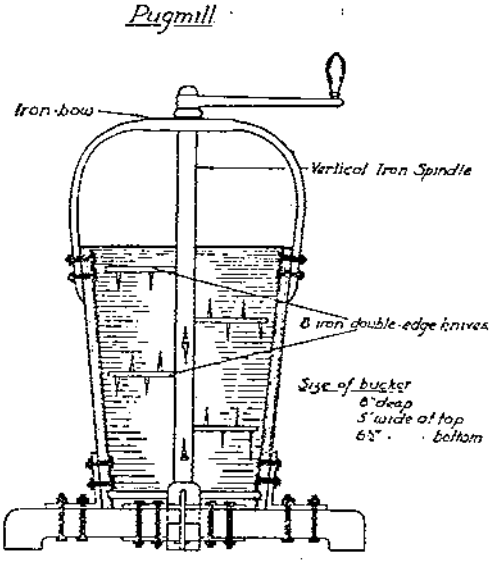


FIG. 2.

chemical constituency of Pasley's mixtures was thereby completely upset.

This point having been painstakingly cleared up, manufacture was restarted, aided by the introduction of the luxurious plant shown in Figs. 2, 3, and 4.

The cement produced was submitted to the tests applied to the earlier products, and the results were an unqualified success, the number of bricks projecting from the wall (Fig. 1) coming in at least one instance to 31—a total which compared favourably with the rosiest recollections of disputative members during the discussions of the period at the Institute of Civil Engineers.

Space will permit of only two more experiments being mentioned, the first of these being designed to disprove the prevalent theory that cement mortar was unsuitable for masonry joints.

Small Iron Furnace used as a Cement-Kiln.

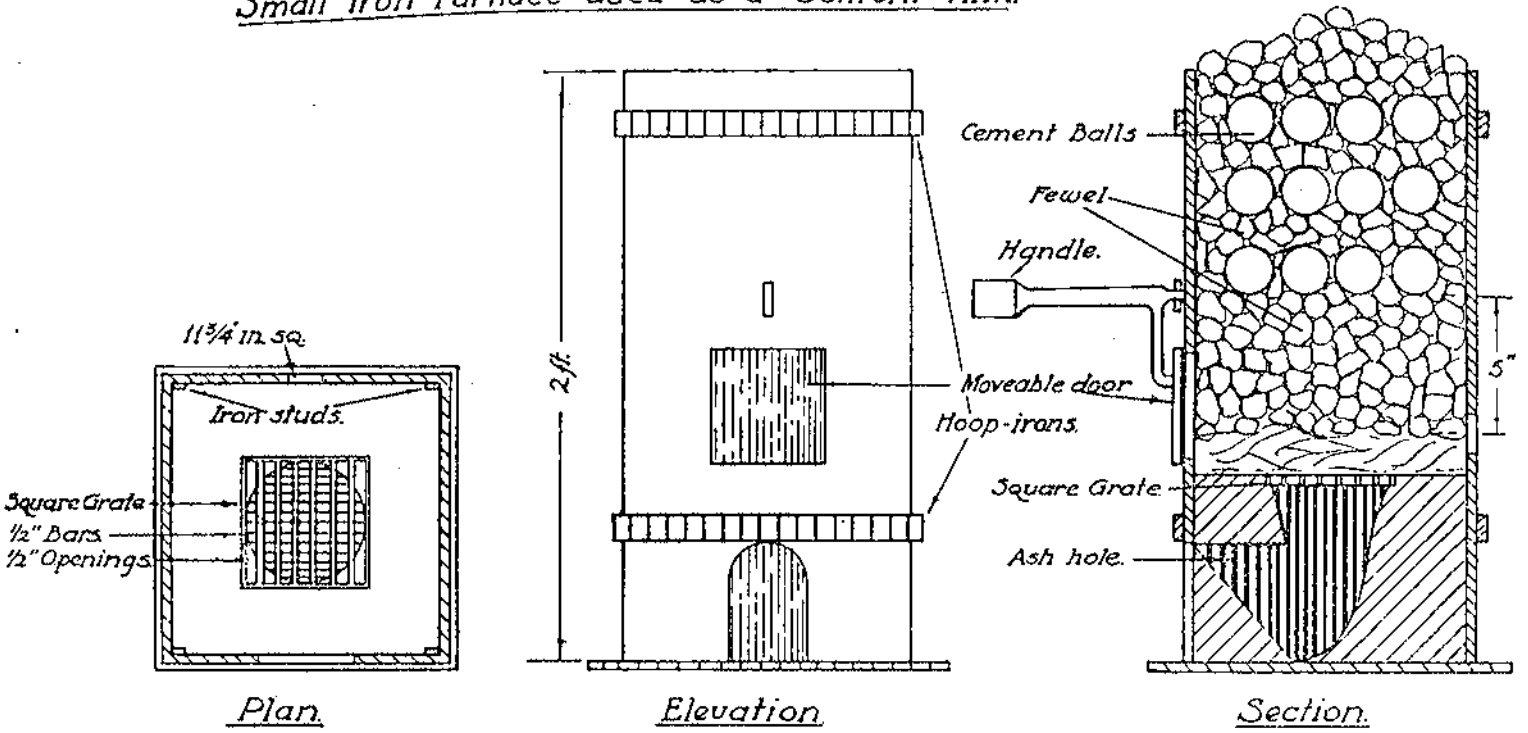


FIG. 3.

Pasley considers himself to have been successful in his efforts, but the most striking impression gained from a perusal of his account of the proceedings, is a feeling of disappointment at the continual failure of successive portions of the tackle employed. In no single case was a joint tested to destruction, and the budding Construction School was largely deprived of the laurels it undoubtedly deserved by the inadequate co-operation of its companion establishment, the Field Works School!

The last series of experiments which can be touched upon is that connected with the reinforcement of mortar joints by hoop-iron strips.

Three brick beams were built on shuttering to the dimensions shown in Fig. 5.

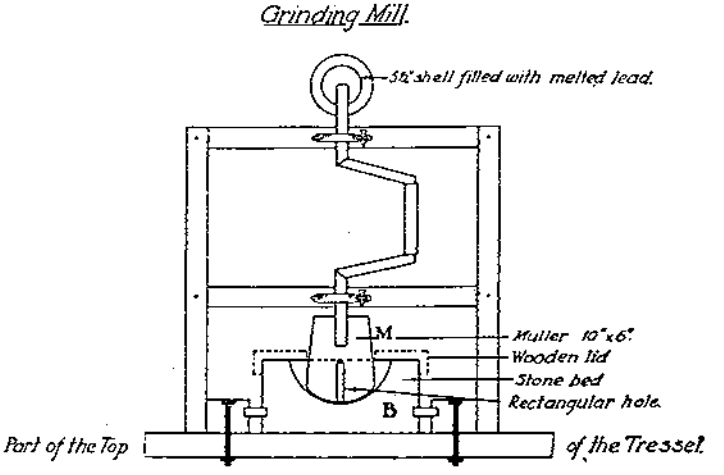


FIG. 4.

The joints in the first beam were net (neat) cement.

Those in the second beam were also net cement, reinforced with five longitudinal strips of hoop-iron, extending the whole length of the brickwork. Two of these strips were placed in the lower joint, one in the centre joint, and two in the upper joint.

The third beam had 3 : 1 lime mortar joints, with similar reinforcement.

The breaking load, centrally applied, amounted in the first case to 498 lb., in the second to 4,314 lb., and in the third to 742 lb.

All beams were tested when 50 days old, but the shuttering was removed after 10, 7 and 50 days respectively. This undoubtedly goes a long way towards explaining the superiority of the reinforced lime mortar over the cement joint, as the early removal of the shuttering from the first beam resulted in a crack occurring across the two lower joints before any loads at all were applied.

A point of interest to Pasley was the fact that while no relative movement occurred in the second beam, in the third one the reinforcement was drawn bodily through the joints, and the side in which this occurred completely disintegrated on collapse, the remainder being held together still in a compact mass.

It must be admitted that the experiment was not an original one, having been modelled on previous tests carried out by Brunel and Messrs. Francis (Natural Cement Manufacturers) in 1835 and 1838 respectively.

It is, however, interesting to trace in it the germ of the idea which

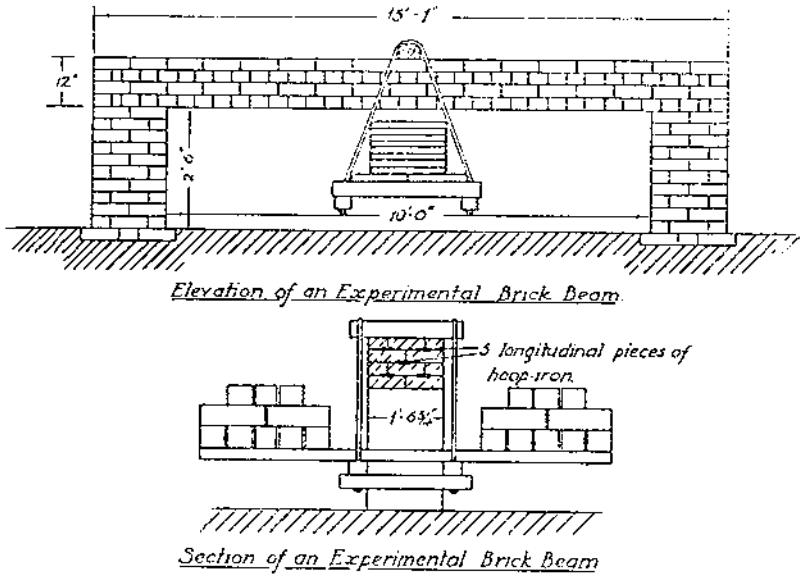


FIG. 5.

subsequently gave rise not only to the numerous patent fireproof floors now on the market, but also to the reinforcing of concrete itself.

While much which was stimulating has perforce been omitted from this short summary of Pasley's work in the early manufacture of synthetic cement, it must be emphasized that infinitely more which was merely laborious and tedious has had to be left unaccentuated.

It is hoped, however, that sufficient has been included to arouse an interest in one of the aspects of the work of an outstanding figure of Corps history, and to demonstrate the peace-time potentialities of sapper work.

(To be continued).

MAINTENANCE OF MORALE IN WAR.

A Lecture delivered at the S.M.E., Chatham, on October 30th, 1930, by F. C. BARTLETT, Esq., M.A.

MORALE is a most slippery subject, and if we are going to discuss it with any profit we must know, to begin with, what we are going to talk about. There is perhaps no topic that concerns human conduct in war about which it is easier to make sweeping generalizations with a complete lack of precision. I shall therefore begin with a definition and then, even though my attempted formulation may appear not wholly adequate, we shall at least know what we are to discuss.

Morale is the name which we apply to those qualities of mind and character which enable a man or a group to meet continued depressing circumstances, or continued success, calmly, with courage and confidence untroubled by any sudden outburst of emotional excitement.

There are two things which I want to stress from the beginning. The first is that continued success may undermine morale as seriously as the threat of failure; and the second is that, whatever morale may be, it certainly is not mainly a state of emotion. The second point is perhaps the more important. Among the people who have written definitely about morale the French probably occupy a predominant position. Running through even the best of their contributions there tends to be the view that morale is very largely indeed a state of worked up excitement. Here, perhaps, we have to do with a very interesting racial difference; at any rate, the view of morale as a state of exalted emotional tension is quite alien to the English way of thinking.

Consideration of the definition which I have proposed will open up certain main questions that must be discussed. In the first place it is clear that morale implies a steady attitude of mind which is largely independent of changes of external circumstance. Psychologically it is impossible that such an attitude should be attained or adopted without a long period of preparation. What may be called the "natural" human way is to respond at once to the demands of the immediate environment. Danger provokes fear, aggression pugnacity, satisfaction smiles or laughter. Change the circumstances and the reaction is changed, not, perhaps, quite as rapidly, but at least with some speed. Not only so, but it is equally "natural" for the emotional response to find a speedy and unreflecting expression

in conduct. Fear slips quickly into flight, and perhaps panic. Pugnacity runs immediately to an uncontrolled and flourishing sort of fighting. The exercise of morale means the steady control of these emotional and instinctive forms of behaviour, and like every other form of steady control it has to be prepared and trained, and can never spring full-formed from the needs of the moment.

Our first question then, is : What kind of preparation is needed if satisfactory morale is to be established in a fighting force ?

It is equally true that the vicissitudes of life being what they are, and particularly the vicissitudes of war being what they are, morale must not only be definitely trained but as definitely maintained. This will give us our second great question : What kind of measures must be taken if satisfactory morale is to be maintained in a fighting force ?

The third question which I shall choose to discuss follows from the consideration that morale may be exhibited either by an individual or by a group. There are important differences between the two cases. A man, faced by conditions demanding a high degree of morale, may emerge satisfactorily from the test, and yet may crack beneath the strain if he has to take his place merely as one member of a fighting unit. Of course, this does not always happen ; but it may, and it is of some interest to consider the reasons. More likely still a group may display splendid persistence and high morale until it is forced to split up into its individual components, and then all the qualities which were marked in concerted action may seem to disappear. The close nature of a great amount of modern warfare, in which enemies and friends alike are often concealed, makes this distinction one of especial interest and importance.

Our first question is : What sort of training can best establish satisfactory morale ?

The root problem is how to control immediate emotional and instinctive conduct in the interests of some steady line of behaviour which is not at the mercy of changes of fortune and environment. There is one method of control which is both often used in war and often preached by writers who pretend to deal with the building up of morale. This is the direct control of one emotion by another : of fear by the pride of display ; of fear by anger ; of fear by sudden, blind rage.

Let us take one or two illustrations. Every large-scale infantry attack in modern warfare is preceded by bombardment of an intense character, by mining and by bombing from the air. This is often justified not only on the ground of material damage inflicted, but for its good effects on the morale of attacking troops. " Witnessing the preparations for attack," says a French writer, " a modern army finds the greatest strengthening of its spirit at the sight of elaborate artillery preparations. The spectacle of overwhelming material

strength rouses its enthusiasm. . . . The tremendous smashing of enemy positions by heavy shells with their catastrophic effects and their terrifying music, the unceasing activity of aeroplanes, the endless streams of transport bringing up food and ammunition impress and encourage the assailant more than any other spectacle could do. His eagerness grows as he realizes the mass of support that will aid him in the struggle . . . all these preparations arouse his enthusiasm and make him optimistic."*

Again it is often laid down that in a concerted attack the precise objective must be defined as narrowly as possible for each unit. This is supported by psychological as well as by material arguments. Precision of aim so narrows the field of concentrated attention that it may exercise a kind of hypnotic fascination, under the influence of which a troop presses forward, oblivious of all else. In his book, *Wooden Crosses*, Dorgelés describes a case. His unit had to clear out defending forces from a small, definite position of cover: "We moved forward straight ahead, rapt, without a sound. We were afraid even of opening our lips lest our courage should escape from behind our clenched teeth. Body and mind were stretched towards a single goal: to reach the wood."† It is urged that the normal state of attacking troops is one of wild emotion. Now, everybody knows that the general effect of high tension of emotion is greatly to narrow the field of consciousness. In emotion we are typically aware only of one set of exciting facts; so that if the objective is very narrowly defined it has the effect at once of heightening the emotional response, and of putting the whole troop into a state of exaggerated suggestibility in regard to those factors in the situation which arouse this emotion. Definition of the objective "meets the psychological necessity to control fear by some stronger passion, by anger perhaps, an anger born of the dread that terror may sweep everything before it unless it can itself be swept away in action."‡

Not for one moment would I have it supposed that I think that elaborate preparations preceding an attack and the most precise definition of objectives are unnecessary. Both have obvious and great material advantages. But the psychological argument that they heighten emotions to control emotions is an exceedingly dangerous one. All crude and explosive emotions are the product and the sport of circumstance. Roused rapidly they can almost as rapidly disappear. They are apt to set up a state of excitement which the actual conditions themselves do not justify. Besides that, they are in themselves psychologically exhausting. It is a curious paradox that while intense emotion may *appear* to issue in immediate, unrestrained action, really it is always evidence of some fundamental

* Charles Coste: *La Psychologie du Combat*, Paris, 1929, pp. 22–3.
† Dorgelés: *Les Croix de Bois*, Paris, p 306.
‡ Coste, *op. cit.* p. 28.

indecision of action. This is particularly marked in the case of fear. Fear arises only when some strong impulse to act in one way is countered or obstructed by a strong impulse to act in a different way. The counter impulse may be temporarily strengthened by some need of the moment, but the psychological state remains always one of conflict, and may produce a condition ultimately of great depression and exhaustion. Consequently, if the emotion which is supposed to be controlled suffers a sudden release owing to a change of circumstances, the individuals or the group concerned have but small reserves to fall back upon and are apt to rebound to the extremes of depression and lack of confidence. This, as everybody now knows, was exactly what happened among the French forces at a very critical stage of the late War, and, as a French observer himself records, " It needed all the psychological insight of a Pétain to dissipate the horrible pessimism which events and propaganda produced, in April, 1917, after the fruitless attack of the Chemin des Dames."

The truth is that control of instinct and emotion must be effected by something which is psychologically more stable than instinct and emotion, if it is to issue in that steady and clear-sighted state of mind which leads to high morale.

The first step towards morale is by way of *discipline*. Let us be clear as to what this means. The smart, concerted performance of evolutions on parade is the smallest part of it. Its value lies in training a man to reject the immediate demands of his individual environment in the interests of some externally constituted mode of conduct. The child in his nursery is normally surrounded by all sorts of toys, and will turn from one to another as his fancy and inclination prompt, usually spending very little continuous time at any one thing. But in due course he must go off to his first school. When the time comes, it is very likely that some toy or game is particularly attractive ; yet off he must go, rejecting the pull of something he can see for something that he can't see, and putting off his game indefinitely. This lecture does not pretend to be a discussion of the basis and conditions of discipline, but there are two things which are very important. The first is that discipline initially has always to do with the establishment of some routine of conduct that remains constant amid much change of the immediate environment ; the second is that, also initially, it does not bother about reasons : this thing has to be done because this thing has to be done. Much discipline never gets beyond this, and so defeats its own end, for it leads directly to a routine and unadaptable behaviour which is bad enough in ordinary life, and may be a definite danger amid the rapid changes of active warfare. Yet there is a very good tradition that when a child or a man asks direct questions about why he should do what he is by discipline compelled to do, the authority which is set

over him should refuse direct answers. This is a good tradition first because direct answers to this sort of question can hardly ever be satisfactorily framed, and second because, even if they can, the direct answer very rarely indeed can be made into a mainspring of conduct. The ultimate psychological justification of discipline is social. Life in groups would be intolerable without it, and any system of discipline found within a group has developed out of its own past history. This is tacitly recognized in the behaviour of the rank and file members of the group, and the main spur to the acceptance of discipline often comes, not directly from the superior authority, but from the fact that so and so is what " is done " in the group. So nobody is likely to go far along the way of organized discipline unless he has enough social sense and social opportunity to mix pretty well in his group. Further than this, when adult discipline is concerned, it soon becomes important to give the individual definite information about the past social history of his particular group, and then he can learn for himself how particular customs of routine discipline came to be set up and what they have helped to accomplish. This is no doubt already widely recognized, and lectures for army units on the great deeds of their immediate group in past history are often a part of the regular training. It is important, however, that such lectures should not be concerned only with glorious or remarkable deeds. It should be their aim to make a man interested and concerned personally in the everyday life of his unit and how it has developed.

The first step then is discipline, initially imposed by external authority, but very soon coming to be based upon social give and take, and upon knowledge of social development.

When we look at the story of great deeds performed in the face of persistent difficulty we find again and again that the most exceptional morale is displayed by the technician : the wireless operator, the telephonist, the signaller and the like. Professional pride comes to the aid of personal courage, and technical training has a definite value in the strengthening of a man's spirit. This is a tool that can be used in the modern army, mechanicalized as it is in every direction, more fully than ever before. In general, a unit will be stronger in times of crisis the more every individual member has his own special task to ply. I am tempted here to make a sweeping generalization and to say that, in the interests of strength of organization, in an administrative unit power must be concentrated in as few hands as possible ; in an executive unit it must be as widely distributed as possible. However that may be, it is certain that professional training is a very great aid in the development of morale.

It will be found, I think, that all troops which display persistent high morale have a pretty strongly developed sense of humour, which finds some relief even in the most depressing circumstances. Can a

sense of humour be trained ? To this question I am not prepared to give a straight answer. There seem to be some individuals who wholly lack any psychological basis for it, and probably they must remain without it all their lives : they had much better keep out of the Army. They are essentially self-centred, egotistical, lacking in all social interests. From them we may learn that a sense of humour, like everything else that depends upon a point of view rather than upon an opinion or upon information, is developed mainly through social contacts, and not by individual teaching. One thing perhaps a trainer may do. If he has a group that is already some way advanced in discipline he may deliberately give them something too hard to do, and then laugh with them over their failure. But this is a ticklish and a critical method, because on the one hand the instructor has to avoid every appearance of suggesting that unsatisfactory performance does not matter, and on the other he has to beware of producing just that self-conscious attitude which is the greatest of all enemies of humour. The worst breakdown of individual morale I ever saw in the course of the last War was the direct result of laughing *at* a man instead of *with* him.

Meanwhile I wish that somebody would make a study of the typical humour displayed by the individual or the group at moments of high tension. I think this might well be found to vary significantly from race to race, and perhaps from branch to branch of a Service, and that the differences might throw a good deal of light upon the outstanding combatant qualities of different groups. There is not time for more than one or two brief illustrations. The typical English humour in this connection seems to lie in a way of looking at the situation that has to be dealt with so as to connect it with something a little less sharp and painful. Names play a great part. A pestilential stretch of trenches is called " Rotten Row " ; a peculiarly unhealthy dugout " the Ritz Hotel." During the general strike a few years ago things looked bad in a certain northern town. Violence was more than threatened, and bricks began to fly through the windows of municipal trams. Somebody then chalked up " Passengers are requested not to close the windows," and the storm was weathered without much trouble.

The typical French kind, on the other hand, seems to depend more on a rapid and often an impertinent play on words. It has about it something sharper, more defined than ours, and is more a matter of intelligence. We should call it wit rather than humour. In face of a heavily defended section of trenches, during the European War, an infantry section was waiting to go into action for the first time. A few days before, a whole regiment had been practically wiped out in an attack on the same trenches. It was a critical moment. Just before they moved off the officer commanding explained the job :

" We are going to attack the Cowfold (*l'Enclos des Vaches*). We shall pass along by the wood of the Heralds (*Héraux*). The cows are the Bosches. You are the heroes." The troops behaved admirably.

For the English humour there is one splendid training ground: that of the really strenuous group game, which has in it some danger and the chance of a good deal of fatigue and pain. Players and spectators alike may develop, through the group game of this character, much of that grimly optimistic and half-laughing attitude which sees the facts clearly enough and refuses to be daunted.

There is nothing that can more effectually sap a man's moral qualities, either in civil life or in the Army, whether in peace or in war, than having nothing definite to do. And in the modern war of attrition, enforced inactivity is common enough. A French observer who was there, writing about life in the trenches, says: " You sit with your back to the wall and wait. To make war becomes merely a matter of waiting; for relief, for letters, for food, for death." This, particularly the waiting for death, is a demoralizing state of mind. Here comes the value of a hobby in the development of morale. A few people seem to be capable of being interested in everything; practically everybody can be got to build up an interest in something outside of his main professional preoccupation. It is my firm belief that a serious attempt to help men to develop hobbies that can be ridden when outside sources of amusement are restricted will do a lot to keep men steady when the prolonged crisis comes. It is no use being haphazard about this. A great amount of modern civilization seems to be a gigantic conspiracy to prevent a man from building up reserves of amusement and interest within himself. The organized effort to stimulate and develop extra-professional interests is directly worth while from the professional point of view.

Finally, let nobody who is training men or groups be afraid of freedom of speech. There is a French proverb which has come down from the days of the Empire: " An old soldier is an old grouser." The people to be afraid of are the people who do not let off their grievances, or who air them furtively and in secret to an audience of one or two. The grouser when things are easy will often, though of course not always, be the steadiest of stand-bys when things are difficult.

These are some of the things in the development of steady morale: the first step, discipline, to set up a routine of conduct and to free a man from the control of the immediate environment. Then knowledge, to show how his discipline is the entirely natural expression of the demands of life within his group, and to remove from it the appearance of merely irksome external compulsion. Then technical training whenever possible, to bring professional pride to the aid of personal courage. Then the stimulation of a sense of humour, built

up in the rather rough and ready give and take of social life. If possible, a hobby to sustain a man when he simply has to wait; and an atmosphere in which a man is not afraid to speak out what he inwardly thinks.

What about the maintenance of morale? I shall have to be very brief and inadequate. Probably the two greatest causes of breakdown of morale in active service are continued extremes of bodily and mental fatigue, and the strain which results in lack of mental balance, and in extreme cases in some form of nervous or mental disease.

It is no use saying that extreme bodily fatigue should be avoided in war. It may and should be guarded against; avoided it cannot be. There is one rule only: if morale is to be maintained, both body and mind must be as fit as possible. The guarantee of fitness is exercise. There are dozens of systems of physical training, and no doubt most of them are pretty good. Two things are important. It is no use training the body so that it can make one or two prodigious efforts and then be beaten. What is needed is a capacity to *go on* making efforts, no one of them, perhaps, anything very terrific in itself. It is the cumulative strain that breaks morale, and not the sudden sharp effort. Secondly, a number of systems of physical training are to the normal person dull and uninteresting. These will not produce as good effects as they might. There is no royal system, and a trainer must fit his way to his men, and be able to change from one way to another as soon as the men begin to find any particular method a bore.

To be frank, nobody knows anything about mental fatigue; but it is tolerably certain that mental fatigue in the rank and file in war is not due to an overdose of mental effort, but to an underdose of it. This again is a part of the value of technical training and of the hobby, that they help to guard against the insidious mental fatigue of boredom. I would like to assert again and again that the steady control of emotions which we call morale is enormously easier when the troops concerned are alert and trained in intelligence. What is really needed is not so much a development in the ordinary school subjects as a training in the capacity for observation and in keenness of interests.

Mental and nervous instability are most insidious causes of the breakdown of morale, largely because, of all conditions, they are the most likely to operate by suggestion. By common consent the two great predisposing causes are: a conflict of instinctive danger responses with ideals and traditions of disciplined courage; and a failure of social adaptability. The first cannot be avoided, but every soldier ought to know clearly and effectively that he is in no way abnormal when he suffers it. The brave man is not generally fearless;

only the reckless man is fearless; the brave man controls his fear. It is not difficult to build up traditions, sentiments and ideals of loyalty, obedience and service. But all the time a man has a right to know as much as he can about the hardships of the conditions under which he will have to hold fast to these ideals; there is no sense in minimizing the pain, danger and horror of warfare. And in actual war it is, with the bulk of the rank and file, worth a lot of effort not to impose the sharpest and hardest tests at the beginning, and to avoid unnecessary prolongation of extreme conflicts, if possible until a routine attitude to extremes of danger has been acquired. But of course there are times when military need overrides all else.

A study of the records that are now available concerning the causes of nervous and mental breakdown in war shows that one of the most important of these is a lack of adaptability to changing conditions of environment and of society.* There is no way, in war, of getting rid of the chances of these, and how to guard against their bad effects is a difficult question. The increasing specialization of the modern army makes the difficulty more acute. There seem to be two main ways of developing and maintaining adaptability. One is by affording an opportunity for a man to mix up in as many groups as possible consistently with the maintenance of discipline within his own special group. The other, once more, is simply by general all-round development of interests and intelligence. The former is most possible, no doubt, with the officer class, but only the expert, with an exact knowledge of the particular circumstances can say what precise practical steps can be taken to facilitate either of these desirable ends.

I have left myself no time at all to deal with our third problem. Yet it opens up a most attractive field for study. Many a man, staunch and loyal when he is thrown upon his own resources, finds the strain of co-operative effort in a social group too much for him; many a group, persistently brave and cheerful so long as a co-operative effort is possible, fails badly when the cohesion of group life is slackened or disappears. Here arise problems of the basis of good comradeship, of group leadership, of the differences between restraint exercised by a social organization and that imposed by an individual upon himself. I can say one thing only. Whether a man is best playing a lone hand, or in co-operative effort depends fundamentally upon the relation of individual temperament to persistent group tendencies. There are some men who are temperamentally unfitted for concerted group effort. To force them into a closely organized social unit is to court failure, directly of the man and indirectly of the whole group; and yet there is plenty of room for them in the modern fighting force. The converse case may equally well occur. It is worth any amount of trouble to see that a man's temperamental

* See *e.g. Neuropsychiatry and the War*, New York, 1918.

qualities are given that setting in which they can be most effectively developed and kept efficient for fighting purposes. The diversity of grouping in the Army can, I think, match pretty well every diversity of human temperament. I cannot believe that the rigidity of Army organization must be such that misfits between the individual and the group need be as common as they apparently have often been. Finally, and obviously, all sectional leaders must be men who temperamentally have the qualities that develop both social sense and the capacity for individual initiative.

It will seem to everybody, as it does to me, that I have left out far more than I have said. There are the questions of the basis of group leadership, of the nature of the influence that seems to be exerted directly upon the individual by the group itself, the fascinating study of the different typical expressions of morale in different branches of a fighting service or in differing racial groups, the enormous possible influence of propaganda and how this may be controlled, the relation, closer nowadays than ever before, between the morale of troops in the field and that of a civil population at the base. The problems of morale branch out in all directions. Napoleon is reported to have remarked : " War is at bottom an affair of opinion." He meant that, at bottom, success or defeat depends upon the spirit of the troops which are engaged. No sensible person would minimize the importance of the material tools of war. But, in spite of the undreamed of development of these since Napoleon's day, his remark remains a true and a shrewd one. If what I have said induces anybody to try to think out more clearly upon what influences the spirit of the troops depends, it will not have been said in vain.

A SUBALTERN IN THE INDIAN MUTINY.

GROUP OF 23 H.E.I.C. CADETS TAKEN AT ADDISCOMBE ON 9TH DECEMBER, 1854.

(The identification is doubtful in some cases).

A subaltern in the Indian Mutiny

A SUBALTERN IN THE INDIAN MUTINY.

Containing some letters of Lieutenant Edward Talbot Thackeray, Bengal Engineers, afterwards Colonel Sir E. T. Thackeray, V.C., K.C.B., R.E. (1836–1927).*

Edited by BREVET COLONEL C. B. THACKERAY, D.S.O. (*late Lieutenant-Colonel, R.A.*).

IV.—DELHI TO LUCKNOW.

OPERATIONS NEAR DELHI, AND IN THE DOAB,† OCTOBER, 1857, TO FEBRUARY, 1858.

THE fall of Delhi was the turning point of the Mutiny. Many campaigns were to follow, Lucknow and other great cities were to be stormed and taken. Guerilla warfare was to continue until the close of 1859. The backbone of the rebellion had not yet been broken, but with the arrival of the British contingents, the end was only a question of time.

The crimes of the mutineers, whom the inhabitants had, willingly or unwillingly, harboured, fell upon the heads of the people of Delhi. The citizens fled in thousands, and the usually densely crowded streets and bazaars were silent and deserted. This exodus had been deliberately facilitated by the conquerors. The bridge of boats was a tempting target, across which soldiers and populace were streaming. A young infantry officer (afterwards Colonel Wilberforce) was allowed to try his hand at it with a field gun, and was making excellent practice, when an excited message from Colonel Baird Smith put a summary stop to his shooting.

As soon as we had consolidated our hold on Delhi, columns were sent out in different directions to clear the country. Following on the scorching hot weather months, an Indian autumn is fresh and delightful, and it was an intense relief to the troops to get away into the open country. They benefited greatly in health by the regular marches and good food, after the privations and hardships of the siege. Thackeray accompanied the column under Brigadier Showers,

* These chapters are an abridgment of the first part of a future publication. Extracts from Sir E. Thackeray's *Two Indian Campaigns* (published in 1896 by the R.E. Institution), and other reminiscences, are distinguished by his initials, thus, [E.T.T.].

† *Do-ab*, "Two waters." This term implies the plain between two rivers, in this case, the Ganges and Jumna.

which returned to Delhi after a fortnight's bloodless campaign, having destroyed four forts, and captured seventy guns. He brought with him three rebel princes as prisoners, and specie to the value of £70,000 or £80,000. One of the chiefs, a notorious rebel, drove out in state to meet the column with plausible speeches. A cavalry escort fell in round his carriage, and accompanied him back—not, as he flattered himself, as a guard of honour, but to be tried and sentenced to death.

SEVENTH LETTER.

E.T.T. to his guardian, the Rev. T. Hood.

CAMP PADSHAHPORE,
Oct. 30th, 1857.

I meant to have written to you long ago, but I know you will excuse it. In fact, for the last month, since October 2nd, I have been marching about the country and not been able to write to anyone. I trust the letter I wrote from Delhi to St. John after the taking of Delhi, and giving a description of the assault, and some of my letters written when before Delhi, have been received. But up to this time I have received letters dated from home Aug. 25th, and they have never heard from me since I was at Meerut. I wrote home long descriptions both of the battles of Hindun, May 28th, and Alipore, June 8th, at both of which I was present, but I have never heard anything about them, and I am afraid they must have been stopped. I wrote, every mail for the three months before Delhi, accounts of the operations, etc.

The assault of Delhi was on the 14th Sept., and the whole town was taken on the 20th. I never was touched through the whole siege and assault and am very thankful for having been spared. I have lost, though, many of my best friends. In my last letter to St. John dated the end of Sept. I gave a list of our losses in the Engineer Brigade, which were very heavy. Since then the two officers whom I had marked Victoria Cross against, have both died. Poor Salkeld died of his wounds received in the assault, and Home, who escaped untouched in the most dangerous part of the assault, was blown up while destroying the fort of Malaghur, and killed on the spot.* I hope you have seen some of my letters.

I stayed in Delhi after the taking till the 2nd of October, when I was ordered out with Lieut. Humphrey,† Engineers, and two companies of Sikh Sappers to go with Brigadier Showers' column, consisting of 120 men of H.M. 6th Dragoon Gds., the 2nd European Fusiliers, one regiment of Gurkhas, one regiment of Sikhs, and two

* *Vide* Part VI., *Five Victoria Crosses.*

† Afterwards Major E. W. Humphrey. This very gallant officer was obliged to retire in 1868, as a result of wounds received whilst with this column. For some thirty years he was Major of Invalids at Chelsea Hospital.

regiments of Irregular Cavalry, one battery of Artillery and two heavy guns. We have had no fighting. We have walked into four empty forts which were in a perfect state of defence. One of these, Rewarry, was held by a refractory Nawab named Tooley Ram. He seemed to have been preparing his defences to the last moment, but on our arriving within about eight miles his courage failed, for he fled with all his troops, leaving all his guns loaded to the muzzles with grape and his ammunition, etc. This fort Rewarry, Humphrey and I (the only two Engineer officers with the column) were ordered to destroy, which we did by blowing up the bastions and gates with enormous charges of the Nawab's own powder. We then set fire to the place and left it. The effect of the explosions was tremendous. These Sikh sappers (low caste Muzbis) we have are wretched untrained men, enticed down with the hope of plunder from the Punjaub to work at the batteries before Delhi, which they did very well, as far as the mere digging under fire is concerned, but when any nicety is necessary they are useless. Our regular sappers you know mutinied, first murdering Capt. Fraser, our Commanding Officer. Consequently our work (the European commissioned and non. com. officers) has been doubled all through the siege and operations. Sappers are no use unless they have had a regular training of at least two years. Some two hundred remained staunch and did good service before Delhi, but of these more than one half have been killed or wounded. Consequently, at Rewarry, Humphrey and I had to fill the powder hose and place the charges in the mines ourselves. If you are not constantly looking after the Sikhs they are no use. Rewarry is 50 miles from Delhi. Another fort we went to was Jhujur, where the Nawab was taken and sent into Delhi. He is to be tried by Military Commission, and will almost certainly be shot. Four of the King's sons and his grandson have been shot. Why the horrible old villain himself is spared I cannot think, but he is still in Delhi, and is allowed his servants, etc.

We (the column) have been marching about in a most wonderful manner since we left Delhi, at an average distance of about 40 miles from it. The Brigadier seems vainly endeavouring to prove that two sides of a triangle are together less than the third. If we are to go to a place ten miles off we always make two marches of about twelve miles each to get at it. We have never been able to come up with the enemy except once, when of course they fled and the cavalry cut up about 50. However, it is very healthy work, the constant change of air and the exercise. I never have been better since I have been in India.

My first nine months in India have been rather eventful. Six of them have been engaged in fighting. Since I have been ordered out with this column, the whole of the Engineer officers and sappers have been ordered to Agra, and I believe are going to Cawnpore,

and I hear that when I get back to Delhi I am to stay there under Tennant of the Engineers (he married Augusta Dick, as I daresay you have heard) as an Assistant Garrison Engineer. I believe an order has come from the Governor-General that the walls of Delhi are to be destroyed, and as there are seven miles of them, there will be plenty of work for us. [*They were, after much discussion, left standing.*—ED.] I wish very much I had gone to Agra with the rest; I have had quite enough of Delhi. I had two attacks of fever there and never was quite well. However, it cannot be helped. I thought myself very lucky in coming out with this column, thinking I should see some more service, and little thinking the rest would soon afterwards be ordered away to Agra. However, I think I have seen enough for one year, and only hope we shall get a medal for Delhi. I am so glad we took it and stood all their attacks before the European troops arrived. Not a European has arrived higher up the country than Cawnpore, which is 300 miles from here, since May 11th, the date of the breaking out of the Mutiny. I suppose you have heard that Lucknow has been relieved.* I think all fighting now is nearly over. Sir John Lawrence in the Punjaub behaved splendidly in sending us down troops from the Punjaub. I see the English papers always, though I do not get letters sometimes. I often laugh at some of the absurd speeches about India. Mr. Vernon Smith, I think it was, in the House of Commons, who wanted to know whether the troops before Delhi were supplied with tunics. If he had seen the ragged state of our poor fellows it would have astonished him. The 1st and 2nd European Fusiliers had nothing but their shirtsleeves, and the Queen's regiments wore clothes dyed a sort of grey dirty colour, both to prevent their being seen and not to show the dirt. Another honourable member moves for the number of men blown away from guns, and whether such a punishment was actually in practice in India. Had he seen what we saw when we first took the heights of Delhi, a cart full of murdered English ladies and children,† and the four or five hundred bodies of women and children at Cawnpore, he would not ask.

I am very glad to see that the English Government is sending out so many troops. I hear we are to have eleven regiments of Cavalry and 55 of Infantry. I wish we had all European Sappers here. After the men at Chatham it is miserable work having these Sikhs, they know no drill or anything. If I could change into the Royal Engineers with my rank from date of commission I think I

* The relief force, under Havelock and Outram, fought their way into Lucknow on 25th September, and reinforced the garrison at the Residency. But they were not strong enough to cover the withdrawal of women and children, and to fight their way out, and they remained shut up in Lucknow for nearly two months, until relieved by Sir Colin Campbell. The city was recaptured in March, 1858.

† They were the bodies of officers which the survivors had caused to be removed from the city covered by women's dresses, with the intention of burying them.

would, though the pay is only about half. You get a sort of abhorrence for a black face after their murders and unmentionable atrocities. Brigadier Showers is very lenient to them. I have seen him let off men known to be guilty. I think every village that ever harboured a mutineer ought to be burned, but they have all been spared. These natives don't understand kindness, as this mutiny has shown. I believe the natives in this part of the country do not believe that there are any Europeans except those now in this part. It is now six months and none have arrived. I have lost friends whom I have known at Addiscombe, all over the country, murdered and killed in action. My best friend Jones was killed. We have lost ten Engineer officers that I know of, and I daresay there are more. Hundreds of innocent English women and children have been killed in the most horrible manner. I hope the mutineers and rebels will be pursued till not one is left. The Mussulmen are the worst. It was the Mussulmen incited the Hindus to mutiny. All danger is over now for India. I am very glad I was present the whole time at Delhi. I think I would as soon have been there as in the Crimea. We were out in the batteries on an average of three nights a week. I was mercifully spared the whole time, and was only four days on the sick list the whole time, and had some narrow escapes.

This place is 25 miles from Delhi. We are mending the fort here. I don't know when we shall go back to Delhi; I do not look forward to going there at all. It is so very unhealthy. The cold weather is beginning now. At night it is very cold and we are glad of rugs or anything. We generally march about two or three in the morning till about eight or nine o'clock, so as to avoid the heat of the day. Humphrey and I live in one tent. He is a very nice fellow. We are honorary members of the Fusilier Mess.

I hear our share of prize money for Delhi is to be pretty large.* I am afraid my saddles, books, instruments, value about £30 or £40, have been plundered. I have never heard of them since I have been in India. I believe I also lost £40 when the sappers mutinied, the Pay Havildar having decamped with the treasure chest, but this is nothing. Some people have lost everything they had in the world. Sir T. Metcalfe's loss in his house and grounds alone was £90,000. It was a most beautiful place about 600 yards from the walls of Delhi. We had a piquet in it for a long time till the enemy's round shot made it too hot to hold us, and the piquet moved into his stables, 200 yards in front, which was not such a mark. The house now is almost knocked to pieces. Sir T. Metcalfe† was magistrate of this district, and has been out with our column. So has Robert Low.† I have never been able to hear from the Ritchies† at Calcutta since the

* The distribution of prize money caused great dissatisfaction among all ranks. Col. Baird Smith mentions in a letter that none had been received by any officer or man as late as April, 1860. (See Part VI.)

† His cousins. Mr. William Ritchie was Attorney-General, and afterwards Legal Member of the Viceroy's Council.

mutiny, but I believe the road will be clear in a week. Col. Greathed's Column, which marched from Delhi to Agra, routed the Pandies, as the mutineers are called. Lieut. Lang, of our Corps, killed twelve of them himself.

I hope, my dear Mr. Hood, all are well at Nasing. I should like to see you again and tell you all about the siege, for you can't do it in a letter. In the assault I went in with the last column, being the junior Engineer officer present, and was not exposed so much as the others. Ten out of 17 of our officers were struck down in the assault. I hope Capt. (Engineer) Taylor, the Director of the attack, will be made a C.B. He is a splendid officer. Our total loss in the assault and capture of the town was 92 officers, 1,360 men killed and wounded.* I shall be very glad to see some European troops up country. It will have a very great effect.

The Sikhs I don't think much of; they are tremendous plunderers. The quantity of jewels and money found in Delhi is enormous. I am glad to say not a woman or child was hurt by our men. I spent my 21st birthday (*October 16th*) in camp, after a night march of 20 miles, and consequently was very tired.

Soon after, Thackeray succeeded his friend Humphrey, who had been severely wounded with another column. Humphrey had joined a force, which left Delhi on 10th November, under Colonel Gerard, on whose staff he was Commanding Engineer and acting Aide-de-Camp. Retaking Rewarry fort, which had been re-occupied by the enemy, Gerard pushed on, and on the 13th fought a successful, though desperately contested, cavalry action near Narnoul Fort, in which he himself was killed. Humphrey gallantly put himself at the head of some raw Multani levies, who were hanging back. They did not follow him, and he charged alone, to be cut down with seventeen sabre wounds. He survived, and lived to an old age, and did good service, but never wholly recovered.

Brigadier Seaton, "the brave and gentle Seaton," was appointed to succeed Gerard. He gave his young Commanding Engineer a seat on his elephant, which took twelve hours to cover the thirty-five miles. This compared favourably, Thackeray observes, with a ride of thirty-seven miles in a day in Assam, a few years later, when the elephant had frequently to swim over swollen streams. "While marching with General Seaton's column, we saw very large herds of antelope, but we had no time for shooting. On one occasion several of the animals leapt right on top of a detachment of the 1st

* Field-Marshal Sir Henry Norman, who was Deputy Adjutant-General of the Delhi Field Force, gives the figures in killed and wounded as, 8th to 14th September, 327; 14th September, 1,170; 15th to 21st September, 177; total, 1,674, during the final operations.

Fusiliers, who were marching in a deep ravine, and a number were killed by the men."

The column returned to Delhi, and marched out again on 8th December, with orders to join Sir Colin Campbell, the Commander-in-Chief, at Futtehgurh, on the Ganges, after clearing the country. Seaton's convoy of stores and cattle was of enormous length, extending over about nineteen miles of road. The question was, how was it possible to arrange for its safety, and to fight battles at the same time? Seaton solved this problem by a very simple and effective method. On his arrival at Aligarh he placed the convoy under cover of the fort guns, defeated the rebels at Khasganj (Gangari) and Patiali, returned to fetch the convoy, gained another victory at Mainpuri, and moved thence to meet Brigadier Walpole's column, which had been making a sweeping movement through the lower Doab.

It was a brilliant little three weeks' campaign, in the course of which Thackeray was able to add three cavalry engagements to his war credit. In one pursuit, a number of elephants were overtaken and captured, and in another, six guns. The Carabineers went into action wearing their brass helmets. It was said that the burnished metal reflected the heat rays, and that they suffered less from sunstroke. The Queen's regiments wore a sort of khaki (an innovation after the recent Persian campaign), with the exception of the 9th Lancers, who were always in white jackets and cap covers, and the 60th Rifles, who kept to their dark green uniforms. The latter wore their small caps, and suffered terribly from sunstroke. It was some time before even white cap covers to their forage caps were regularly used by British troops.

At Patiali, "Hodson, with his regiment, pursued the rebels for several miles, and left about 500 dead on the ground. Either on this day or the preceding, Hodson killed twelve armed mutineers in a room with his own hand. A few days after this, Hodson volunteered to ride across the enemy's country to carry dispatches to Lord Clyde. The distance was about 55 miles, and had not been traversed by a European since the outbreak of the mutiny. He returned the same night, skirting a village occupied by the rebels, but some of his men were killed. I saw him come into our camp on his return, and he looked fresh and smart as if he had just come back from a morning ride. The men cheered him as he walked through the camp.

"General Seaton's column arrived at Futtehgurh on the 6th January, 1858, and joined the army under Sir Colin Campbell. It was an inspiriting and delightful sight to see again the kilts and bonnets of the Highlanders and the troops fresh from England, and the sailors of Peel's Naval Brigade." [E.T.T.]

A few days after the junction of Seaton's and Walpole's columns with the main army, a force under Brigadier Walpole, about 3,000

strong, with a detachment of the Naval Brigade under Sir William Peel, was dispatched to the Ramgunga River, about ten miles distant. Lieutenants Patrick Murray and Thackeray were the Engineers. "The movement of a force on the Ramgunga River, which was not fully understood at the time, was afterwards ascertained to have been a feint to induce the rebels to suppose that we were meditating an invasion into Rohilcund, while Sir Colin Campbell concentrated his forces for the capture of Lucknow. The ruse answered its purpose effectually, as it kept a considerable number of the enemy engaged in watching our movements." [E.T.T.] The two armies sat watching each other on opposite banks of the river. The rebel horsemen performed dashing evolutions at a safe distance, and both sides indulged in an exchange of sniping. But no serious operations were undertaken. "On one occasion a round shot pitched right into the tent where Murray and myself were sitting, smashing the table that was between us, and embedding itself in the ground in the floor of the tent. The shot was of irregular shape, about the size of a large orange." [E.T.T.]

EIGHTH LETTER.

E.T.T. to his Aunt, Miss Henrietta Shakespear.

CAMP ON THE RAMGUNGA,
NR. FUTTEHGURH,
Jan. 17th, 1858.

I write nearly every mail and am afraid you don't get all my letters. I have not received the *Virginians* you so kindly sent.

We joined the Commander-in-Chief at Futtehgurh on the 6th of January. It was very jolly to see all the troops from England, the first we had seen. The sailors and Highlanders, as happy as possible, the Royal Engineers, too. We are all doing duty together now, Royal and Bengal Engineers. I knew all the officers at Chatham.

This is ten miles from Futtehgurh. There is a river here called the Ramgunga. There was a bridge of boats here, which the enemy burnt. I was sent out here with Brig. Walpole's column, with another Engineer officer and a company of sappers. The enemy are on the other side of the river with two or three guns. Occasionally they send a round shot into our camp (the Engineers), which is close to the river, but they are always silenced immediately by our guns and we have not had a single casualty.

Sir Colin does not seem anxious to cross, as he gives no orders to make a bridge. He seems taking things very quietly, and it almost seems like waiting for the next cold weather to go into Oudh or Rohilcund. The ladies and garrison of Lucknow have been moved

safely, and must now be in Calcutta. Lucknow is in the hands of the rebels, but Gen. Outram is at Alumbagh with four thousand men, about three miles from Lucknow. I suppose we shall have another great fight or siege there. There are now about five thousand men at Futtehgurh and about three thousand here.

Forbes is quite well and is a great warrior, having been all through Delhi and Lucknow. We are going to make a bridge here as soon as the order comes. I am quite well and tired of doing nothing. It is almost a year now since I landed in Calcutta. . . . You are losing all your many nephews, as they all seem coming out here.* I get all your letters and you can't think what a blessing it is to hear from home in this barbarous country.

I must now go and have a look at the enemy cavalry, who are prancing about on the other side of the river. It is great fun to see them. When a shot from one of our nine-pounders goes near them, away they go as fast as their horses will carry them. The sailors have made a raft of barrels and I hope we shall go across and take their guns.

The Engineers shortly afterwards received orders to join the head-quarters of the Engineer Brigade under Colonel (afterwards Sir Robert and Lord) Napier, which was concentrating at Jellalabad, about four miles from Lucknow, and arrived there on 11th February, 1858. Thackeray acted as orderly officer and galloper to the Brigadier during part of the operations. The capture of Lucknow had at length been definitely decided upon, and was to be the next move.

* Miss Shakespear had no less than eleven nephews and grand-nephews, Thackeray's cousins, serving in India in the Army and Civil Service at the time of the Mutiny, in addition to two by marriage, General Sir John Low and Sir Theophilus Metcalfe. Besides Sir E. Thackeray, there were Colonel Sir Richmond Shakespear, Lieut. (afterwards Sir) Robert Low, and Major (afterwards Lieut.-General) John Talbot Shakespear, and many others who served with distinction. Many of them had wives and families in India, and there were also several nieces. Happily, none was killed. Even in the Great War it would be difficult to beat this family record. Shakespears and Thackerays had a century-old connection with India, and besides the above there were Ritchie and Thackeray, cousins. One of them, Major Roger Barnston, described by Lord Wolseley as the best officer he had ever known, was killed at the Relief of Lucknow.

(To be continued).

BEAM WIRELESS.

By CAPTAIN F. C. CURTIS, Royal Corps of Signals.

ONE of the most interesting post-War developments in wireless has been an increasing tendency to rely on "short waves" for long-distance communication. As long ago as 1888 Hertz had generated waves less than a metre long and he had shown that they could be reflected by an electrically conducting surface. It had also long been realized that the efficiency of a transmitting aerial tends to increase very rapidly as the wave-length is reduced. But "short waves," of less than 100 metres, had nevertheless been almost completely neglected from the time when wireless first began to be considered a practical means of communication right down to the time of the War. The reason for this neglect lay in the fact that, as any wireless wave travels over the surface of the earth, it induces eddy currents in the earth, and becomes attenuated as a result of this loss of energy. The higher the frequency (*i.e.*, the shorter the wave-length) the greater is this attenuation; and when the wave-length is below 100 m., the wave is almost completely absorbed within a few miles of the transmitter. Pre-War engineers were therefore driven to the conclusion that the only hope of obtaining world-wide communication lay in the use of long waves of 10,000 m. and more. It followed that "Beam Wireless" was then hopelessly impracticable. For if a reflector is to be effective, its height must be at least as great as the wave-length, and masts several kilometres high were clearly not a feasible proposition.

During the later years of the War the research department of the Marconi Co. had begun to re-investigate "short waves," but the first revelations of their truly astonishing possibilities came as a result of the activities of amateurs after the War was over. Tiny stations with a power supply of no more than 30 watts found it possible to communicate on short waves with similar stations thousands of miles away. Signals were even exchanged between England and Australia. True, the results were most erratic; but the smallness of the power with which tremendous ranges were sometimes obtained was sufficiently remarkable to cause much fluttering in dovecots. The explanation was found in a theory put forward by Heaviside and others in 1900, and now accepted as an established fact: that, owing to the ionizing action of the sun's rays, the electrical conductivity of the upper atmosphere is sufficiently great to have a

big influence on the propagation of wireless waves. For the short wave-lengths with which this article is concerned the practical result is that, although any signals travelling along the surface of the ground are soon obliterated, it is quite possible to achieve long-distance communication by means of waves which start out at a slight angle to the horizontal and so get clear of the earth's surface. In this way they avoid the fatal absorption of energy due to eddy currents in the earth, and after travelling up to a height of 100 km. or more, their direction of propagation is bent down again, thanks to an ionized layer in the upper atmosphere. They may therefore return to the surface of the earth and give good signals at places far distant from the starting point. Since the whole process depends on the condition of the upper atmosphere it is small wonder that the behaviour of "short waves" is erratic, and that quite different results are obtained by day and by night, in winter and in summer, in different latitudes, and with wave-lengths differing by only a metre or two. For this reason the problem of using short waves to give a reliable commercial service of communication bristled with difficulties.

Many features have contributed to the comparative success with which these difficulties have been overcome in modern installations, but it must suffice to mention :—

(*a*) A most careful selection of the wave-lengths to be used. For one channel of communication it is now quite usual to allot several wave-lengths. In this way it is made possible to use different wave-lengths at different periods of the 24 hours so as to suit the differing conditions of the upper atmosphere. For instance, to ensure the efficient working of one short-wave radio-telephony channel between England and U.S.A., arrangements have been made for wave-lengths of 16, 22, 32 and 44 metres to be available.

(*b*) The use of considerably more power than was available to the original amateurs. The more important stations in England now use from 10 to 60 kW. Increase of power alone would have been very far from solving all the difficulties, but it does sometimes make just the difference between signals that are readable and signals that are not. Even at 60 kW. the power used by one of these short-wave stations remains considerably less than the 1,000 kW. proposed for world-wide communication on long waves.

(*c*) The use of "Diversity" reception. This is carried out by combining together the signals received on several aerial systems located, say, half a mile apart. When the strength of signals is fluctuating from minute to minute, a bad moment at one aerial system may be a good moment at

another. The combined signal is therefore less liable to fading than the signal received from any one aerial system alone.

(*d*) The use of "Beam" aerials. With short wave-lengths it became a practical possibility to build reflectors to concentrate the radiation from an aerial mainly in the required direction, instead of broadcasting the signals equally to every point of the compass. It is this use of "beam" aerials which has been most advertised, and which is the main concern of this article; but to form a true picture of the present situation it is important to realize that "Beam Wireless" is but one feature of the practical utilization of short waves.

The earliest beam transmitters followed the analogy of a searchlight with a parabolic reflector. As shown in Fig. 1, the instruments

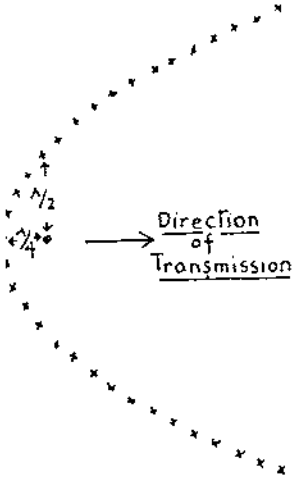


FIG. 1.—PLAN OF BEAM TRANSMITTER WITH PARABOLIC REFLECTOR.

Key.

λ = Wave-length.

• Represents a primary aerial fed with current from the transmitting instruments.

x represents a reflector wire.

used to generate alternating current of the required radio frequency were connected to a primary aerial consisting of a single vertical wire. This in turn was placed at the focus of a parabolic cylindrical reflector formed by a number of other vertical wires. Beam aerials of this type gave quite satisfactory results, and for some purposes they are still in general use. But on the wave-lengths which were found best for world-wide communication a rather costly system of masts was required to support any reflector large enough to be efficient. The cost of the masts formed so great a proportion of the total outlay that strenuous efforts were made to evolve some cheaper form of reflector. These resulted in the "Franklin" type of aerial array which is

illustrated in Fig. 2. It consists of a " front rank " of vertical aerials all fed with current from the transmitting instruments, and a " rear rank " of other vertical wires which act merely as reflectors. To obtain the proper beam effect the currents fed to all the front rank aerials must be in phase, so the impedance of the leads to all these aerials must be the same. This result is often achieved by using a conductor which emerges from the transmitter building as a single copper tube, and then divides and re-divides symmetrically in a manner strongly reminiscent of the standard practice in a certain branch of domestic hydraulic engineering. Other conspicuous features of the system are insulators which " tune " the reflector wires by dividing them into sections approximately half a wave-

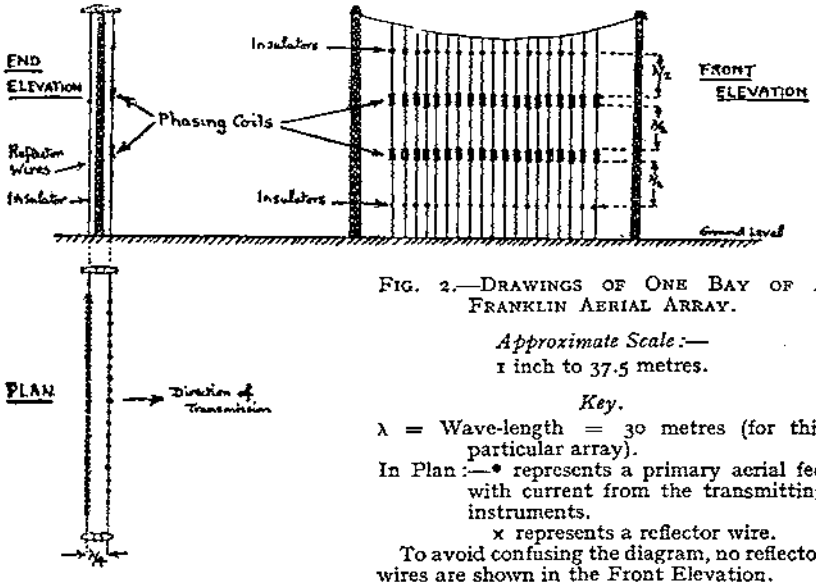


FIG. 2.—DRAWINGS OF ONE BAY OF A FRANKLIN AERIAL ARRAY.

Approximate Scale:—
1 inch to 37.5 metres.

Key.

λ = Wave-length = 30 metres (for this particular array).

In Plan:—• represents a primary aerial fed with current from the transmitting instruments.

x represents a reflector wire.

To avoid confusing the diagram, no reflector wires are shown in the Front Elevation.

length long, and " phasing coils " which are similarly inserted in the front rank so as to prevent the current in, say, the top part of a vertical aerial being out of phase with the current in the bottom part and therefore neutralizing its transmitting effect.

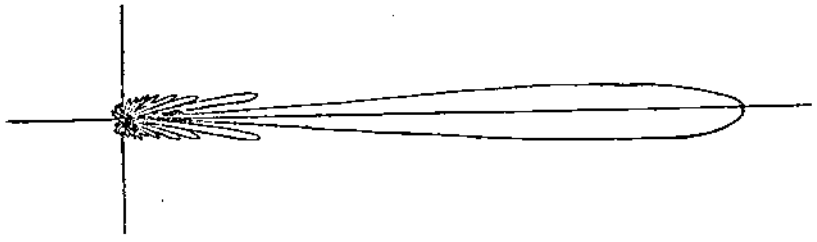
It is fairly easy to prove that in a direction straight in front of the front rank, all the component conductors of an array of this type will assist in producing maximum signal strength. The signals which start out backwards from the front rank are reflected forward again by the rear rank, and if the correct distance has been maintained between ranks, the reflected signals will be in step with those which set out originally in a forward direction, and will reinforce them. A more complicated analysis reveals that the resultant

signals in other directions are comparatively weak, as shown in Fig. 3, which is a typical polar diagram for the signal strength in different horizontal directions. This graph shows up the fact that, unlike the ordinary broadcast type of aerial, a Franklin array does concentrate the greater part of the energy into the required direction. At the receiving end a similar aerial system is used to collect more energy than could be gathered by a single wire, and to concentrate it in the receiving circuits. The over-all increase of efficiency obtained in this way is considerable, and the " beam system " does, therefore, play a prominent part in the commercial success of short-wave long-distance communication between fixed stations.

Military students are, however, less interested in commercial success than in knowing to what extent Empire Beam Wireless fulfils the requirements of a sound system of inter-communication for

FIG. 3.—POLAR DIAGRAM SHOWING COMPARATIVE STRENGTH OF RADIATION IN DIFFERENT HORIZONTAL DIRECTIONS FROM A FRANKLIN ARRAY 10 WAVELENGTHS WIDE.

(Three Bays of the type illustrated in Fig. 2 would produce roughly this polar diagram.)



Notes:—1. This Diagram has been drawn in accordance with a method worked out by M. Green, M.Sc. (*Experimental Wireless*, October, 1927.)

2. It is strictly correct only for radiation in horizontal directions. The Signals which ultimately travel to great distances do start out at angles inclined at only 1 or 2 degrees to the horizontal, and for such directions a diagram of much the same shape holds good. There is, however, also a considerable amount of radiation inclined at much greater angles to the horizontal, for which the polar diagram would have an entirely different shape, the subsidiary beams in backward directions being, for instance, much larger.

purposes of Imperial Defence. The desiderata for such a system are fivefold :—

1. It should be such that each communication channel can deal with a large volume of traffic.
2. It should be such that a large number of similar communication channels can be operated independently without mutual interference.
3. It should be immune from deliberate enemy interference.
4. It should be capable of transmitting a priority message immediately, at any time of the day or night.
5. The danger of interception should be reduced to a minimum.

It will be convenient to deal with these points in a reverse order, taking the question of secrecy first. From a military point of view the danger of interception has always been the most serious drawback to the use of wireless, and unfortunately the present beam system does not go so far as is sometimes claimed towards minimizing this drawback. The 1924 contract for the beam stations only stipulated that the divergence of the main beam should not exceed 30 degrees. The designers were more ambitious and aimed at 11 degrees, but at distances of thousands of miles even this angle subtends a considerable arc. So the care which some text-books on Military Geography devote to tracing out a mathematical line to represent the path of the beam is scarcely justified. Moreover, there are other factors besides the spreading of the beam which make the attainment of a high degree of secrecy difficult. As shown in Fig. 3 there is some transmission of signals in unwanted beams inclined at all manner of angles to the main beam ; and even if these can be eliminated, there remains the tiresome fact that the place where the main beam reaches the reflecting layer of the upper atmosphere is apt to act as a secondary broadcast source of emission, analogous to the luminous patch formed where a searchlight beam reaches a layer of cloud. For transmission over very short distances it may be possible to avoid all these difficulties by using very short waves of less than 10 metres. These would require reflectors sufficiently small for it to be quite practicable to make them nearly perfect, and, so far as can be ascertained, the reflecting atmospheric layers are never in the right condition to bend such waves back to the earth's surface at distant points. A demonstration across the Straits of Dover has recently directed considerable attention to the possibilities of " microwaves." It should, however, be realized that they are very quickly absorbed if they travel along the surface of the ground. The slightest intervening hill or the curvature of the earth may be a bar to communication. If microwaves are to be used to send messages over long distances, it will be necessary to have a considerable number of intermediate relay stations, rather like the visual stations that were established on various " Telegraph Hills " between London and the naval ports in the days of the old semaphore telegraph. The wave range between 10 and 100 metres, therefore, still seems the best for Empire communications, and within this band it is likely to remain true that a well-equipped enemy can intercept messages.

From the point of view of ability to provide immediate communication at any moment of the 24 hours, the beam stations are also faced with a serious difficulty. It has already been said that communication between such stations is entirely dependent on the existence of reflecting layers in the upper atmosphere. So when the upper atmosphere chooses to sulk, things become very difficult for

the short-wave engineer. It was for this reason that the contracts for the beam stations required only the following number of hours' communication out of twenty-four :—

Canada	...	...	18 hours.
South Africa		...	11 hours.
India ...	...	...	12 hours.
Australia	...	...	7 hours.

By the use of such devices as those mentioned earlier in this article, and, in the case of the Australian circuit, by making provision for sending the main beam either way round the world, it has now been possible to improve on these figures. But it is still true that there are periods when instant communication by short waves cannot be provided.

Although a wireless station may be made the objective for an enemy attack, it is obvious that any form of direct radio communication between England and the Dominions is less vulnerable than a cable system which can be put out of action by hostile raids at any point along the routes which the cables follow. Against this it has, however, been urged that in time of war an enemy could and would make wireless communication impossible by resorting to systematic "jamming." Some interference is certainly to be feared as a result of a breakdown of the normal machinery for the international allocation of wave-lengths, but deliberate jamming is fortunately not quite so easy as it sounds. It would require a large number of stations of high power, and would be an expensive process. It might be found worth while in order to prevent communication for a short while on some vital circuit at some vital time. But the wireless history of the last War suggests the conclusion that both sides would normally try to follow a policy of "live and let live."

Readers who remember the days when the Brookman's Park transmitter began to broadcast two different programmes on 356 and 261 metres, may be a little sceptical about the possibility of numerous long-distance beam channels being operated without mutual interference. If there were difficulties when two neighbouring broadcast stations sent out signals on wave-lengths 95 metres apart, they may well ask whether it is not optimistic to hope that a band of wave-lengths only 90 metres wide (say, 100 m. to 10 m.) will suffice for the world's requirements of long distance channels. Moreover, the fact that many stations working in this band require more than one wave-length lends additional force to this question. Fortunately, however, the prospect is brighter than it might seem. The trouble with the broadcasting stations was very largely due to the use of crude unselective receivers, and apart from that, there is another most important consideration. Difference in wave-length is an unsatisfactory and misleading way in which to specify the

separation between channels. The difference in *frequency* of the currents used gives a much truer indication of the effective " separation." It is, of course, partly for this reason that the B.B.C. and all other enlightened concerns now specify their channels in terms of " kilocycles per second," rather than in metres. This point of view applied to the band of wave-lengths between 100 and 10 metres reveals that the corresponding band of frequencies, from 3,000 kc/s. to 30,000 kc/s., is 27,000 kc/s. wide, as compared with a difference of only 306 kc/s. between the frequencies corresponding to 356 and 261 metres. Even so, one may hesitate to say that there is room to provide for all reasonable needs. Unfortunately there is not. But there is at least room for many more channels than could have been obtained by the use of long waves.

When judged also by the last criterion of ability to handle a large volume of traffic, the empire beam system comes out well. It can easily handle a greater volume of traffic than there has hitherto been any demand for. Thanks to the intrinsic properties of short waves, to the use of beam reflectors, and to the fact that atmospherics less frequently cause interference in receivers designed to receive short waves, the signals when they are good are very good indeed. This facilitates high speed working. Speeds above 100 words per minute are usual, and are sufficient to clear all the traffic that is normally forthcoming. At much higher speeds of working some trouble is anticipated from signals which follow a longer path than the main beam and therefore cause " echoes," by arriving a perceptible fraction of a second later. But there is still a very comfortable margin, and when the volume of traffic justifies it, the message-handling capacity of the channels can be considerably increased by the use of higher working speeds and multiplex transmissions.

For most of the long distance messages that are sent in peace and quite a few that are sent in war, neither extreme secrecy nor the possibility of a few hours' unavoidable delay are matters of importance. For this type of traffic, beam wireless already provides a very satisfactory system of communication. Much research work is still going on, with a view to improving the Franklin aerials and to filling in the large blanks that still exist in our knowledge of how signals travel from transmitter to receiver. It would, therefore, be rash to prophesy dogmatically about the future. But it seems probable that for really confidential or urgent traffic, submarine cables will continue to have their uses.

THE ABOR MILITARY AND POLITICAL MISSION, 1912–13. (*Continued.*)

Compiled from the Diary of the late Capt. P. G. Huddleston, R.E.

5. THE SIRA PATENG.

June 14. Miging. Both doctors Macdonald here. The coolies below, who have been going six months, are about on their last legs, and some of them are shadows of their former selves, but I hope the signs of rolling up will put enough spirit into them for another month or six weeks. A *yoksha*, or naked sword, which Simung, a powerful village on the opposite side, has been passing round (*à la* Loch Katrine fiery torch) to try and get all the tribes to down us, has fallen into our hands. It is very childish.

June 16. Went up to the village and talked with the *gâms* in the *moshop* about their sending an advance party ahead to clear the road. Slacked generally. Very pleasant. Rain all day.

June 17. Hore and Bamba Ram arrived, which completes party. Rain all day.

June 18. Fine, but no high hills clear. Miging men will not go and clear the road ahead for five silk cloths. This is the time for working in their fields and Hore will not press them. We start to-morrow with 19 days' rations.

June 19. Off at 7 a.m., with Bamba Ram a little ahead, as it looked like clearing. Interpolated myself with theodolite at Miging village on the spur connecting with Luyor. This may enable me to get a theodolite height, after one interpolation on the Sira–Pateng–Tsang-po junction, as *pucka* heights on the Tsang-po are rather interesting scientifically. It is 1,300 a.s.l. to within 50 ft. over or under. Joined Hore and main party at the Yinggong bridge about noon, where the Abors were repairing the bridge which had decayed badly in the last six months. When made, it took the coolies 4 hours to get across. Camp at Yinggong. Very hot. Wretched night with the sandflies, as the mosquito net had not arrived. It is too hot for a blanket and if one does not cover the whole of one's body, one gets bitten mercilessly. Oh, land of little worries! If there is not rain it is too hot, or there are mosquitoes, sandflies, *damdins* (less now), or swarms of bees (more or less harmless), which swarm round you to suck the sweat off you or your clothes, ending in one getting inside a hole in your rags and stinging you.

June 20. Went ahead to clear path for Hore and main party

and to start repairing Kerak bridge (over Sira Pateng). Path very overgrown as it had not been used for six months. The Miging men and near villages generally have an early shoot up here, but our advent this year has so far postponed it. The snow on the passes melts about June 1, and when they have finished their fields in July and August they send out a party of 20–30 ahead to clear the trade route, repair the bridges, ladders and galleries. Camp 2,000 ft. up. Cooler from draft off the snow water.

June 21. Tunging Hut camp. Luckily plenty of canes were found up the hillside and the bridge was finished about 11.30. Self, the surveyor, 3 khalasies, 4 rifles and 11 coolies went ahead to clear the road with 3 days' rations separate. Path leads along left bank of the foaming, roaring Sira Pateng. Very pretty. Rather fun being first along the path this year. Snake in camp, but none on the path yet.

June 22. Shondak. Hore caught us up, repairing some rather nasty ladders and galleries. The road also is so overgrown with creepers and weeds that progress is very slow. Swarms of bees in all camps and at night sandflies, but cooler. Lovely scenery up this gorge, but like a hothouse out of the breeze, and we stick our heads in every little waterfall.

June 23. Tamidenung (means abode of flies). Good march in spite of clearing path. Spirits rising a bit, like the river, now 3,500 ft. If only this was the start of the show, how lovely this would be, but I fear we are on a forlorn hope. Issue of rum in camp.

June 24. Waterfall camp. Hore was effectually waked up by shouts of a black bear, which was walking along the opposite bank, but it disappeared into the jungle before we could get a shot at it. Just as well, as we could never have got across the Sira Pateng.

June 25. Andrung stream. 4,800 ft. Passing Pirking cave (for 40–60 men) *en route*. The river is now appreciably smaller, but roaring down at a tremendous pace, with a continuous series of small waterfalls and rapids and slides—the din has now been in our ears for 5 days. The path is still good for Aborland, though there are successions of ladders and galleries, and need for a lot of repairing to the rotten ones. Getting quite excited as there is *just* a chance of our reaching the top of the pass. Let us hope there will be no floods for our return journey.

June 26. Runo stream camp. 5,700 ft. Rain most of night and hard all day. Beastly wet and coldish. Went ahead early with advance party, which has daily to cut the path clear and to-day we had three log bridges to patch up. A coolie and load of rice fell in at one of them and after going through two pools, he was hauled out just before reaching the main stream, where he would not have had a dog's chance for 10 seconds. However, he escaped with many bruises, and the loss of his kit and 60 lb. of rice.

June 27. Simu-Sigong junction camp, 6,000 ft. Here, on right-hand bank, the Turo route goes up the Sira Pateng, and we take the Lamdo route up the Simu. Went ahead again and got this bridge patched up as the main party arrived, mixture of cantilever and suspension, rather neat design. Rain most of day, but in early. Must nurse the coolies for the dash to the top *if* we can get there.

June 28. Aiyi Lipuit. 8,200 ft. Still raining. Bridge at Jorging intact over Simu, and only needed a little patching. Then one or two nasty galleries a few hundred feet above the river. All the time rising fast and it is lovely in spite of the rain, seeing the firs come down to us at about 7,800 ft., until for the last 1½ hours of the march we were walking among them. If only the sun had been out, it would have been really beautiful. Every ¼-mile, enormous waterfalls of 300–400 ft., toppling over into the gorge, until we reached this place, a sort of semi-circular basin with streams pouring in on all sides. The streams are now at full flood level, a wonderful sight, and the whole ground seems to ooze with water and springs. Luckily, only one small bridge was carried away and we were able to get it rebuilt in about an hour, thanks mostly to a coolie who very pluckily, without orders, swung himself over the worst part of the torrent by an overhanging tree. The Abor sleeping place here is an enormous rock, about 50 yards in diameter, which in its crevasses is accommodating some 30 coolies and our own servants and cook-house. Hore sent back 4 rifles, and 23 sick and weakening coolies, to strengthen the bridges in our rear.

June 29. Upper Simu bridge. Camp 10,100. Steadily rising. After about an hour we saw, 200 yards opposite, a patch of snow, then larger and larger patches. Plenty of fresh *shikar* marks and Hore and I kept 2 sepoys with their rifles near. The gorge was now narrow, the sides being mostly bare rock cliffs. At the bottom of the gorge the firs got shorter and less, more mosses, and in places just like an English park, with flowers just like home, wild strawberries, cowslips, sort of daffodils and innumerable others. How we enjoyed life and how wonderful the scene was! If the sun had been out instead of rain and mist, it would have been and felt like fairyland. Hullo! What's that—right up on the cliff opposite? Four black bears? No, *takin*, and there are two more. And there they were, looking down and across at us like enormous black sheep. An excited discussion as to how to get at them and (having sent the main party on to the camping ground), as luck would have it, we found a fallen fir tree bridging the stream just near. This was roughened before Hore and I, taking our boots off, dared to go across. Even then it was a most terrifying performance, as the torrent was lapping the trunk, and if one had lost one's balance, one would have been pounded to pieces in a few seconds. Luckily, the *takin* could not see us crossing and, seeing the convoy go on, had come down to

within 100 ft. above us. So, after a little scrambling and a most exciting ten minutes, Hore had bagged a young bull and myself a very large cow, with which, as so few have been shot, we were, of course, delighted. There is a Bhutan *takin* in the Zoo in London, and the first Mishmi *takin* was shot by Bailey last year, so it seems probable that we are the next *sahibs* to bag one. There is some doubt whether the Bhutan and Mishmi *takin* are the same beast. We carried as much meat as we could, leaving the rest in the snow to be fetched later and got into camp very cold and weary and drenched through, but most elated withal. The Abors who had gone off early had climbed some impossible cliffs, and said they shot 5 *takin* with their arrows, but they were poor heads. So the camp, with an issue of rum, is in high spirits. The addition of the meat is a godsend to our rations. Several have not touched meat for months. Liver, steak and marrow for dinner, with wild onions. Excellent.

June 30. Still raining. Got off 8 a.m., reached Dile Rock in an hour, where the stream breaks over a precipice at the head of the valley like a semi-circular cup. Up through a glen and along through meadows of grass, peat moss, ferns, thistles, just like any Scotch valley or meadow. Reached at 10.15 Lower Nambui Dibba, 11,300 ft., another semi-circular cup of precipices. Here the wood practically ended. Tibetan hut, 300 ft. above. Here we left the camp and went on. Forded thigh-deep icy stream. Raining cats and dogs. Reached Nambui Dibba and got into another semi-circular cup, which we again got out of on to a promontory 12,400 ft. This we reached at 12, the khalasies and the surveyor rather done. From here the Abors pointed up to a very steep snow field through the mist, which they said was the top of the pass, and they seemed surprised and rather frightened at there still being so much snow. As there was no chance of its clearing, Bamba Ram went back to camp, doing a prismatic compass traverse, and taking back the plane-table and theodolite. Hore had already started off, and crossing an easy ravine started up the snow field, which continued for 1,200 ft. Hore reached the top about 1 p.m. and myself a few minutes' later, pretty good going. The snow was frozen but just soft enough from the rain to dig footholes in it with our boots, where we had to zig-zag up. Two khalasies, one sepoy and one Abor got up later, but the other sepoy and Abor chucked it. The barometer made the top of the pass 13,700 ft. Drenched through as we had been with the rain, snow and slush, and fording the stream, we could only stay a few minutes in a cutting wind to take a few bearings and a photo which will not come out, and look down on a little stream some 500 ft. below flowing into the Tsang-po of Tibet. Also some trees round blue pools covered with ice, which mark the first halting-place on the other side. Through the mist we could see several peaks about 14,000 ft., but unfortunately nothing more. If

only it had been clear and the sun shining, it would have been easy to get up one of the peaks on either side of the pass and what might we not have seen! Being only too glad to get away, we rushed down again, the sepoy slipping and doing a slide of some 100 ft. before, luckily, a ridge in the snow and his rifle stopped his progress over the precipices below. We halted after about 500 ft., and had a nip of brandy and I carried through my bearings. On the way down we had a look at the Nambui Dibba, Tibetan sort of hut, with a stone wall round it. The Abors say that the Tibetans bring their *yaks* over to graze from August to October, and it seemed as if they had also been over two months ago. It is difficult to say when the pass is open. With snow on it now it is certainly easy, bar avalanches and crevasses, and where the snow below 12,500 ft. had melted, the road was well marked. What a pity we cannot stay here a month, but that would need laying out a line of stages to feed us, or a large convoy. Still, we reached the top of the pass. Hurrah! In at 4.30 and soon cosy in camp. Still raining.

July 1. Upper Simu bridge camp. Got here by 1 p.m. Both Bamba Ram and I doing a traverse. Heads and skins of *takin* have been cleaned and rubbed with ashes, but I doubt whether we shall be able to prevent them from going bad in the damp heat below. Still raining. It is very bad luck, since camping as we did 2½ hours from the top of the pass, if only the weather had cleared we could have done two days of survey work, probably all that was required. Well, we cannot help the weather and the fact of reaching the pass and proving its comparative easiness is of considerable strategic importance. It is, I suppose, a definite fact as to our frontier in this part, and disposes of any of the old theories of a double range. It now remains to get back to Miging in 7 days (our 6 days' rations having come up the same distance in 11 days), with all streams in full flood. If landslips occur and bridges are washed away, we can yet easily go on half rations. Unwar Hussain remarked to Hore the other day, "Sahib, if we did as much work and went through as many hardships in our own interest as we do in your honour's service, we should be very rich men." But it is the coolies who, with a few ration bags as extra clothes over their cotton garments, have the really bad time of it. It is extraordinary that they are so cheery.

July 2. Simu-Sigong camp. Rain all night but slight respite till 11, when it came down harder than ever. Path a foot deep in mud, in many places very bad. About 3 p.m. the Simu came down another 3 ft. higher in flood and the Jorging bridge was only just negotiable. Another 2 ft. may wash the Simu bridge clear away, leaving us here with 2 days' rations till the flood abates, but I think it will be all right. So far so good.

July 3. Andrung camp. Woke 5.15 to find, to our relief, that, though the river had risen a little, the bridge was still quite safe. All

in by 5 p.m., an easy march on the whole. It stopped raining for quite long periods. Two coolies and their loads fell over some steep places, but both eventually caught themselves and loads up in the scrub before reaching the river. The Sira Pateng was simply roaring and raging down at top of flood. In several places we had to cut back into the jungle, where the path goes along its edge. It is here about 60–70 yards broad and the various streams we cross 20–30, and the Simu 35–45, all roaring, raging torrents. However, the returning party had strengthened all the bridges and they held, though the top of the rock pier in the centre of one was just lapped by the water. Truly this gorge is a wonderful sight and the din of rolling boulders is appalling. No one seriously sick, though there are several slight fevers, and swollen legs. Nice dry camp, as there are plenty of banana leaves. The light loads and old camps ready make these double marches more or less reasonable.

July 4. We had a shock on reaching here (Tamidenung) and not finding the 4 days' rations which were to have been deposited. Has the sepoy in charge played the fool ? Or been held up by one of the rivers ? At the worst the coolies will starve for 2 to 3 days. At present they are making their dinner last over for to-morrow morning's meal.

July 5. On reaching Shondak Camp we found to our relief that rations had just turned up this morning. Two bad landslips on the way to-day, one from about 50 ft. above the path, 200 ft. sheer down to the river. With our rations was also one *dâk*, so we and the coolies are all very cheery, and to cap all, no rain, and the sun has come out, so ourselves, clothes and blankets can dry again at last.

July 14. Angong. Piping hot. Two coolies and the surveyor temporarily fainted with the heat.

July 19. Riga. One of the biggest villages in Aborland situated on long road, spurs high above the Dihang. *Gâms* came in for a friendly chat. They are evidently much relieved that there has been no snap or unfriendliness with the Membas. Hottest day yet.

July 22. Yekshing. Coolies off 5 a.m., self fishing till 6 a.m. at the now famous Shimang-Dihang junction, where thousands of pounds of fish have been caught since Williamson's murder. I caught a sprat and hooked another, when the Shimang suddenly came down muddy and I had to put away my rod. There had evidently been a landslip. Much easier march but piping hot. Very nice to see the old Siyom again full of snow water : it increases the Dihang appreciably and it is now a gigantic river. It is difficult to compare rivers, but to my imagination it looks now about twice the size of the Rhine at the Lorelei Rock. There has been, except for one or two thunderstorms, no rain for 20 days, and I fear the rear-guard will feel the strain even more than we do.

July 24. Off 3 a.m., and all in to Rotung before 8 a.m. Quite

cool, but blazing during day. Gets light about 4.30. This part of Aborland will (save for the snow passes above) always have the most hold on me. The river is very fine and the jungle often runs down to the river and there are few fields. With this part are associated the treacherous murder of Williamson and Gregorson and the previous attempts to open up the country and to solve the Tsang-po mystery, and the futile attempts of the Abors to fight the Abor Expedition last year, resulting in the mule roads and *pucka* bridges. And now we know the old Tsang-po is breaking through the outer range of the Himalayas on to the plains of India. The relief of getting on to a mule road and being able to swing one's legs out is enormous. Half the strain in the long coolie marches farther up is in having to see where one is going to put every step, especially down hill. But it is the most terrifying thing to pass a convoy of 300 yards of mules on a narrow path, at the mercy of any mule who may see fit to let out his heels at you. Reached Renggung.

July 26. Off at 1 a.m., dark and raining, and a downpour on last rise before descending to the plains. Had to hurry on coolies in case Sibokorong should come down in flood, as I had heard that the bridge had been carried away for about the sixth time. Reached Jannek Merk at 5.30. Cliff slithering and sliding, and a permanent post camped there to keep it open. All back to Pasighat by 8 a.m. Found Porter, Boyce and Wickham. Most cheery and the delights of a table cloth and fresh eggs and coffee most satisfying.

Aug. 7. Pemberton and Trenchard actually got over the Doshung Pass and reached Pheo-Doshing village on the Tsang-po, returning in 5 days from the Tsang-po to Tsang-po over a pass about 13,500, similar to ours but shorter. They got within 3 days' hard pony-riding of the falls, *if they exist*, but the Tibetans, though communicative on other subjects, shut up and contradicted themselves when inquiries were made about the falls. Oakes, Dundas and Macdonald got within 4 or 5 villages or 5 marches of the south end of the gorge, through which the Dihang must fall some 6,000–7,000 ft. They got well past Richenpung. Of course it seems extraordinary that, being so near, we should yet fail to complete the Tsang-po. The explanation is that such an expedition depending on communications, rations and coolies has a limit, and Dundas risked that limit much farther than most men would have had the pluck to do. Luck has been with him, and he has got us out of the Abor country during the monsoon, only losing 2 coolies and a few odd pounds of tea, sugar, rations, etc., a feat which was looked on as impossible before ; and if anyone had been in Pasi when, a few nights ago, a cyclone passed over, hurling down enormous trees, I think he would have said impossible, too.

Aug. 9. To Kobo by boat. Here endeth an experience I would gladly repeat.

[This concludes the *Diary*.]

The following extracts from an article entitled "The Mishmi Mission Survey Detachment," by Capt. C. P. Gunter, R.E., which appeared in *The R.E. Journal*, January, 1915, deal with the start of Captains Bailey and Morshead to try and solve the mystery of the "falls" of the Tsang-po.

"During the halt at Mipi, Capt. Bailey, who is a good Tibetan scholar, managed to extract a good deal of useful information from the Tibetans about the Tsan-po and country north of the Andra and Adzon watershed, and it was here that the plan took shape of his crossing over into the Chimdru Valley with Capt. Morshead to unravel the mystery of the 'falls' and course of the Tsan-po between Chamkar and Rinchengpung. It was interesting to discover that the name Pemakoi (Tibetan for promised land) which has been entered haphazard over different areas of the old maps of this part of the world, really refers to this valley of the Matun. Seven years ago, some thousand Tibetans from Chimdru, on the strength of a prophecy that this was their promised land, came over the Andra and Yonggyap Passes into Mipi and turned out the few Mishmis whom they found in the Matun Valley. It did not take them long, however, to discover that this was not the land flowing with milk and honey that they expected and that the country could not maintain them. They had already left many dead along both the Andra and Yonggyap routes. Apparently all who could, soon made up their minds to quit and return to Tibet, which they did by way of the Yonggyap, Dri and Jairu Passes, leaving many hundred dead along the various routes. A small party of 80 souls, who were either too old or too feeble to travel, remained behind and with them a few able-bodied men; these now form the community of 60 who live in Mipi." * * * * * * *

"The 11th (May) was a fine morning. . . . By 10 a.m. three of Capt. Bailey's coolies reached us from Mipi, and with the help of three more of our coolies (it had taken several days of persuasion and promises of *bakshish* to induce these men to consent to go), Capt. Morshead, equipped with a 3-in. theodolite and small plane table, left Karwadi for Mipi on his adventurous journey to unfold the secrets of the Tsan-po gorges."

The efforts of these two officers were successful and an account of their adventures was given to the Royal Geographical Society by Capt. F. M. Bailey, I.A., and published in *The Geographical Journal*.

"An Exploration in South-East Tibet," by Major H. T. Morshead, D.S.O., R.E., also appeared in *The R.E. Journal*, January, 1921, from which the following brief details are taken.

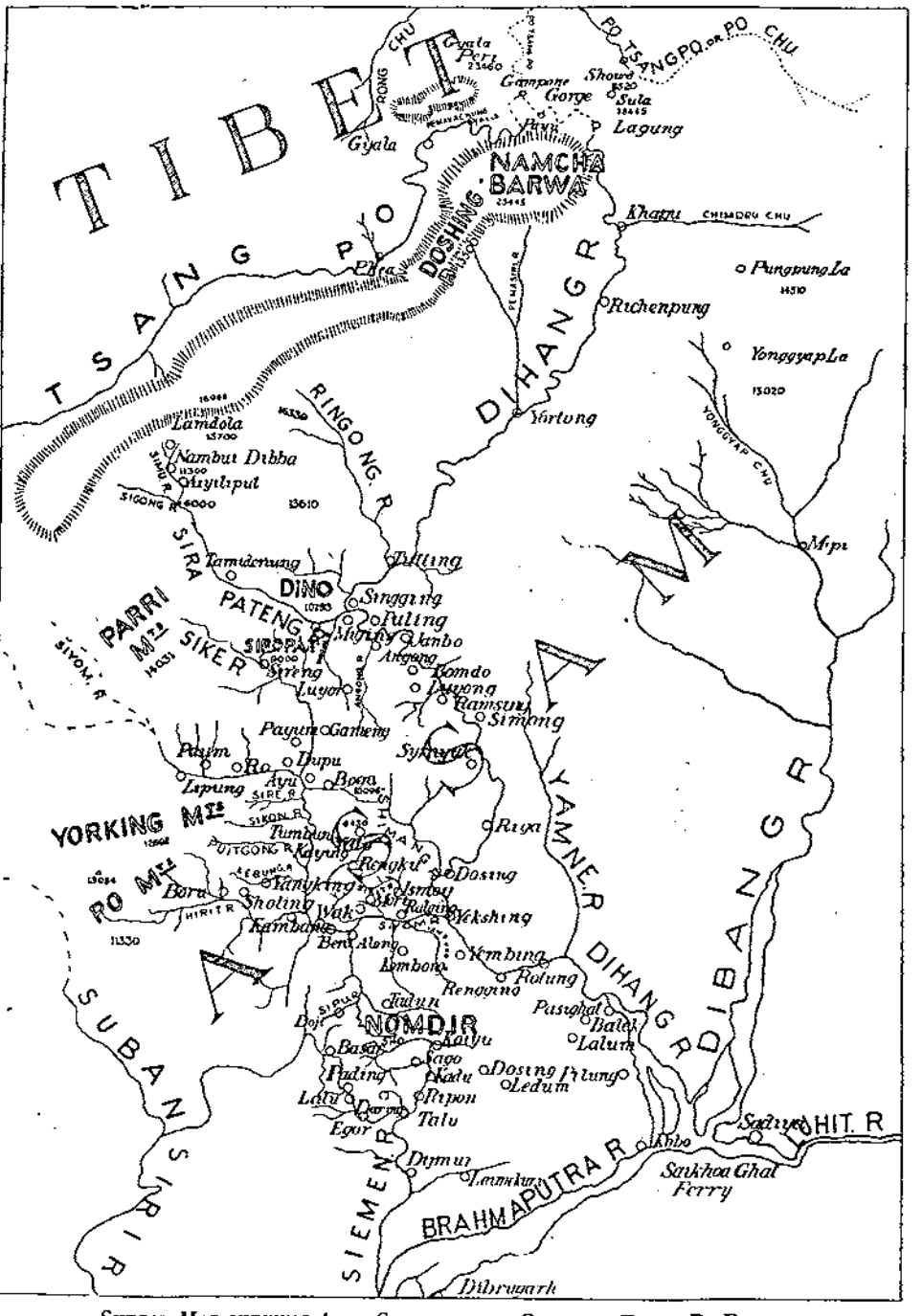
They left Mipi, on the Dihang River, on May 16th, in pouring rain, with ten coolies and three local guides. The Yonggyap La (Pass) and then the Pungpung La were crossed in deep snow and with

great difficulty. By 5th June they had reached Khapu on the Dihang River, and heard that the Abor Column were six marches downstream. The next march was to Lagung, where they met a local official who regarded them with considerable suspicion, and insisted that, instead of proceeding up the gorge of the Tsang-po, they should accompany him to Showa over the Su La, where a council would be held as to their disposal. After three days' detention, affairs were satisfactorily settled, and they were allowed to proceed. Showa is on the Po-Tsangpo, which the explorers were very anxious to trace to its source on the Chinese frontier. The local officials would not agree to this, so they made their way down the Po-Tsangpo, hoping to survey it down to its junction with the Tsang-po at Gompone, and then complete this river through the gorge down to Latung, where they had left it. Owing to broken bridges they had, however, to leave the Po-Tsangpo itself and go up one of its tributaries, and they eventually reached the Tsang-po at Phea, where Trenchard and Pemberton had arrived from the south seven days previously and had left after a day's halt. (See entry in the *Diary* for August 7th.)

Proceeding downstream to Gyala, it was found that below this spot the Tsang-po gradually changed from a placid stream into a roaring torrent. Pemakochung, the last Tibetan habitation, was reached on July 21st, and here were found falls of 30 feet in height. As there was no road down the gorge, they determined to cut their own path down the valley and to proceed as far as the provisions would allow them to. A prominent spur, 13 miles down the valley, was reached, from which Morshead was able to trace the general alignment of the river for the next 30 or 40 miles. On returning to Pemakochung, it was found that a party, escorting a holy man on his way to Lhasa, had come up the gorge along the water's edge, and Bailey determined with a single coolie to follow them back, whilst Morshead returned to Gyala, the provisions being exhausted. Bailey succeeded in getting a few miles farther down the stream, when the party of " Monbas " gave him the slip and he had to return to Gyala. The length of the river unvisited was estimated at 45 miles between Lagung and the spot in the gorge reached by Bailey, and it was practically settled by observation and from local information that the stream through the gorge continued the same seething, boiling current, but that there are no actual waterfalls as large as the falls at Pemakochung. Bailey and Morshead continued their exploration to the west up the Tsang-po, and returned to India across the headwaters of the Suban Siri. The map accompanying this article shows the places visited during this exploration of the great bend of the Tsang-po.

EDITOR, *R.E. Journal.*

THE ABOR MILITARY AND POLITICAL MISSION, 1912-13.



SKETCH MAP SHEWING ABOR COUNTRY, AND GORGE OF TSANG-PO RIVER.

TANK v. TANK.

(*April 24th*, 1918.)

By MAJOR-GENERAL J. F. C. FULLER, C.B., C.B.E., D.S.O.

THE 24th of April, 1918, is one of the red-letter days in the history of the Royal Tank Corps, the significance of which may be bracketed with the 9th March, 1862, the day the "Merrimac" met the "Monitor." It is a day which has never as yet been fully described, therefore, it may be of some interest to set on record what happened, quoting as far as possible from the messages and reports received at the time.

The great German offensive of March, 1918, petered out a few miles east of the city of Amiens; the enemy's line running from immediately east of Villers Bretonneux, of 1870 fame, southwards to the village of Hangard. About half-way between these two places, and about a mile and a half west of Villers Bretonneux stood three woods—the Bois de Blangy, the Bois d'Arquenne and the Bois d'Abbé, the last being nearest to this small town.

On April 17th, the second of these woods was shelled with mustard gas, and part of A Company, 1st Tank Battalion, sheltering in it, suffered heavy casualties, 6 officers and 32 other ranks having to be evacuated to hospital. As soon as the shelling was over, this company was moved to the Bois d'Abbé, which on this day presented a picturesque spectacle. In this wood was crowded a bit from nearly every branch of the British and French armies. There were to be found there tanks of all descriptions, Mark IVs, Whippets and French Renault machines; heavy and field artillery of both armies; English infantry and Australian; French cavalry, infantry and Moroccan troops, as well as a detachment of the Legion of Frontiersmen mounted on little Arab ponies which seemed strangely out of place among the armoured machines, the guns, the wire and the shell holes.

On the next day, Lieut.-Colonel R. H. Broome went sick, and the command of the 1st Tank Battalion was taken over by Major J. C. Tilly. Reconnaissances were at once carried out, a very necessary precaution, for, at 3.20 a.m. on the 24th, a heavy enemy barrage was put down north and south of the River Somme, to be followed at 6 a.m. by a strong infantry attack in the Villers Bretonneux area. Tank assistance being called for by the 3rd Corps, at 8.30 a.m. No. 1

Section, under Captain J. C. Brown, moved forward to engage the enemy at, or near, the village of Cachy.

Meanwhile, on the 18th, the 3rd Light Tank Battalion occupied a position of readiness in the vicinity of Hénencourt, some 10 miles north of Villers Bretonneux. On the 19th, X Company was formed from the Brigade reserve and was placed under the command of Captain T. R. Price. This company consisted of two sections, one of four tanks and the other of three. At 2 a.m. on the 21st it moved to the Bois de Blangy, three miles west of Villers Bretonneux, a total of 16 miles by road, passing through several villages. The first tank covered this distance in three hours and five minutes, and the last in just over four hours, which was considered a remarkable performance in these early days of tank history. (In 1929, a light tank in England covered just under six times this distance in the time taken by the first of the above machines.) At 10.20 a.m. on the 24th, X Company was ordered to clear up the situation east of the village of Cachy.

At Tank Corps H.Q. at Bermicourt, a small village between St. Pol and Hesdin miles away to the north, the telephone soon informed the headquarter staff that early on the morning of the 24th the Germans had launched a heavy attack on the Villers Bretonneux position. Then came various rumours that they had attacked with tanks and driven the Australians back, occupying the eastern half of the town. Needless to say, this caused considerable excitement; for the Villers Bretonneux position was of the highest importance, because it covered the Amiens–St. Just railway, which, though under German gunfire, could still be used at night-time. If Amiens fell, then the only railroad left between the British and French armies was the one passing through Abbeville, and Abbeville was but 12 miles from the coast.

I cannot now remember the various telephone conversations which took place that day, but the following telegram from the 3rd Tank Brigade was received at Tank Corps H.Q. at 7.11 p.m.:—

> "Situation. X Coy. 3rd Battn. attacked 2 battns. enemy infy. massing E. of Cachy at about 11.0 a.m. and scattered them inflicting heavy losses. Enemy employing 4 very large tanks, carrying three 2-pdr. guns each, which knocked out 2 female Mk. IV British tanks. 4 Whippets lost in this morning's operation, 3 returned. Casualties light."

With this information and that already received by telephone, at 8.15 p.m. the following telegram was sent to G.H.Q.:—

> "Following report from 3rd Tank Brigade received. 7 Whippets attacked enemy east of Cachy at 11 a.m. Met 2 or 3 battalions massed. Estimate they killed and ran over at least

400 Germans, some reports give 1,000. 4 Whippets lost, 3 returned covered with blood. 4 German heavy tanks seen. Have top turret and said to be armed with three 2-pdrs. They knocked out 2 female Mark IVs. Our male tank knocked out one German tank and dispersed other three, of which one ditched. Crews of two seen to get out and run away. Am confirming. Addressed G.H.Q., repeated Fourth Army."

Meanwhile, at 3 p.m., a report had been dispatched by the Fourth Army to G.H.Q. It reads as follows :—

"Attack south of the Somme was made by four divisions of which identifications have been obtained from all 12 regiments except one. Enemy success attributed solely to tanks which approached our lines under cover of the fog after the first attack had been repulsed, over-ran our infantry accompanying machine-gunners. Enemy infantry accompanying tanks reported to have provided excellent targets for our rifle and Lewis gun fire. 8th, 58th and 5th Australian Divisions, together with 3rd Tank Brigade, all fought with greatest gallantry. During day about 150 prisoners were taken. Prisoners state objectives for that day were Fouilloy–Cachy road from about 0.22 Central to Cachy, including Cachy village. Nearest point reached by enemy was 500 yards from objective, about 0.33 b.8.2."

The next day Major Tilly sent to Tank Corps H.Q. the following report :—

"At 1.0 a.m., 24th instant, Captain J. C. Brown moved his tanks to U.1.a.8.4. owing to gas shelling of his original position. This he intimated to the Infantry Brigade.

"At 8.30 a.m. the G.O.C. 23rd Infantry Brigade gave Captain J. C. Brown verbal orders to proceed at once to the Cachy Switch in U.3.b. and c., and to patrol the Switch to prevent the enemy gaining access to it.

"At 8.45 a.m. Captain J. C. Brown moved his 3 tanks up to the Cachy Switch and reached there about 9.30 a.m. On arrival he observed an enemy tank in U.4.c., quite different in shape to any of our own, though not larger than our Mark IV. This tank immediately commenced firing on the 2 female tanks (Lieut. E. Hawthorne and 2nd-Lieut. J. Webber), who replied with M.G. fire. About 10.0 a.m. both these tanks received direct hits from the enemy tank and were temporarily put out of action and withdrawn. The male tank of the section commanded by 2nd-Lieut. F. Mitchell brought his 6-pdrs. to bear on the enemy tank as soon as it was sighted. About this time a second enemy tank appeared about U.4 Central and commenced firing at 2nd-Lieut. F. Mitchell's tank. This officer manœuvred

his tank into a favourable position, and at 10.15 a.m. he obtained a direct hit on the first enemy tank and put it out of action, and the crew were seen to leave the tank. 2nd-Lieut. Mitchell continued manœuvring about and engaging the other tanks, which were four in number at this time.

"At about 12.0 noon, 2nd Lieut. Mitchell's tank received a direct hit from enemy artillery."

Brown was awarded a bar to his M.C., and Mitchell received this decoration for the gallantry displayed by him during this engagement.

In spite of the fact that German tanks had been engaged at fairly close quarters, and seen by a number of officers and men, for a day or two it was impossible to ascertain anything definite about them. One report says :—

"The hostile tank is large and of a mushroom shape. It has some sort of a turret and small sponsons have been noted by close observers. [Quite wrong.] It is known that our female tanks were hit by British 6-pdr. shell. It is, therefore, probable that the enemy has added additional armour plates to captured Mark IV tanks. The purpose of these plates would be, firstly, to reassure his own personnel, and, secondly, to deflect bullets and form a 'burster' for bombs. This would account for the large mushroom-shaped appearance and also the use of the British 6-pdr."

As regards the 6-pdr. shells, one, unexploded, much cut about by its crash through the tank armour, was sent to Tank Corps H.Q. some days later, and it is still in my possession. There is no doubt as to its being a 6-pdr. shell, but later on several German tanks were captured and none of them was armed with British 6-pdr. guns, but with one 57-mm. gun and six machine-guns. I have also in my possession one of the shells taken from the "Elfrieda," the first German tank captured, and though it appears to be of similar calibre to the 6-pdr. shell, there is no mistaking it, for it has a nose fuze in place of a base one. My own theory is, though this is an assumption, that in the "fog of war" and the hurly-burly of the fight, our male tank mistook one of our female tanks for a German machine and fired on her. Nevertheless the next report I will quote may be right, though the description of the German tank is altogether wrong. It is the report of the Fourth Army intelligence, dated April 26th, 1918.

"The Germans appear to have used both tanks captured from us and a new tank of their own in the attack on the 25th [Error for 24th.] Their employment of our tanks is established by the fact that tank No. 2606 A Coy., 1st Battn., 3rd Bde.

Tanks, was put out of action by a shell which has been identified as one of our own six-pounders fired by an enemy tank.

" The following description of a German tank is furnished by a corporal of the 23rd Infantry Brigade observers and confirmed by one of the observers. They were at the road fork in O.35.c. and observed the tank manœuvring in U.5.b. They were about 400 yards away from it. The tank is not at all the same shape as our tanks ; it moves at about 8 to 9 miles per hour. It is over 10 feet in height and 9 to 10 feet wide. They say ' it looked enormous.' It was painted bright grey, and had two turrets and was flying a red and white flag from each turret. Each turret had two loopholes and there was a large loophole in the body. It was firing machine-guns, and one of them believes small shells as well. The guns were not visible ; no wheels or caterpillars could be seen, and both men say it reminded them of a tortoise. An officer of the Tank Corps says it reminded him of a tin hat.

" The attached sketch is a copy of one made by the observer."

I will not attempt to reproduce the sketch, but it looks like the rear end of a squatting rabbit drawn by a child of five, the animal's ears represent the turrets (incidentally, the German tank had none), with a red and white flag stuck into the tip of each.

History supported by eye-witnesses is generally believed to be reliable. In my opinion, as no two pairs of eyes ever see the same thing, such history is little more than romance. Whether this applies to law as well as to war I am unable to say, but if it does, then most people who are sent to jail must be as innocent as the babe new-born.

At length, when the German prisoners came in, we were able to flatten out several obscure points. From their statements we discovered that seven tanks were allotted to the 4th Guard Division and four to the 77th Reserve Division, and that the objective of the seven was the Fouilloy-Cachy road. The most reliable information (this was proved to be so after the capture of the " Elfrieda ") was given by a prisoner of the 1st Sturmpanzerkraftwagenabtheilung (short for German Tank Corps). Amongst other things he said :—

" Every man in the tanks gets an Iron Cross. A demonstration was arranged for von Hindenburg, during the progress of which an attempt was made to cross a shell hole eight feet in diameter. The tank got ditched and had to be pulled out by another one. He stated that Hindenburg was reported to have said, ' That the tank would not be much good, but might be tried.' Two mechanics go with the tank into action. Loops for holding on to are provided for the crew. Training ground for tanks was at Charleroi. Roads were adhered to as far as

possible, and bad ground is never attempted. That the total weight of the machine is 45 tons. That one tank got 'bellied' on a raised footpath in a street in Charleroi. That his tank, the 'Elfrieda,' has turned completely over on its side, due to running with one track on a bank from three to four feet in height."

Further enquiries resulted in ascertaining the exact position of the recumbent monster. It was at point U.5.c.8.8, some 50 yards from the French front line and about 200 yards from the Australian's right flank, but owing to the formation of the ground this spot was not overlooked by the German line.

On the night of May 2nd, Lieut. Barnsby, *officier technicien* of the Groupeenent 2, French Tank Corps, went out and inspected the tank by means of an electric torch. In his opinion it would be extremely difficult to salve the tank until the line had been advanced. To do so, it would be necessary to employ four Mark IV tanks with eight towing ropes, one dozen coupling shackles, one dozen full-size sleepers, one dozen half-sleepers and three dozen sacks. The work, he calculated, would take anything from two to twelve hours and would be most difficult except in daylight.

This information and the knowledge that the tank, now known to be the "Elfrieda," was not under the immediate fire of German rifles, proved too strong a temptation for Major-General H. J. Elles, G.O.C. Tank Corps, and I think it was on May 3rd, or perhaps the 4th, that he, accompanied by the Brigade Major, 3rd Tank Brigade, and a tank engineer officer, sallied forth in broad daylight to examine the machine. All went well on the outward journey, but shortly after they had set forth on their return all went wrong, for some German riflemen had meanwhile crept up to a small rise from which they commanded Elles' line of retreat. "Zip," went a bullet and "zip, zip, zip" went several others. Whereupon Elles and his companions had no option but to run. Fortunately the hundred yards or so back to the allied line was well sprinkled with shell holes, and from one to another they bolted; the engineer, one of the most gallant officers in the Corps, breathing forth a "Holy God!" each time he threw himself into a friendly crater. How it came about that they were not hit is hard to say, but the fact remains that they all got back safely, with no loss other than a good deal of breath. That night there was much merriment in the Tank Corps mess at Bermicourt.

"Fear Naught" was the chosen motto of the Corps, so undaunted by enemy or darkness. A day or two later a party of Tank Corps engineers, accompanied by tanks and tackle, crept out under cover of night to bring in the "Elfrieda." That after many hours' work, during which silence was imperative, seeing that the first suspicious

noise would have brought down a hundred guns upon them, they accomplished their object remains to me one of the most remarkable feats in engineering carried out by these exceptionally gallant and skilful men. The "Elfrieda," which, as the prisoner had stated, weighed some 45 tons, was lying on her side, and consequently had to be righted before she could be moved. The whole work had to be done in almost complete darkness, in No Man's Land, and at no great distance from the German line.

This brief history would hardly be complete without further reference to the action of the seven Whippet tanks of the 3rd Tank Brigade which, at 10.20 a.m. on April 24th, were ordered forward to clear up the situation east of the village of Cachy. Each of these machines was manned by one officer and two other ranks, 21 officers and men in all. They debouched from the north of the village and made for the spur which juts out east of it towards Hangard Wood. On reaching this spur, they found it strongly occupied by light machine-gun groups in shell holes, whilst farther down the slope a force, estimated at three battalions of Germans, was seen forming up in the open. Such an opportunity seldom presents itself in war, and down rushed the seven tanks at top speed, some ten to twelve miles an hour, upon their prey; 21 men behind armour against three battalions in woollen jackets. In man-power the odds were terrific, probably 75 to 1, but in machine-power these numbers must be reversed, for the Germans had not a chance to escape. Before they could scatter, the machines were amongst them; but in place of dwelling upon the horrors which resulted, I will let the cold words of the Tank Corps' report to G.H.Q. describe what happened.

> "The tanks during this engagement fired between 600 and 800 rounds S.A.A. apiece at ranges varying from 10 to 100 yards. I have closely questioned officers who took part in this action and cannot reduce the enemy's casualties below 400. Tanks proceeded from shell hole to shell hole and also ran down a number of the enemy who attempted to escape. The enemy's attack naturally did not materialize . . . [our] total casualties are 5 officers and O.R.s."

From the Tank Corps Intelligence report of April 26th, we learn that:—

> "A prisoner of the 77th Reserve Division stated that he saw the attack of the British Whippet tanks on two or three companies of his regiment, which were in a forward position east of Cachy (prisoner himself was at that time with the Support Battalion). He states that he saw the Whippet tanks firing on and running over the men of these coys.; he thinks they were all destroyed as none appeared to get back; he could, however,

only see a certain distance and could not follow the movements of the Whippet tanks against other companies located further south."

Once the enemy had been slaughtered, the seven Whippets cruised about until our infantry had consolidated the position won; it was during this covering operation that four of the tanks were hit by shell fire, one being badly damaged and three slightly.

The three surviving machines were not, however, destined to rest for long, for at 5.30 p.m., on the 25th, they were ordered forward again to clear up the situation in front of the 58th Division. On approaching the enemy's trench, which was strongly held, a terrific machine-gun fire was opened on them; nevertheless they did much execution, "not a man escaping from the heavy fire directed upon them by the Whippets," so the battalion report states.

The 24th of April, 1918, seems far away now, few pondered over its events at the time, many have forgotten them since; yet it was truly an historical day, not only in the history of the Royal Tank Corps and the British Army, but in the history of war itself. On this day tank met tank, and tank met infantry. The first of these meetings was a unique event from which nothing much can be learnt, but about which much will have to be before long. The second was remarkable in that it was the first occasion upon which our own infantry were attacked by tanks, clumsy, cumbersome machines which had failed to negotiate a footpath in Charleroi—blunderbuss tanks compared to the present-day rifle ones. The Australians broke before them just as the Germans had done at the battle of Cambrai, and the Australians are probably the staunchest offensive infantry in the world. Seven tanks, also crude compared to those we now know, manned by 21 officers and men, overran 1,200 to 1,500 infantry and slaughtered 400 of them (some accounts put the figure at 1,000), and at a cost of five men killed and wounded. If this is not a weather-cock to show which way the wind of future warfare is likely to blow, then nothing has been learnt from this engagement.

MILITARY ENGINEERS IN THE BOMBAY MINT.

By MAJOR D. FITZJ. FITZMAURICE (R.E. *retd.*).

THE first military engineer whose name is mentioned in connection with the Bombay Mint was Captain (afterwards Major) John Hawkins of the Bombay Engineers, who designed and constructed the present Mint. The building was commenced in 1824 and finished in 1829, on a site forming part of the Mody Bay Reclamation Scheme, close to the Dockyards and Arsenal. Hawkins was never Mint Master, but he continued to hold the position of Mint Engineer ; the Mastership being in those days vested in a civilian, " one of the Chief Financial Officers."

Previous to the construction of the " new " Bombay Mint, the work of coinage had been carried on in the old Bombay Mint by a " Mint Contractor," whose operations were supervised and controlled by a Mint Master, an Assay Master, and the Mint Committee, who were Administrative Officers of the Territorial Department (Finance). The Bombay Government was supplied with drawings of the machinery in use at the Madras Mint as early as 1812, when there were also Government Mints working at Calcutta, Benares and Farukhabad ; the Mint Master, Madras, also furnished a copy of his code of rules, but there is no record of the services of any military engineers in connection with minting in Bombay prior to Hawkins. At Broach there was a small copper mint, in charge of the Collector ; and the East India Company had a mint in Poona.

The capacity of the Bombay Mint has been added to from time to time in the last hundred years, and gold and silver refineries have been built, but the fact that the original quadrangular buildings are in use to-day with only minor alterations, the layout of the various departments having been skilfully arranged to facilitate the passage of the bullion from process to process, is a lasting memorial to the credit of Major John Hawkins, F.R.S., of the Bombay Engineers.

Hawkins was Inspecting Engineer of the Bombay Presidency and was given the additional appointment of " Mint Builder," which, on completion of the building, was altered to Mint Engineer. He was a tireless worker and a willing horse ; when his mechanics and millwrights were sick (or drunk) he did their work with his own hands rather than allow any delay to occur. As the machinery was erected so the work of training his assistants and some dozen apprentices, and the instruction of a number of soldier artificers, fell on his

shoulders. In addition, three steamboat engineers were placed under his orders, and he was liable to be called away from work at the Mint to carry out his duties as Presidency Inspecting Engineer.

It should be realized that the industrial applications of steam power were still in their childhood in India, and that the "New Mint" was equipped with its steam engines at the same time that the first railway worked by steam locomotives was opened in England. A knowledge of the science and practice of steam engines was therefore a great asset, and it is for this reason that we find Hawkins called away from his mint duties "with six of our best machinists and several of our best natives" to instal the engines of the East India Company's steamship *Hugh Lindsay*. This work lasted four months, working overtime and holidays. It was quite common for the mint engineers and mechanics to be called upon to undertake work for the Navy, the Dockyard, the Arsenal and the Gun-carriage Factory.

In April, 1829, Lieut. F. McGillivray, of the Engineers, was appointed personal assistant to Major Hawkins, and his duties extended outside the Mint to assist Hawkins in all his operations connected with the application of steam power. McGillivray was deputed to Calcutta for a few months in 1830 "to obtain information regarding steam vessels." On the 6th July, 1831, he was appointed Mint Engineer, Hawkins having died on 20th February, 1831, after being invalided home at short notice.

During McGillivray's absence in Calcutta in 1830, Lieut. H. Blois Turner, of the Engineers, was appointed as assistant to the Mint Engineer, a post which he held until he succeeded McGillivray as Mint Engineer in March, 1838.

Attempts had been made by Lieut. Geo. Fulljames, 2nd Assistant to Hawkins, to provide the Mint with water by means of sinking boreholes, but without success. For water the Mint relied entirely on the supply in the large circular tank in front of the Mint building. This was fed by a ditch which brought rainwater to it in the monsoon, and at Hawkins' instigation a breakwater was constructed to prevent sea water from reaching the ditch. That the Mint tank was the envy of neighbouring eyes is seen from a letter from the Acting Persian Secretary to Government, dated Christmas Eve, 1830, requesting that water might be pumped from the Mint tank to allay the dust, which was "completely destroying the handsome and expensive furniture" in his office, opposite the Town Hall.

McGillivray, as Mint Engineer, continued to train apprentices and soldier artificers; and, at the special request of the Superintendent of the Indian Navy, permission was accorded to two young men (natives) "to attend at the Mint, for the purpose of making themselves acquainted with the general usages and particular duties of the steam machinery." He also carried out the repair of the Dockyard

steam engines, when required, and spares for steam vessels were stored in the Mint.

The appointment of 2nd Assistant to the Mint Engineer was revived on 12th April, 1834, when 2nd-Lieut. John Skirrow, of the Engineers, joined the Mint. He was succeeded on 1st March, 1836, by Lieut. James Cruickshank, of the Engineers. Lieut. Fulljames returned to the Mint for a period of one month, December, 1837, to January, 1838.

In March, 1838, McGillivray died, and was succeeded by his 1st Assistant, Captain H. B. Turner, of the Engineers. Turner had as his Assistants Lieut. J. Estridge and Lieut. Wm. T. Suart.

In 1840, Bazette Doveton, Civil Auditor and Mint Master, was succeeded by W. C. Bruce, Esq., who held the Mint Mastership only till 1841, when E. E. Elliot, Esq. (previously General Paymaster and subsequently Accountant General) was appointed Acting Mint Master. A good deal of dislocation was undoubtedly caused by such frequent changes, and Captain Turner put up a memorial proposing that the system current in the new Calcutta Mint from its inception, and since 1840 in Madras, namely, the amalgamation of the posts of Mint Engineer and Mint Master, should be adopted also in Bombay. It is clear from a perusal of the old correspondence that a great part of the functions of the Mint Master in Bombay had been that of a forwarding agency for reports originating in the Mint Engineer's office. We find Elliot, for instance, as Civil Auditor, addressing a letter to himself as Mint Master, asking for particulars of the pensioners whose names are borne on the Mint books, and then as Mint Master minuting the letter on to the Mint Engineer to supply the required information. It was not, however, until 1853 that the four offices of Mint Master, Deputy Mint Master, Mint Engineer, and Assistant Mint Engineer were combined in one in the person of Captain James H. Burke, of the Engineers. The Mint Committee, which had been revived at the instance of James Farish, Esq. (Civil Auditor and Mint Master, 1830–1836), continued to control the operations of the Mint Master. Retiring Mint Masters were generally placed on the Committee, and must often have been a thorn in the flesh of their successors.

On Turner's resignation owing to ill-health, the following very appreciative letter was penned to the Mint Master by the Secretary to the Bombay Government :—

" Sir,

" Captain H. Turner having obtained leave in the Military " Department to proceed to Europe on Sick Certificate, the " Hon'ble the Governor in Council has directed me to convey to " you the expression of his regret that the state of that officer's " health obliges him to relinquish the office of Mint Engineer and " deprives the Government of his valuable services in an Estab-

"lishment with which he has been connected during a period of "nearly seventeen years.

"2. The Governor in Council has on several occasions noticed "Captain Turner's services in distinct terms of approbation, but "he is aware that there is much in the conduct of the extensive "Establishment over which he presided which could not be "brought prominently to view, while the regularity with which "the working of the Mint has been carried on, the preservation of "good order and discipline among the machinists, the entire "absence of all complaints, and the quiet surmounting of all diffi-"culties show that Captain Turner's management has been "eminently successful.

"3. Captain Turner's zeal and energy have not been confined "to the Mint. His exertions in erecting the steam factory and "setting up its machinery have been favourably noticed by "Government, and were declared by the Hon'ble Court to reflect "the highest credit on that officer. And it is well known that on "the institution of the Board of Conservancy, of which he was "one of the first members, he zealously assisted in bringing that "newly constituted body into order, and contributed to the "beneficial results which have arisen through its agency in the "improvement of the town and island of Bombay.

"4. The Hon'ble the Governor in Council will not fail to bring "Captain Turner's services to the notice of the Hon'ble Court.

"I have the honour to be, etc.,

"(Signed) G. J. NEMESDEN,

"*Acting Secretary to Government.*

"Bombay Castle, 30th August, 1847."

On 1st November, 1847, Lieut. James H. Burke, of the Engineers, assumed charge of the office of Mint Engineer in compliance with a Government order of 12th October, 1847, taking over from Lieut. H. W. B. Bell, of the Engineers, who had been appointed Assistant Mint Engineer in August, 1847.

Continuity of policy, coupled with an ever advancing evolution of minting processes, had been ensured in the Bombay Mint by the long tenure of office of three Mint Engineers, Hawkins, McGillivray and Turner. The Mint Mastership had changed hands no less than seven times in the same period. Burke was destined to hold the offices of Mint Engineer and Mint Master for a total space of fifteen years.

Burke was advised by his doctor to take two years' leave to Australia for the recovery of his health, and although he postponed his departure, he had eventually to comply with the medical recommendation, so that in 1857 we find Col. H. B. Turner back in India, as Acting Mint Master. Before his arrival, the Mint Mastership was held for a short period by Captain W. F. Marriott (Secretary, Military Board, P.W.D., Military Department); and in 1858 we find

Lieut.-Col. J. H. G. Crawford, Consulting Engineer to Government for the Bombay Waterworks, acting as Mint Master: while later in the same year the post was held by Captain Wemyss, Engineer to the Dockyard. In 1857, Col. Turner had recommended the establishment of a new copper minting department in the Bombay Mint, and on sanction being given for the necessary expenditure, he returned to England in 1858 as Inspector of Construction (Machinery). The six new coining presses were made by Jas. Watt & Co., and were ready at the end of 1859, when Turner travelled back once more to India. The new additions to the buildings were commenced in 1860, when Burke had once more resumed charge of the Bombay Mint.

A heavy demand for coinage ensued, and it is interesting to note that Burke had to apply through the Mint Committee to Government for sanction to employ his operatives on overtime to meet the demand. The coinage programme was very variable, depending as it did on the tenders of bullion by the public, the activities of the Mint consequently falling off during the monsoon, when bullion could not be landed safely. Extra-time pay was agreed to for the operatives, but the peons were left out. Burke had this put right, stating that the peons "were not engaged on the understanding that they should guard the Mint day and night."

Burke would apply to the Town Major for a suitable military guard to escort the bullion from Mazagaon Dock to the Mint, the necessary boats, carts and coolies being provided by the Commissary General's contractor. This individual could generally be expected to produce half the carts, and one-third of the coolies requisitioned.

One hot weather, Burke was asked to allow a fire engine to pump fresh water from the Mint tank to water the parade ground of the European Lower Barracks. He regretted his inability to accede to this request, pointing out that until the anticipated pipe-line from Lake Vehar Waterworks was connected, the activities of the Mint were dependent on the supply in the tank, which would not be renewed until the monsoon broke, and that "last year the water was so low and so putrid that even the cat-fish died." Some of Burke's letters are humorous reading. Here is one of the 17th September, 1860, in reply to a request by Captain Southey, Garrison Engineer, that the contractor for the new Mint buildings might be permitted to keep in the Mint compound at night two buffaloes employed for *chunam* grinding.

"My dear Southey,

"I should have great pleasure in complying with your request "regarding the two buffaloes being kept in the Mint compound "at night; but I have to assure you that such a breach of discipline "cannot be allowed; inasmuch as it would be but a stepping-"stone to other abuses, moreover a man would have to remain

" with them, and all three would be liable to be shot at any hour " by the sentries.

" You have no idea what scoundrels these natives are, and so if " I feel compelled to decline accession to your request, do not be " offended, please. The contractor can keep his animals where " he chooses, and have access at any reasonable hour in the morn- " ing, up to any reasonable hour in the evening, to his work ; but " during the night, not a rat, if I could help it, should remain on " the Mint premises, and on this point there cannot be any sur- " render. . . .

" Believe me,

" Sincerely yours,

" J. H. BURKE."

The most famous of all the Bombay Mint Masters was Ballard. Lieut.-Col. J. A. Ballard, C.B., came to the Mint from the P.W.D. early in 1862, as Mint Master and Currency Commissioner. He held the appointment for the record period of 17 years. Outside the Mint his name is perpetuated in the Ballard Pier and Ballard Road, flanking the Mint and leading to the Ballard Estate, for it was Ballard's foresight and acumen as Chairman of the Port Trust, that noted the possibilities of an extensive reclamation of the foreshore to the north-east of the Mint, coupled with the building of an ocean quay to accommodate the largest liners afloat.

Ballard's assumption of office in the Mint coincided with a period of very heavy demand for coinage, the tenders of bullion being actually heavier than the Bombay Mint could deal with in a reasonable time. At the end of 1863, Ballard was compelled to ship bullion to Captain H. Hyde, R.E., Master of the Calcutta Mint, and to Lieut.-Col. J. Carpendale, R.E., Mint Master at Madras. The warm approbation of Her Majesty's Government was conveyed to Ballard and his establishment for their untiring zeal in coping with the exceptionally heavy pressure of work.

The year 1862 also saw the introduction of the new rupee, bearing on the obverse, the inscription " Victoria Queen " and the crowned head of the sovereign ; while the reverse no longer bore the inscription " East India Company."

In 1863, the Mint Committee was finally abolished, and all its duties and functions were placed in Ballard's hands.

By the early sixties the cost of living in Bombay had risen out of all proportion to the salaries and wages enjoyed by Government servants and employees, and the Government of India was taking measures to alleviate the hardships of the position. The report of the Commission of Inquiry into Prices was published at long last in November, 1863, and established the fact that in the last 15 years, rents had trebled for first-class accommodation, and doubled for second and third-class houses. Ballard went straight to the point,

and applied for quarters for the Mint mechanics. The proposal hung fire, and it was not till three years later that a measure of satisfaction was given in the form of a grant of housing allowance. Some concessions were given to workmen in the form of accident compensation—and gratuities to old employees on discharge. Labourers' wages had risen considerably, this factor having always been controlled by supply and demand. Whereas thirty years previously rough labour was recruited in the market at Rs. 5 per mensem, the rate had risen by 1863 to Rs. 8. It was the European and superior native classes who felt the pinch most, and that considerable dissatisfaction still existed was shown by Government calling in 1865 for a report, covering the previous five years, showing the number of men who had " resigned their appointments in consequence of the rise in prices and the offer of more lucrative posts elsewhere."

In January, 1866, Lieut.-Col. J. Harley Maxwell, R.E., from Calcutta, was appointed to officiate for Ballard, and continued to press the question of provision of quarters for the Mint Staff. Seventeen months later Captain E. C. S. Williams, R.E., from the P.W.D., was officiating, as Maxwell was on furlough. Although he served for only a short time in the Mint, Williams was responsible for an interesting and comprehensive report to Government on the Mint establishment, embodying practical proposals for proportioning the numbers of permanent and temporary hands.

Ballard, after officiating as Mint Master, Calcutta, resumed charge of the Bombay Mint on 26th December, 1867. His proposal, as Commissioner of Currency, for the issue of silver token coins of reduced fineness of the denominations of half, quarter and eighth rupee, was turned down by Government as being a debasement of the coinage. There was, of course, a large copper currency at this time, which was in itself a token coinage, rated at about double its metal value. But, as Ballard pointed out, a copper currency lacks portability, and, although showing a profit to Government, is expensive to coin, sixty-four blows of the coining press being required to produce a single rupee's worth of quarter annas, apart from the labour of the preliminary processes. It is interesting to note that Ballard's proposal has since been adopted in a different manner by the issue of cupro-nickel token coins for the smaller denominations, and that at the ruling price of silver in 1930, the whole of India's currency consists of coins whose intrinsic value is far below their face-value, this bringing her into line with European countries.

As Ballard said :—" An article of low value may serve its purpose " better than one made of more costly material. If the public " fountains of a town were supplied with silver drinking ladles, the " thieves would benefit but the public would regret the change from " iron. The Indian money dealers benefit by the issue of small coins

" at their full intrinsic value, but the public would prefer an article " less liable to be withdrawn from circulation."

At this time the importation of gold into India was encouraged by the acceptance of sovereigns in payment of sums due to the Treasury; and Ballard wrote an interesting memorandum on the exchange rate at which sovereigns should be accepted, and also on the relative rates as between the gold mohur and the rupee.

Ballard took a year's leave to New Zealand from March, 1871, to February, 1872, and during his absence Col. J. Jones officiated for him as Mint Master. It was a slack year so far as coinage was concerned, and establishments were reduced. At this date the Bombay Mint came under the Presidency Administration, but in 1876 a change was made. A Government resolution, dated 18th May, 1876, reads: " Since the abolition of the Madras Mint, the duty of providing the " entire coinage of British India has been left to the Mints at Bombay " and Calcutta, and the importance of the Bombay Mint relatively " to that at Calcutta has been much increased by the opening of the " Suez Canal. The Mint at Bombay has hitherto been under the " immediate supervision of the Government of Bombay, while the " Calcutta Mint is under the Government of India. The manage- " ment of the Mints is intimately connected with the administration " of the finance, the distribution of the cash balances, and the " currency reserve, and the movement of the public funds generally.

* * * * * * *

" The Governor General in Council is accordingly pleased to declare " that the Bombay Mint shall be henceforth under the direct adminis- " tration of the Government of India. In making this declaration " the Governor General in Council desires to cordially acknowledge " the success with which the administration of the Mint at Bombay " has been uniformly conducted by His Excellency the Governor " in Council at Bombay."

There followed a period of famine, and an accompanying heavy demand for small coinage, mainly 2-anna pieces. The exceptionally strenuous work at the Mint was efficiently coped with by Lieut.-Col. John Hubbard White, R.E., who was appointed from the P.W.D. to officiate for Ballard, who had proceeded to England on furlough in May, 1876. White's work was the subject of a very appreciative letter from Government, the Governor General in Council acknowledging with satisfaction the success which attended Lieut.-Col. White's management of the Bombay Mint during the year 1877–78, a period of much labour and anxiety.

On Ballard's return to India in January, 1878, he was at once deputed to Calcutta for two months to confer with Col. J. F. Tennant, R.E., the Mint Master there, prior to advising Government on important currency questions, and a year later, February 7th, 1879, he handed over charge of the Bombay Mint, with which he had been

connected for seventeen years, and proceeded to Europe on retirement.

General Ballard was succeeded by Lieut.-Col. J. H. White, R.E., who held the post of Mint Master for 10 years. He had previously been Deputy Consulting Engineer for Railways, and Under Secretary to Government (Railway Branch). After the fluctuations of previous years, the coinage programme during White's tenure of office remained comparatively steady, and advantage was taken of this state of affairs to investigate closely technical questions affecting the efficiency of the Mint, and the losses inherent to the Melting and Mechanical Departments. The estimation of losses necessitated accurate valuation by the Assay Office of the bullion tendered for coinage, and that there was room for improvement in the method of taking musters, or samples, for assaying, is shown in Col. White's report for the year 1885–86.

> "In former years the greater portion of the bullion tendered "to this Mint was tested by cutting off small pieces of silver from "the corners of the bars, which pieces were then run down in a "crucible, from which a muster was taken out and sent up to the "Assay Master for report: on the report of this muster the whole "bar was valued. Now the bar itself is melted; the bars are "run down generally five or six together in one pot, and from this "pot containing 12,000 to 22,000 *tolas* of molten metal, a muster "is sent up for assay, the touch of which fixes the value of all the "bars in the pot. This is a more accurate method."

The new type of lever coining presses was introduced for the first time in 1886–87 but General White still preferred the old screw presses which were installed between 1861 and 1865, had turned out eight million coins with only trifling repairs, and were still in most excellent condition. That his preference was justified is borne out by the fact that these same screw presses are in use at the present day, although seventy years old.

In 1889, Major-General White was succeeded as Mint Master by Lieut.-Colonel Robert Vansittard Riddell, R.E., who came to Bombay from the Calcutta Mint. He had previously officiated as Master of the Bombay Mint from 12th October, 1882, to 5th January, 1883, and from 3rd May to 31st December, 1883. As the extent of the silver coinage rose to 745 lakhs in 1889–90, and to 930 lakhs in the following year, the working of the Mint showed a very considerable profit from Seigniorage charges, but much speculation in the precious metals was rife, and in 1892–93 the silver coinage fell to 450 lakhs. In 1893, the unrestricted coinage of bullion tendered by the public was stopped, and Government hereafter controlled the quantity of coin put into or withdrawn from circulation, a system which has remained in force to the present day.

It was the custom for the Senior Mint Master to issue an annual review of the administration of both Mints and Assay Offices, and to forward the detailed reports to the Secretary to Government of India, Finance and Commerce Department. Col. Riddell reports that "an "experiment was tried during the year to ascertain whether, when "gold existed in fairly large quantity in silver, it could be separated "with profit. A number of Burma peacock rupees, in which there is "more gold than in the silver ordinarily received at the Indian Mints, "was sent to the India Office and treated for gold by the bullion "brokers of the Bank of England. The results proved that no profit "could accrue from such transactions, and it has been shown that "refineries cannot profitably be established in connection with "the Indian Mints: the experiment of treating silver for the separa-"tion of gold will probably not be repeated." Col. Riddell's deductions in this connection were true enough in 1890, but forty years later we find a modern silver refinery installed at the Bombay Mint, where considerable quantities of gold are recovered as a by-product of the refining of rupees. It was calculated that gold to the value of £27,000 odd existed in the silver coined in Calcutta alone during the year 1890–91.

In 1895 Major (later Col. Sir) B. Scott, C.I.E., R.E., was appointed Mint Master. He held the post until 1897, but most of his time was spent on furlough, and he was succeeded by Major G. Davidson, R.E., who had officiated for him during the greater part of his absence. Scott took over the Calcutta Mint as Senior Mint Master. There being no coinage on Government account, a part of the plant at Bombay was converted in 1895 to meet a demand for British, or Hong Kong dollars, a demand which continued mildly but steadily for the next six years.

During the first four years of Davidson's tenure of office, the coinage programme was small but steady, and the staff of the Mint was accordingly cut down. A considerable quantity of small silver pieces was demanded for famine districts in 1896–97, and in the following year the Mint commenced recoinage into Government of India rupees of the silver coinage of certain Native States. A coinage of copper pice for the British East Africa Protectorate was also initiated. A sudden change in the Government coinage programme ushered in the new century. The report of the Secretary to Government states:—"The year 1900–1901 was a remarkable "one in the history of the Mints. For over six years, from the "latter part of 1893 to the early part of 1900, the work of the Mints "had been comparatively light, and establishments had been "reduced: they were then suddenly called on to face a year of work "heavier than that of any year in their history. New workmen had "to be engaged and trained by the small staff of trained men on the "establishment. With a full complement of skilled and trained

" labour a heavy rupee coinage requires at all times most watchful " and careful supervision, and with a large element of imperfectly " trained labour the strain thrown on the whole staff and the diffi- " culty and responsibility of successfully carrying through the heavy " coinage were very great. All these difficulties were cheerfully " faced and successfully overcome; and the results of the year are " regarded with great satisfaction by the Government of India. His " Excellency the Governor General in Council desires to place on " record his high appreciation of the most excellent work done by the " officers and the members of the establishments of the Mint and " Assay Departments. He wishes to convey his special thanks to " Col. Scott, Major Davidson and Col. Porter, the Masters of the " Mints, and to Col. Milne and Col. MacCartie, the Assay Masters." The coinage in Bombay reached the figure of Rs. 1,114 lakhs.

Lieut.-Col. G. M. Porter, R.E., was appointed Mint Master, Bombay, and took over charge from Major Davidson in 1902. The heavy demand for coinage abated, and advantage was taken of this to withdraw from circulation and re-coin the first two issues of 1840 "Victoria Queen" rupees. British dollars for Hong Kong, and re-coinage for Native States, continued to provide employment for the Bombay Mint. On January 1st, 1903, the King Edward VII. rupee was first issued, and in the same year a Straits Settlements dollar was struck, of the same weight and fineness as the Hong Kong dollar, but of 1-16 in. smaller diameter.

Major W. G. R. Cordue, R.E., succeeded Col. Porter as Mint Master, Bombay, in 1905, and held the appointment for five years. During his time the demand for British Imperial Government silver coin rose once more, the Bombay out-turn reaching in 1906–1907 the new record total of 1,607 lakhs rupees in value. In 1905–06 the output of the Indian Mints was 3-8ths of the sum total of all other mints in the world. Such a heavy coinage meant much hard work and constant care and attention to detail on the part of all the staff; many repairs to machinery, installation of new cutting and coining presses (made in the Mint workshops), apart from the normal maintenance and repair of buildings carried out under the supervision of the Mint Master and staff, acting for the P.W.D.

In 1906–07 a great improvement was made by the installation of electric lighting and fans, and indeed it is difficult nowadays to visualize the conditions under which our prodecessors laboured without such " modern improvements."

In the same year the Government of India approved the design for the new nickel 1-anna piece, with scalloped edge. This scalloped edge was the subject of much argument, many experts maintaining that the manufacture of such a coin was impracticable. Captain A. L. C. McCormick, R.E., who officiated for Cordue in 1905–1906, was convinced of the possibilities of the coin, and it was due to his

representations that the new coin was launched into circulation. To the skill and perseverance of the Mint engineers is due the surmounting of the mechanical difficulties of manufacture.

In April, 1910, Major A. L. C. McCormick, R.E., took over charge of the Mint from Lieut.-Col. Cordue, and in the following year he instituted enquiries as to the costs of replacing the existing steam power plant of the Mint by electric drive. The electrification of the Calcutta Mint had been satisfactorily completed, and the old steam engines at Bombay were more than due for replacement, and had given a good deal of trouble during the years of heavy coinage. For the time being, however, the electrification question was dropped, and was not revived till 1914.

In 1911, the first issue of King George V. rupees was made. This issue was noteworthy on account of objection being raised by the Mohammedan section of the community to the design of the small elephant appearing on the obverse. The beast's trunk was alleged to be too short and snoutish, giving it a general hog-like appearance and thus causing offence. It was withdrawn from circulation, and subsequent issues were struck from new obverse dies in which the noble beast is provided with a truly elephantine trunk.

1911 was also the year of the Coronation Durbar of their Majesties King George V. and Queen Mary at Delhi. Over three and a quarter million Durbar medallions were struck in the Bombay Mint, in four months, for distribution to students and pupils of educational establishments on Durbar Day. Special machinery had to be made in the Mint to cope with this work, which gave employment to some 400 men and boys.

Captain (now Col. Sir) George Willis, R.E., joined the Bombay Mint in November, 1907, and was transferred to Calcutta in 1908, where he officiated as Mint Master for two years, 1909–1911, and carried through the electrification of the Calcutta Mint machinery. He officiated as Master of the Bombay Mint during the last six months of 1912, when he was again transferred to Calcutta, rejoining the Bombay Mint as Master in March, 1915, after a short period in England. While at home he made a report to the India Office on the subject of electrification of the Bombay Mint.

In July, 1914, McCormick had again put up to Government an electrification proposal and estimate, embodying a report on the state of the existing steam plant and the cost of renewals prepared by Captain R. E. Stace, R.E., who had joined the Bombay Mint as Deputy Master on 23rd March, 1914. Administrative sanction was accorded to the scheme, and Stace was entrusted with the preparation of the necessary specifications. Stace was, however, recalled to military duty in November, 1914, and the project was placed in the hands of Major Willis, who was specially fitted to carry it through after his experience of similar work in the Calcutta Mint.

The British Empire was now, however, involved in the Great War, and the energies of the Mints were directed to special War work, in addition to an increasingly heavy coinage programme. Electrification had to be dropped once more, for not only was the time unsuitable for carrying out the work, which would involve a stoppage of the Mint's activities, but prices of machinery were in a very unstable state, and deliveries could not be guaranteed.

The Government of India silver coinage programme reached unprecedented figures during the War, the value of the Bombay output (mostly whole rupees) being :—1916–17, Rs. 1,453 lakhs ; 1917–18, Rs. 1,395 lakhs ; 1918–19, Rs. 2,457 lakhs. In addition, coinage was carried out for Egypt, and the Straits Settlements, and nickel one- and two-anna pieces for the Government of India.

This period of exceptional stress coincided with a shortage of superintendents and engineers, due to the calls of military service and to ill-health ; there was also a scarcity of labour, due to the very busy state of industry in Bombay. The period closed with a strike in 1919, attributable to work-weariness and affluence after much overtime, the Mint having been putting in 20 hours daily in two 10-hour shifts.

The demand for silver coinage continued to be very heavy in 1919–20, when Rs. 2,091 lakhs were minted in Bombay. Nickel 8-anna and 4-anna pieces were also struck, but these denominations have subsequently been discontinued. Small coinage for Ceylon and the Straits Settlements was carried out in addition.

The outstanding features of the War work carried out by the Bombay Mint under Major Willis were :—

(*a*) *Direct War Work.*—Including melting and casting copper into slabs, and pressing out into driving bands for shells from 7·5-inch down to 13-pounder. Some three-quarters of a million driving bands were turned out.

Manufacture of standard gauges of all sorts for rifle and shell manufacture, the working gauges being made by the factories concerned from the standards supplied by the Mint.

Manufacture of aim detectors and other small gadgets.

Building of some 60 ambulance and other motor bodies, fitting the ambulances with stretchers, and training large numbers of Indian motor drivers.

(*b*) *Indirect War Work.*—Enormous quantities of gold in ingot and coin from all parts of the world were handled by the Mint on behalf of the Bank of England as well as the Indian Government. After the Germans captured the *Appam* carrying gold from South Africa to New York, no more gold was sent that way. It was shipped to the Bombay Mint from Durban.

In 1919 Willis built and equipped a gold refinery employing the chlorine process, which refined large quantities of raw gold from

South Africa and the Indian mines, as well as gold coin. During the year 1919–20 nearly two million *tolas* of gold were refined.

In August, 1918, a branch of the Royal Mint was opened in an enclosed corner of the Bombay Mint compound. This was built and equipped by Willis, and consisted of a stamping room, a weighing room and an assay laboratory: this work being done by a staff sent out by the Royal Mint. The melting and casting into bars, rolling into straps, and cutting out of blank bits was carried out by Willis in the Bombay Mint. In all some 1,295,000 pieces were struck.

Previous to the opening of the branch Royal Mint, the coinage of gold mohurs, of sovereign weight and fineness, was sanctioned by legislation, and over two million pieces were struck at Bombay.

The Mint also sold on behalf of the Bank of England and the Government of India large quantities of both raw and refined gold. On one occasion an Indian buyer of some £75,000 worth of gold took delivery in the Mint and then deposited the bars on the steps of the main porch, whilst he and his peon departed to bring back victorias, leaving the gold entirely unattended. When asked why he was so foolhardy, he replied that he, like everyone else, had complete trust in the Mint, even to the steps outside.

Of all the very large quantities of gold which were conveyed from the Mint through some of the most turbulent parts of the town in open bullock carts or hack victorias, without any guard except a *ramosi* or two in addition to the owner and sometimes also his business agent, only one case of theft of one bar is known. What would have happened in Chicago, New York or even London? Before leaving the Bombay Mint, Colonel Willis spent some time in England on deputation, and on his return to India he built and equipped at Nasik Road the Security Printing Press, of which he is Master, for the production of postage and other stamps, and currency notes.

After the War, Major Stace returned to the Bombay Mint, and his first care was to get the electrification project on its feet again, and after much work in collating of data, he completed the general outline specification for the work in 1920. In accordance with Willis' original recommendation it was decided to ask selected firms to tender for the work, which was put in hand in 1921–22 and completed in 1923–24.

In the gold refinery he introduced the use of chlorine cylinder gas and improved the conditions of working by better evacuation of the noxious fumes.

In the melting department he introduced oil-fired furnaces, with preheating chambers, resulting in increased speed and convenience of working, and economy of fuel. During the War years drosses from melting had inevitably accumulated to a great extent, and Major Stace dealt with these partly by sale of the lower touch dross and partly by recovery in the Mint of the precious metal in the

higher touch dross. An amalgam pan was installed for the latter purpose. Major Stace was specially thanked by the Government of Bombay for his work on the Weights and Measures Committee, 1924–25. The difficulty of setting up standards of weight and measure throughout India is very great, and can only come about slowly.

Perhaps Lieut.-Col. Stace's greatest work in the Bombay Mint was the setting up of the electrolytic silver refinery, which is the most up-to-date and the largest of its kind in the world.

The object of building this refinery was to enable Government to reduce the large quantities of silver rupees in circulation and in reserve, the outcome of the very heavy coinage programme necessitated during the War years. Lieut.-Col. Stace went to England on deputation to obtain full information as to the latest methods. With the assistance of a well-known London firm of refiners who had lately installed a very modern equipment of their own, embodying the latest ideas from Germany and America, he worked out the project in all its details, and returned to India. A site was cleared in the Mint compound, the building was erected, machinery and equipment arrived from England and was installed, and the refinery was set to work in March, 1929. It is officered by a staff from the Mint, and the fine silver product is of a very high quality.

Stace was assisted by Captain (now Major) A. J. Ransford, R.E., who joined the Bombay Mint on February 4th, 1924, as Deputy Master on probation for one year. During this period Captain Ransford held charge of the Bombay Mint for the four months of Stace's absence at the Senior Officers' School; and in February, 1925, he proceeded to Calcutta to officiate for eight months during Major Stagg's absence on leave. On his return to Bombay, Ransford officiated for Stace from 1st November, 1925, to 1st July, 1926, during which period he rebuilt the Mint strong rooms. He spent a further eight months in 1928 at the Calcutta Mint, officiating for Major Stagg. He assisted Stace in the completion and setting to work of the silver refinery, and officiated for him for twelve months from May, 1929, when Stace proceeded home on leave.

Work in the mints demands a high standard of accuracy, and careful organization, coupled with a heavy responsibility. The work of Sapper officers in the Indian Mints over a period of more than 100 years constitutes a record of which the Corps may well be proud, and it is to be hoped that the Sapper tradition may continue unbroken for many years to come.

CHANGI, 1930.

By LIEUT.-COLONEL A. T. SHAKESPEAR, D.S.O., M.C., R.E.

IN September, 1929, an article appeared about Changi and its electric light. Since those days progress has been made; the electric light now comes from a more normal source, and supply is nearly continuous, but as for the rest of the Changi affairs normality has not been obtained. It is not politic to expose in this article some of the abnormalities, but a few of our experiences may be of interest.

(*a*) WELL-SINKING.

About a year ago, a start was made to sink a well to an estimated depth of 85 ft., with the idea that this would supply the water necessary for the whole cantonment. The site was carefully selected, a bore was taken and, in the opinions of an expert water engineer, an expert geologist, and ourselves, this well should have delivered the goods, viz., about 50,000 galls. a day. The results are an excellent example of the idiosyncrasies of well-sinking. The final output at the lowest level was about 2 galls. a minute, or 3,000 galls. a day. The failure of the well to produce water is not the most interesting part of the story, and it is still hoped by blasting and other processes to increase the output materially. The soil through which the shaft passed was normal clay and mould for about 30 ft., then an increased proportion of laterite was found; at 45 ft. down to 70 ft. a very liquid laterite and clay stratum was pierced, which received the local name of tooth-paste; it was of just about the same consistency as that useful toilet article. It was peculiar in the way that it was saturated with water, and yet in the strata below of white clay and sand mixed, there was hardly any water at all; in fact, it seemed almost impossible for the water to drain out of the tooth-paste. The well lining was of reinforced concrete 4 in. thick, and 6 ft. in diameter. The method of sinking selected by the contractor was to sink the lining under its own weight, casting consecutive 5-ft. lengths at the top as and when necessary. All went well till at about 50 ft. the lining began to jam. Although the excavation allowed a good clearance, and although the bottom of the lining was in tooth-paste, yet it refused to sink freely. The work got delayed for various reasons, the tooth-paste was continually rising up from the bottom of the

shaft, and time passed with little progress made. However, by loading the lining at the top, the contractor eventually got it down to 68 ft., where it stuck. It was then carefully examined ; it was found that the lining was seriously out of the vertical and cracked at the lower end, where it had got compressed to an oval shape. These defects had arisen chiefly from the slow progress of the work and from the subsoil flow of the tooth-paste. A water-logged stratum of decomposed granite on a firm rock foundation is liable to such a flow, although it had not been anticipated on this site. The site was on a flat slope at the head of a valley, and it was thought that the hard rock (granite) stratum, shown by the borehole to lie at a depth of 85 ft., would be practically horizontal. In fact, experience showed that, even in such conditions, the decomposed granite, saturated as it was with water, would flow downhill subterraneously, if given the opportunity. This tendency to flow distorted the lining of the well, caused the cracks, and produced the conditions which irrevocably prevented the lining being sunk farther. To avoid a total waste of the work already executed and to discover if the required water would be forthcoming at the bottom, the contractor asked to continue the sinking using a 4-ft. diameter lining. Under some rather complicated conditions dependent on the results obtained he was permitted to continue on these lines. More delay ensued, but eventually a couple of pre-cast linings were lowered into the wall and excavation continued. The work was still going on in the tooth-paste stratum, as some yards of that material had risen up the original shaft. For some reason which was not very clear, the 4-ft. lining, having sunk under its own weight reasonably well, suddenly refused to continue sinking. Three 20-ton jacks were fitted at the top of it, held down by stout timbers, and by these means a pressure of 30 to 40 tons was applied, pressing the 4-ft. lining downwards. Progress was made until one night with no warning the bottom of the well, the 4-ft. lining, excavators and jacks rose twenty feet up the shaft, breaking the timbers which had been holding the jacks down. At the same time a large cave appeared at the surface about 8 yds. from the top of the wall, 25 ft. deep and about 20 ft. in diameter. Obviously the ground through which the work had been carried on had been so messed up and had got so liquid that the top weight had thrust up the bottom of the shaft, more or less as happened in the Culebra cut of the Panama Canal, but of course on a very small scale. It was then considered too dangerous to continue with the work, but we had all counted without the *Kepala* of the Chinese well-sinking gang. We knew that if he got no results he would get no pay, so some days later he came to the contractor and explained that there was a devil down the well who was greedy ; apparently the devil spent his time eating the soil, and then, as it gave him a stomach-ache, he vomited up the well shaft. However, the Chinaman knows well how to deal with

devils, so he searched till he found a priest who would exorcise it for 30 dollars. The *Kepala* was quite confident that he could then go on and finish the job. The contractor agreed to pay the 30 dollars, but told the *Kepala* that if he carried on the work he must do so at his own risk. A ceremony involving many crackers and secret processes was carried out, and next morning the gang was hard at work sinking the 4-ft. lining again. Moreover, they succeeded ; they got the lining down to rock, sunk the bottom of it two feet into the rock to form a foundation, and corked the space with concrete between the 6-ft. and 4-ft. linings. So, obviously, the *Kepala* was right ; the devil was driven off or put to sleep. The question now is whether for another 30 dollars or so, the devil, when he has recovered from his previous treatment, will produce the water which is such an essential feature for a well, but is so noticeable by its absence at present. The *Kepala* thinks he will do it all right, and he knows more about such things than we do.

(*b*) ANTI-MALARIAL DRAINAGE.

The clearing of a virgin jungle and the drying out of marshy land in the tropics are both processes which are almost invariably accompanied by outbreaks of fever. The fact that no fever was experienced at Changi during the early days when this work was being done, was most creditable to those responsible for the work. The anti-malarial work was excellent, and it is doubtful whether similar work has been done elsewhere in Malaya on the same scale with such success. As this anti-malarial drainage is a common necessity in the tropics, but not frequently carried out by R.E. officers, perhaps a few notes on the subject may be of interest.

The ground where such treatment is necessary is usually of the form of a flattish valley in which the bottom is bog or marsh overgrown with scrub. The first thing to get firmly into one's head is that this marshy ground is not marshy because of the rain, even though the rainfall may be heavy and regular. Moreover, surface water from rain which drains off more or less slowly to lower land is not of primary interest to the anti-malarial drain digger. For this reason the normal central drain down a valley, which will carry off surplus surface water is not an anti-malarial drain at all and from the A/M point of view it may be of no interest, or may be a convenience only as an outfall for A/M drain. In this article A/M indicates anti-malarial, a very common abbreviation.

The water that it is desired to get rid of is seepage water, which is subsoil water soaking out somewhere at the surface of the ground. This seepage causes small pools to be formed, and there the mosquito larvæ will be found. Taking as an example a valley such as that

described above, the first thing to do is to clear a way through the brushwood up the middle of the valley and dig a surface channel. This channel may eventually not be required, but, to begin with, it tends to dry the marshy ground, makes the work easier, and often is of use to carry off the output of subsoil drains. The next step is to decide where one will put one's subsoil anti-malarial drains, or contour drains, or foothill drains, as they are sometimes called. The position of these is fixed by two factors. Firstly, the subsoil drain must be 5 ft. or more below the surface of the ground, otherwise it will get choked by grass roots. If there is likelihood of brushwood growing over the drain, it is better to put the pipes deeper. The A/M drain is simply composed of the usual red porous, agricultural drainpipe, which is laid butt-jointed. Concrete pipes are not good, the humic acid in marsh water eats away and disintegrates the concrete unless *ciment fondu* is used or high-class spun pipes are employed. The same thing happens in concrete inverts carrying water from marsh land. The water enters through the pipe and the joints, and roots, if in the vicinity, can get in through the joints quite easily.

Secondly, the position of the drain is fixed by the height of the water table. This is presumably at the surface or very close to it in the low-lying marshy part of the valley. The object of the A/M drain is so to lower the water table, that it will be below the surface of the ground everywhere ; in such conditions there can of course be no seepage. Where subsoil drains are laid fairly close together on a flat plain, they will lower the water table down almost to their own level, provided the outfall is good. For such a purpose in average clay they might well be placed about 20 yards apart ; in sandy soil some 50 yards apart. But in arranging for the A/M drainage of a flat valley such as we are considering, the intention is to intercept the subsoil water at the foot of the slopes surrounding the valley and remove it by drainage before it can collect in the marshy bottom.

If, therefore, the foothill A/M drain follows generally the contour line say 5 ft. above the valley bottom, the actual drain itself at a depth of 5 ft. below ground level will be about level with the ground surface of the valley bottom.

The fall of the A/M drain will follow generally the fall of the valley and will have a height suitable to deliver, if necessary, into an open or closed central drain. The general layout is completed on these lines. The foothill drain intercepts most of the water from reaching the lowest part of the valley and the central drain—if necessary—both lowers the water table in the bottom of the valley and receives the outfall of the foothill drains, as and when required. The foothill drains are usually 4 inches to 6 inches in diameter. The central drain usually requires at least an 8-in. pipe or may have to be an open ditch.

In the case of an open ditch being necessary, care must be taken to avoid forming a seepage area in the sides of the ditch ; for this reason concrete inverts are laid along the ditch bottom, and concrete slabs as required along the sides above them. All joints, except the bottom half of the invert, are made in cement mortar, thus forcing the seepage water to rise up through the bottom of the inverts.

The laying of the agricultural drainpipes requires considerable care and skill. The fall may be anything from 1/150 to 1/1000, so that accurate laying is essential ; but, in addition, it is important to give free access to the water to rise through the bottom of the joints between the pipes. No access should be given for water to enter the pipes through the top of the joints ; the reason for the latter requirement is that, if water falls into the pipe from the top, it will carry soil with it and in time will tend to choke up the system. The pipe, therefore, is usually laid on a bed of about 3 inches of broken stone, brick or ashes ; the pipes are laid as close together as possible, and over the joints is packed tarred paper, with a stiff clay seal or any other arrangement with local materials which will close the top of joints against ingress of water and soil. Round the pipe to a depth of about two feet selected soil or gravel is packed loosely, and the trench is then filled in and rammed. If soil is used to fill the bottom two feet of the trench, it should be dry soil and porous, not wet or lumpy. Inspection pits should be left every 200 ft. along the subsoil pipe line. These can be in the form of vertical lengths of pipe with a lid on, or a small manhole. In general the vertical pipe is sufficient and is, of course, cheaper, but a pit similar to a manhole is very useful at important junctions or where a sharp change of level occurs.

A most important feature of this type of work, which is often overlooked, is the maintenance of the system. The grass must be kept cut over the area or seepage will occur and be concealed. Long grass may also conceal outfalls and the fact that a drain is not working properly.

Weeds and grass may creep down into an open channel, and in bad cases will give mosquitoes both hiding and breeding places. Long grass alone does not supply breeding places for mosquitoes normally ; what is concealed by the grass, viz., tins, seepage, etc., causes the trouble.

An excellent book on this subject is called *The Principles of Underdrainage*, by R. D. Walker, published by Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. This was used at Changi as our textbook on subsoil drainage, and is most valuable to all railway engineers when the questions of the slipping of banks in cuttings, drainage of marsh land, and protection of banks against tropical rain are matters of interest to them.

(c) Concrete Work.

During a prolonged lull in the work some interesting tests were carried out by Staff-Serjeant A. Maclean in the cement testing room. The testing plant was one of the best in Malaya. After many tests of various cements and mixes had been made it occurred to the experimenter that he might develop a new system of supplying concrete to scattered works or, in particular to a long concrete road service. His idea was to make and mix his concrete thoroughly and carefully at a central station with half the necessary water, issue it in bulk to the various sites and then, when on the site, the remainder of the water would be well mixed in and the concrete laid. The intention was to reduce supervision on the works, ensure the use of sound materials in proper proportions, and to avoid waste of transport and plant in mixing on the site. Obviously there would be delay between the first mix with water and the final addition of the rest of the water. Allowing 3 hours as a maximum for this lapse of time he carried out a great many tests, of which some of the results are tabulated below :—

Concrete 1 : 2 : 4.

Adding	8%	water	in	ordinary	way	after	2	days	tested	to	4000	lbs.	per	sq.	in.
,,	4%	and ½	hour	later	4%	water	,,	,,	,,	,,	,,	3460	,,	,,	,,	,,
,,	4%	and 1	hour	later	4%	,,	,,	,,	,,	,,	,,	4300	,,	,,	,,	,,
,,	4%	and 1½	hrs.	,,	4%	,,	,,	,,	,,	,,	,,	3230	,,	,,	,,	,,
,,	4%	and 2	,,	,,	4%	,,	,,	,,	,,	,,	,,	3420	,,	,,	,,	,,
,,	4%	and 2½	,,	,,	4%	,,	,,	,,	,,	,,	,,	3710	,,	,,	,,	,,
,,	4%	and 3	,,	,,	4%	,,	,,	,,	,,	,,	,,	4600	,,	,,	,,	,,
,,	4%	and 2½	,,	,,	6%	,,	,,	,,	,,	,,	,,	2380	,,	,,	,,	,,
,,	4%	and 3	,,	,,	5%	,,	,,	,,	,,	,,	,,	2275	,,	,,	,,	,,

These were averages of several tests, and would seem to indicate that a system such as he proposed would be practical and useful, so long as excess water was not added in the final mix.

Having carried out these experiments, it was then noted in an engineering journal that an American firm quotes for delivery of a dry mix in any proportions required for concrete work in a town in the U.S., so it would seem that others have also thought of the scheme of supplying the mixed constituents for concrete work from a central organization, instead of supplying the constituent parts separately to each individual site of work.

EARLY DAYS IN MESOPOT.

By COL. F. C. MOLESWORTH.

ON the 31st October, 1914, Great Britain declared War against Turkey; on the 6th November, a combined naval and military force from India captured Fao, where the old Turkish Empire looked out on the Persian Gulf.

Such promptitude requires explanation. The entry of Turkey into the War had long been foreseen, and Turkey took the initiative by bombarding some Russian towns on the Black Sea. Mesopotamia was one of the places where we could best attack her. We were, moreover, bound to defend the Anglo-Persian oil line and refinery in S.W. Persia, close to the Turkish border. Persia was ostensibly neutral, but was powerless to protect herself from invasion.

On October 16th, in anticipation of probable hostilities, the 16th Infantry Brigade of the 6th Poona Division, under Brig. Gen. Delamain, with a brigade of mountain artillery, and the 22nd Field Coy., Bombay Sappers and Miners, under Capt. Twiss, sailed from Bombay for Bahrein in the Persian Gulf. As the transports approached Bahrein, a huge water-spout arose out of the sea in front of them. It was dispersed by a shot from the naval escort—a curious opening for a campaign.

Bahrein, where they arrived on October 23rd, is under British protection. Only the staff and a few officers went ashore, some of whom found a German employee of Wonckhaus & Co. in the act of dispatching a letter to the German Consul at Bushire, giving accurately the strength and composition of the British Force destined for Mesopotamia, including the rest of the 6th Division, which had not yet received its embarkation orders!

The troops remained off Bahrein for ten days, practising disembarkation and rowing. On the 2nd November, they left for the mouth of the Shatt-al-'Arab. Here they were joined by the *Odin* and *Espiègle*, gunboats which for the past few days had been dodging the Turks among the creeks forming the delta of the Karun and Shatt-al-'Arab.

Fao was defended by about 400 Turks with a few old guns. After a bombardment by the *Odin*, our troops were landed and the place occupied without loss. Leaving a small garrison, the brigade re-embarked and proceeded up the river.

The Shatt-al-'Arab, here about half a mile wide, wound its way through a monotonously flat country. On each bank palm groves,

irrigated by cuts from the river, stretched inland in places to a distance of two or three miles. The landward side of the groves was protected by an embankment to prevent flooding from the desert side. Beyond that stretched bare and level plain as far as the eye could see. The Shatt formed the boundary between Turkey and Persia up to a point a few miles above Mohammerah.

The brigade landed, without opposition, at Sanniya, two miles above Abadan, where the Anglo-Persian Oil Coy. works were situated. Deep water close inshore allowed lighters to unload, but wind, current and lack of suitable craft made the process of disembarkation long.

The first objective of our force was Basra, but as the opposing Turks were reported to number at least 3,500, exclusive of Arabs, Gen. Delamain had to await the arrival of reinforcements, now on their way, before an advance was possible.

The Turks' main concentration at this time was at Baljaniyah, about 15 miles upstream, with an advanced force at Saihan, about 4 miles from the British camp. Opposite Baljaniyah, the Turks had sunk the *Ekbatana*, a river steamer, in the fairway of the Shatt, and it was thought that the obstacle so formed would stop our ships from going upstream.

On the early morning of the 11th, while it was yet dark, the Turks made an attack on the British camp, which was easily repulsed. So well had the routine of picking up empty cartridge cases been impressed on the *sepoy* in peace time, that many of them did so even in the heat of action. On the 15th Gen. Delamain defeated the advanced enemy force at Saihan.

Meanwhile reinforcements were arriving. Maj.-Gen. Sir A. Barrett, who was now to take command of the Force, arrived with the 18th Bde. (Maj.-Gen. Fry), a bde. of Field Artillery, and the 17th Coy., Bombay Sappers and Miners (Capt. Arbuthnot). Lt.-Col. U. W. Evans commanded the Engineers, with Tomlinson as his S.O. The greater part of the Force had landed by the evening of the 16th.

Early the following morning, the Force left camp and moved out into the desert. It advanced with some difficulty, as rain had fallen a few days before. The deserted camp of the Turks at Saihan was reached and passed. It was soon evident that the march was to be opposed. The Turks had constructed a position at Sahil, running roughly from S.E. to N.W., almost parallel to our line of advance. An old fort with ruined mud walls formed the only feature of interest, for the rest the defences consisted of shallow trenches. Their left rested on the palm groves and their right was refused.

The palm groves formed a considerable obstacle in themselves; there were innumerable cuts, some deep and all muddy, observation was everywhere difficult, and in places the young trees made a dense undergrowth. It was obvious, therefore, that the position must be attacked frontally, and over as open ground as it is possible to find.

Heavy rain, falling as our troops were deploying, increased our difficulties. The ground became a quagmire, in which men, guns, and animals, were alike reduced to a snail's pace.

The hostile position was at first reported as running perpendicular to, instead of parallel to, our line of advance, necessitating a considerable change of plan after our troops had got well engaged. However, the advance continued, and four hours after the first shots had been fired, the enemy evacuated their trenches and retired. They lost considerably in killed and wounded, and two guns and a few prisoners were taken.

Pursuit was impossible owing to the state of the ground; our artillery kept up a damaging fire as long as they could see, but presently a mirage blotted the retreating Turks out of sight. The mirage was invisible to observers in the rigging of our ships in the Shatt, who could not make out why our guns suddenly ceased fire.

We camped in the palm grove at Sahil,* a place which has given its name to the action. The site, intersected as it was with water cuts every few yards, was not an ideal one. A violent storm during the afternoon, which sunk some of our boats in the river, and sniping during the night, did not add to the comfort of the troops.

Both S. and M. companies were engaged, the 22nd rendering gallant service in the storming of the old Fort, for which it was publicly thanked by the Force Commander; Matthews, who temporarily took over command when Twiss was mortally wounded, afterwards received the M.C. The 17th Coy. also lost its C.O., Arbuthnot, who was seriously wounded; he was sent home, recovered, went to France and came back to Mesopot early in 1916, only, however, to be "missing, believed killed" in the attack on Dujailah redoubt during one of the desperate attempts to relieve Kut. Col. Evans was wounded and taken to a hospital ship, rejoining a fortnight later, while H. E. Winsloe received three slight wounds. The troops engaged received the battle honour "Basra."

The next four days were spent in landing troops and stores, and in strengthening the outpost line, which ran through the old fort previously mentioned, resting on the river near a police post. In a room therein were found some illustrations from the *Graphic*. Three Turks surrendered to a party with the writer, expressing their submission by trying to kiss us, actually succeeding with one Hindu *sepoy*.

The landing of troops and stores was about as difficult an operation as can be imagined. About 100 yards of sticky mud lay between firm ground and the water. We were almost without materials, as those destined for the Force were just about leaving Bombay. Date palm trunks and leaves were the only local produce, and some

* Sahil means "the shore," and might equally well have given its name to any place along the whole length of the river.

sort of road had to be made with these. Half an hour's traffic sunk such a road irretrievably into the mud, whereupon an hour or so would be needed to make good again. At length some genius discovered that the night tides were considerably higher than the day tides, and lighters were successfully piloted over what had been a dismal waste of sticky mud.

On the evening of the 20th information was received from the Shaikh of Mohammerah that the Turks had vacated Basra. The following morning the naval ships examined the *Ekbatana*, and found a practicable way round. Thereupon the *Espiègle* steamed past, found the Baljaniyah position deserted, and steamed on to Ashar, the port of Basra, where she arrived late in the evening and fired a blank charge. Thereupon the looting stopped as if by magic. A small party was landed, and next morning two river steamers brought the half of the 18th Bde.

Meanwhile the rest of the Force, a brigade and a half, traversed the 28 miles to Basra. Leaving Sahil camp at 8 p.m., the column moved out into the desert, where the Basra-Fao telegraph line made an excellent guide. The young moon presently set, and the column marched along under a perfect starry sky, in such complete silence that the occasional barking of dogs in the palm groves a mile to the right was clearly audible. For some miles the going was ideal, but presently the ground grew rough and halts became more and more frequent. Some irrigation cuts were met with, which proved difficult to fill in the dark. One never knew whether a halt would be for a minute or an hour. The last cut was bridged as dawn was beginning to break. As soon as it was light, the column halted to consume "unexpended portion of previous day's ration," Sykes put up his wireless and got into touch with the ships, and the cavalry were sent on ahead. The force then pushed off to complete the remaining twelve miles into Basra.

Soon after sunrise, an extraordinary phenomenon presented itself. The desert was not more than five or six feet above the surface of the river, and between the two was a belt of palms some 30 or 40 feet high, yet for some minutes the water ahead, with steamers on it, was plainly visible.

Of greater moment was the discovery that the desert had at no distant date been under water flowing with some speed; the Force was to become painfully familiar with this phenomenon.

It was difficult to spot Basra from the desert side, since the palm groves enclosed it in this, as in all other, directions; indeed, the vanguard overshot it. A camping ground was chosen south of the city, and about noon the troops marched in. The weary and overworked staff had some difficulty in allotting sites; that for the Sappers was changed six times. At 6 p.m. the last of the transport came in. The inhabitants were already coming in with dates and

other things to sell, the *sepoy* feeling it a distinct grievance that the Arabs could speak no language known to him.

The next morning, the 23rd, the Force marched through the streets of Basra. Smoke from the Custom House, which the Arabs had set on fire, guided the column to the Belgian Consulate, where the Union Jack was hoisted and a proclamation read out in Arabic by Sir Percy Cox, the Chief Political Officer with the Force, to the effect that Basra had passed for ever from the rule of the Turks.

The river front, where we now found ourselves, was the best part of Basra, though that is not saying much. A few good buildings were to be found along the shore, but inland of these, and stretching as far as the town of Basra, two miles away, was a series of palm groves. Now, as the Arab puts it, the palm grows best with its feet in water and its head in hell, and so from the river ran canals which divided and sub-divided until each separate tree had its channel, perhaps 5 ft. broad by 2 ft. deep. As the rise and fall of the tide was considerable, sections of the groves were enclosed by mud bunds, through sluices in which irrigation was effected. By far the greater part of this area was below h.w.m. Such parts as rose above the prevailing level were covered with reed villages, cemeteries or sheds for the date harvest.

The troops were accommodated in old Turkish barracks, filthy and in bad repair, and such other buildings as could be found. The Sappers occupied two rooms in the late German consulate, whose occupants had had a fine dinner ready as a welcome to the Force. Three days later we moved into the Commodore's house, which remained Engineer H.Q. for the remainder of the War.

With creditable promptitude, the first number of a daily paper, the *Basra Times*, appeared only six days after the entry of the Force.

Basra did not immediately lapse into the paths of peace. To begin with, there were frequent alarms, and a good deal of sniping by local *budmashes*, which did not stop until two or three were caught and publicly hanged. A story, *ben trovato* at any rate, is told of a football game got up by the Dorsets soon after that occurrence. Seeing the erection of the goal-posts, a crowd of Arabs collected, but seemed to lose patience when only the apparently aimless kicking of a ball followed. At length a linguist approached and asked a Dorset, " When is the execution coming off ? "

Needless to say, there was plenty for the Sappers to do. Roads had to be made, the innumerable creeks bridged, buildings put in some kind of order, water supply schemes initiated. K. B. S. Crawford, of the 22nd Coy., was busy getting the Shaikh of Mohammerah's palace, a mile or so upstream, fitted up as a hospital.

The greater part of the defeated Turks had retired to Qurna, 40 miles upstream, where the Tigris and the old bed of the Euphrates join to form the Shatt.

It was, of course, desirable to occupy such a strategic point, and consequently on December 4th, Lt.-Col. Fraser, of the 110th Mahratta L.I., with a force of two battalions and a quarter, with two field guns and half the 17th Coy. under Lord, with two gunboats and two armed launches, was sent up there. They landed a few miles below Qurna, on the left bank of the Shatt. In spite of the disparity of numbers, for the Turks were afterwards discovered to exceed 3,500, our force gained a considerable success, but were unable to exploit it.

On the 7th, the rest of the 18th Bde. arrived, and operations were energetically pushed on. The whole of the left bank of the Tigris was cleared, losses amounting to several hundreds inflicted on the Turks, and a body estimated to number 1,500 driven northwards.

There remained the Turks in Qurna itself to dispose of. The crossing of the Tigris was effected at two points respectively a mile and three miles north of Qurna. At the latter, the 104th Rifles seized two *mahailas* (local river craft), crossed, and worked southwards. At the former M. G. C. Campbell, of the 17th Coy., with an Indian officer and three Sappers, had swum across hauling a log line, by means of which a cable was dragged over and a flying bridge established before the Turks were aware of it. The current was strong, the water very cold, and the stream 130 yards broad; Campbell thoroughly deserved the M.C. he got. An Indian battalion was then ferried across, and, joining hands with the 104th, reached the outskirts of the town before dark. The next morning the Turkish commander surrendered with 1,034 men and four guns.

Thus, in little more than a month, our two brigades* had advanced 110 miles inland, had accounted for 3,000 Turkish casualties, and taken 1,400 prisoners and 19 guns, at a cost to ourselves of only 115 killed and 668 wounded. Bad as the Turkish strategy had been—they had allowed their forces to be mopped up in detail—they had shown considerable skill in the selection of defensive positions, and the British felt justifiable satisfaction. It seemed unlikely that the Turks would resume the offensive, and junior officers began to discuss the possibility of the British part of the Force being shipped to France.

The higher command, however, was far from sharing in these anticipations; still less the Turks, who had no intention of allowing us to remain in undisturbed possession. There were three methods of attack open to the Turks, and they chose all three. They attacked Qurna; they struck at the oil pipe line in S.W. Persia; and they moved down the Euphrates and attacked the force guarding Basra. Fortunately, the main attacks did not synchronize. In each case they received great help from the Arabs, who, as long as the Turks seemed to be winning, were enthusiastically pro-Turk.

The first offensive on their part was directed at Qurna. Such Turks

* The 17th Bde. of the 6th Division, with L. E. Barnes, R.E., as Staff Captain, had landed, but had not been engaged up to this time.

as had managed to get away from Qurna retired some miles northwards; there they remained until reinforced to a strength of about 5,000. At the same time, our position in Qurna was regularly sniped by Arabs. The latter made a point of carrying off the yellow sanitary flags outside our perimeter, no doubt to be exhibited as trophies, until land mines were arranged to explode on a flag being pulled up. Several reconnaissances were pushed out towards the Turks, and losses inflicted on them. Their expected attack, when it did eventuate on the night of January 29th-30th, proved a very half-hearted affair, and, shortly after this, rising floods rendered further operations on the part of the Turks unlikely. The Turks reduced their forces here, and we followed suit, sending troops to other places where they were badly wanted.

Their attack on our right flank was more serious; on January 26th a Turkish cavalry regiment and an infantry battalion were reported moving eastward from Amara, and the Army Commander sent an Indian battalion to Ahwaz. The Shaikh of Mohammerah was on our side, but was unable to control all his tribes, some of whom breached the pipe line. By the end of February, Ahwaz was practically surrounded by Turks and hostile Arabs, and our force there suffered something like a reverse. It had been decided to strike at one of the Turkish camps about ten miles N.N.W. of Ahwaz, and a night march was made, so arranged that our field guns should open fire on the camp at daybreak. As soon as the first shell fell, the enemy turned out in overwhelming numbers. A retirement was ordered and begun, but the enemy got round both our flanks and even to some extent between our force and Ahwaz. The force reached Ahwaz with a loss not only of about 15 per cent. of their numbers, but of a field gun as well. But heavier losses were inflicted on the Turks, and the garrison remained little molested for some weeks. The conduct of a small party of some 20 of the Dorsets in the retreat was beyond all praise; they took command of leaderless men and carried out the duties of company and platoon commanders; it is pleasing to record that one and all received the D.C.M.

It should be remembered that at this time the force had no aeroplanes and no armoured cars; and that the difficulties of reconnaissance were immensely increased by mirage and the prevailing flatness of the country.

The offensive by the Turkish right wing was the most serious of all. A part of the enemy defeated at Sahil had retreated to Nukhaila, on the right bank of the new Euphrates: there, reinforcements were constantly arriving throughout the early months of 1915.

The "new channel of the Euphrates" was, as its name implies, a recent geographical change. In fact, old men remembered the time when it was possible to step across the channel at Kurmat Ali, where it was now 100 yards wide. Leaving the Hammar lake, the channel

wandered over flat country and joined the Shatt at Kurmat Ali. Great use was made of this channel by our "Euphrates blockade force," which, with two 5-in. guns mounted on barges, interfered with the Turkish river communications. Dewing, of the 12th Coy. Q.V.O.S. and M., which had just arrived, accompanied the flotilla as engineer officer, and found plenty to do in blowing up captured Turkish supply vessels, etc.

Early in December, 1914, a British detachment had been pushed out to Shaiba, nine miles west of Basra; here the absolute flatness of the desert changed to slight mounds, nowhere exceeding 30 feet in height. By the end of January, Turks and Arabs were reported only seven miles west of Shaiba. On February 9th, a reconnaissance discovered some 2,500 Turks holding a position at Nukhaila. On March 2nd, another reconnoitring force was hotly pressed by mounted Arabs on its way back to camp, and a machine-gun was lost. A supporting party, owing to dust and the sun in their eyes, was unable to see anything but a confused mass of horses until they came within 100 yards, when their fire drove off the enemy with loss.

Meanwhile the floods, rising a month before their usual time, were adding immensely to our difficulties. Early in February, the Euphrates began to flood the country between Basra and Shaiba, and by the middle of that month it became impossible for mules to traverse the direct route between the two places. The nine miles of desert were covered with water, in places 3 ft. deep, with horribly sticky mud at the bottom. Thereafter, mules could only cross by a circuitous route, landing on the shore three or four miles south of Shaiba, and marching thence. A convoy of *ballams* was organized; but this method of transportation suffered from the disadvantage that a southerly wind, which was not infrequent, drove the water northwards, leaving only stretches of water too shallow for *ballams* and stretches of mud horribly sticky to march over.

Abandonment of Shaiba was out of the question, and the only thing to do was to make the best of a bad job. A causeway was begun, but not only was it difficult to get dry earth, but, unless revetted, the embankment melted away under wave action, and there was not enough revetting material in the country.

In Basra itself floods were causing an infinity of trouble; all our base depots were, at one time or another, under water. At that time, practically the only remedy was to heighten and strengthen existing bunds; earth for the purpose was hard to come by, and transport for it difficult to procure. In a few cases, power-driven pumps were installed to drain depressions.

Owing to the menace of a Turkish attack, Basra itself had to be fortified, and two redoubts were made on the edge of the inundation, north and south of Basra city. To cover a possible forced embarkation, a position, locally called Torres Vedras, was prepared to guard

the port itself. Cusins, as Field Engineer in charge, was told that he must not fell more than 20 palm trees; seeing that these trees surrounded us for miles on every side at a density of about 1 per 10 square yards, the permission did not amount to very much.

To add to the worries of the higher command, Bushire, in S.W. Persia, where there was a small British garrison, began about this time to call for help. Further, as German cruisers were still about, it was deemed necessary to lay a minefield at the mouth of the Shatt; and, although it was ten years since submarine mines had been handed over, lock, stock and barrel, to the Navy, the work devolved on the Sappers. Fortunately, a R.E. N.C.O. who had served in the old Submariners, was present with the Force.

At Shaiba itself, a strongly fortified position had been made. There, by the beginning of April, were a cavalry brigade and the 16th and 18th Brigades, with the 17th and 22nd Companies S. and M. The Turks facing Shaiba numbered about 12,000, with approximately 10,000 Arabs.

Bodies of Turks and Arabs were also facing Qurna and Ahwaz, where they timed attacks, in neither case very serious, to synchronize with their offensive at Shaiba.

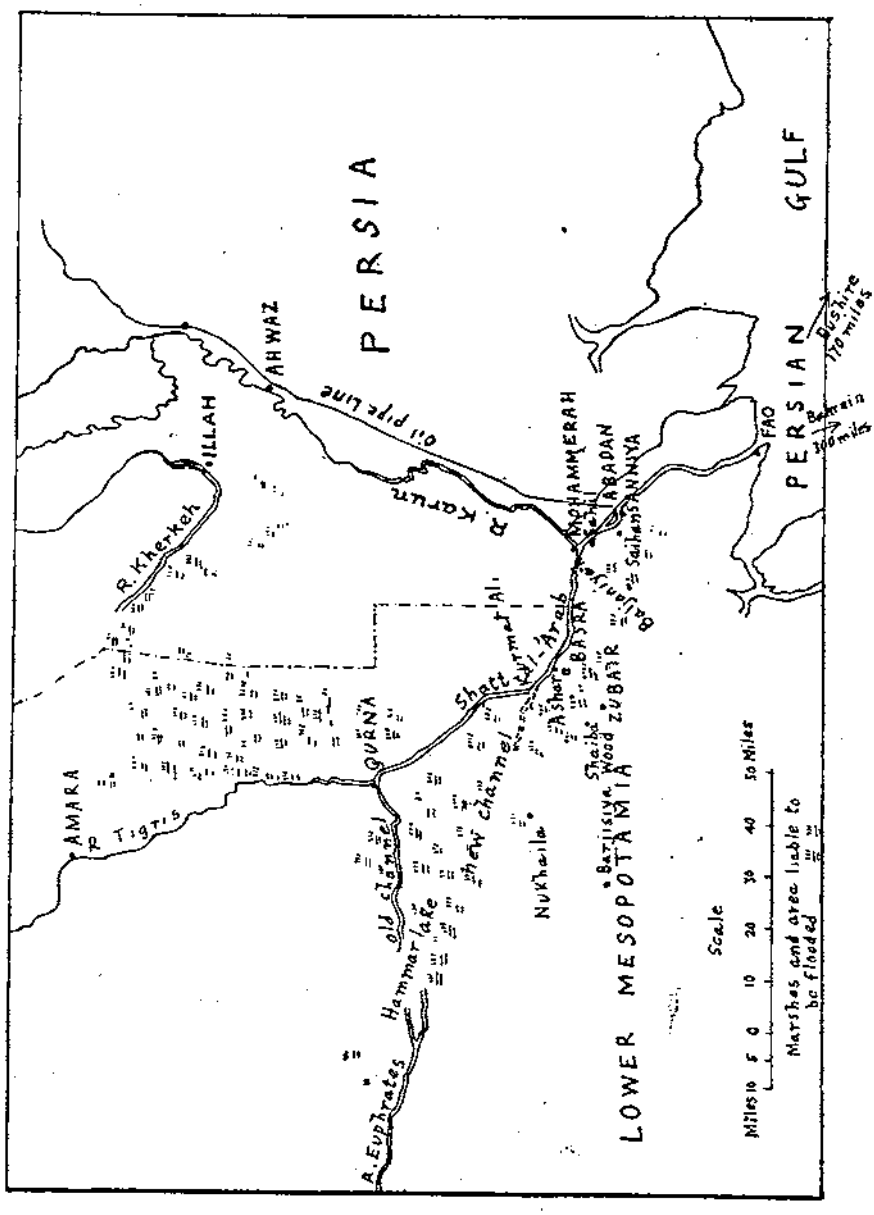
This materialized early on April 12th. The Turks made a regular attack but failed to make any impression. The official account records that "The brunt of the fighting had fallen on the 48th Pioneers and the 17th Company of Sappers and Miners, who had withstood the onslaught with conspicuous steadiness, assisted by the particularly good work of the Norfolks' machine-gun section."

The Turks made some effort to interrupt our water communications, where some 30 *mahailas* tried to sail into the flooded area, drawing the fire of the redoubt south of Basra City.

The 30th Infantry Brigade, under Maj.-Gen. Melliss, tried to reach Shaiba from Basra, but as the marching route was considered too risky, were withdrawn and as many as possible sent direct by *ballam*. This party, with which were 6th Division H.Q. with Col. Evans and Tomlinson, reached Shaiba under some fire from the enemy late in the evening; on their return journey, the *ballams* had something like a naval engagement in three feet of water, with a hostile fleet. Gen. Melliss then took command at Shaiba.

On the following day, the Turks attacked again, and were again driven off. This time the garrison sallied out, cleared the north and west fronts of the position, and inflicted 100 casualties on the enemy, took 400 prisoners and two mountain guns. The prisoners were escorted by *ballam* to Basra. The population had been waiting for days at the Zubair gate with presents for the victorious Turks, and received a rude shock when their friends arrived only as captives.

It was plainly necessary to strike a hard blow at the Turks, who might otherwise indefinitely prolong operations in that quarter. On


PERSIA
GULF
PERSIAN
AHWAZ
oil pipe line
R. Karun
ILLAH
R. Kherkeh
MOHAMMERAH
ABADAN
FAO
Bushire
170 miles
Bahrein
300 miles
AMARA
R. Tigris
QURNA
Shatt el Arab
BASRA
Ashar
Shaiba
Wood
ZUBAIR
Batisiya
Nukhaila
new channel
old channel
Hammar lake
A. Euphrates
LOWER MESOPOTAMIA
Scale
Miles 10 5 0 10 20 30 40 50 Miles
Marshes and area liable to be flooded

the 15th April, therefore, Gen. Melliss marched out against them with the greater part of his force. The hostile position was eventually located at Barjisiyah wood, where trenches had been dug at the lower edge of a glacis-like slope 400 yards wide. The battle resolved itself into a fire fight—British and Indians attacking, over an open plain, entrenched Turks with a superiority of numbers; it was only the sterling fighting qualities of our men that won the day. For four hours, the hottest of a hot day, our two brigades faced a heavy rifle and machine-gun fire, very slowly pressing forward until suddenly parties from each brigade rushed across the remaining space; immediately the whole British line followed suit, and the trenches were won.

Our infantry were too exhausted to pursue, and the cavalry found the edge of the inundation too serious an obstacle; but the Arabs turned on their former allies, fell on stragglers and looted their stores. The Turkish commander shot himself. The Turkish losses were estimated at 6,000. Our own casualties were heavy, amounting to 1,062 out of 5,338 engaged. The 22nd Coy. for the second time lost its O.C. killed in action; Capt. Whiteley, an officer of great promise. His name is perpetuated by the Whiteley bridge over the Ashar canal at Basra. Loring, commanding the 17th Coy., was wounded; he was again wounded at Nasiriyah and once more at Ctesiphon.

Seldom has a victory been more decisive; the menace to our left flank was dispersed once and for all. The troops engaged received the battle honour "Shaiba."

In the first five months of the campaign, the Sappers had about as varied work as it is possible to imagine. Some of the more unusual items were: converting river steamers into ironclads; mounting guns on steamers and barges; submarine mining; construction and maintenance of a bridge of *mahailas* across the Tigris; constructing armoured observation tower; design and erection of gallows; erection of tide-gauge; rehabilitation of a derelict steam launch; installing pumps to drain flooded areas; electrifying divisional H.Q.; while, owing to the weakness of our Force compared with that of the enemy, practically every rifle had to be put into the firing line, and so the Sappers were of necessity in the thick of it.

It is interesting to note how the 16 R.E. officers who came out with the original 6th Division became casualties. Col. Evans, who was successively G.S.O. I. of the 6th Division, and Commander of the 17th Brigade, Tomlinson, Crawford and Matthews were taken prisoners at Kut and interned in Asia Minor; Winsloe, who was also in Kut, was released by the Turks owing to a wounded leg; Twiss, Arbuthnot, Whiteley and Dunhill were killed in action; Lord, Barnes and Campbell were invalided to India, wounded; Sykes (now R. Signals) alone survived the duration, though he was run a close second by Cusins, who, landing in December, 1914, remained in the country until October, 1918.

A VETERAN THEODOLITE.

By LIEUTENANT T. H. B. FOOTT, *Australian Staff Corps.*

IN these days of prismatic astrolabes and autocartographs, we are inclined to forget that such instruments are merely the representatives of a family whose genealogy can be traced back for centuries. Some of the earlier members of the tribe gave every satisfaction in the work they were called upon to perform, and while it is not for an instant suggested that Mr. Ramsden's Great Theodolite should be restored to the active list, it is considered that such old warriors which still survive should be treated with the deference their years merit.

In a recent interview it was my good fortune to make the acquaintance of one of these old gentlemen; he could claim no direct relationship with the Great Theodolites, being of the next generation and of diminutive stature.* His identity disc shows that he was assisted into the world by a Mr. Robinson of 38, Devonshire Street; the date of this event is not disclosed, though presumably it occurred early in the last century.

His greatest claim to renown was that he was instrumental in making the survey of the field of Waterloo after the battle; this I am quite prepared to believe a fact, as no bombastic claim to participation in the battle itself is made. He travelled to France, as to other places, standing upright in a case little larger than that of a metronome; when I had persuaded him to emerge therefrom, he demonstrated how, when in action, he stood with his three feet in the grooves prepared for them on the roof of his sedan chair. Apparently he scorned the use of a tribrach or a tripod.

The centenarian carried his years with dignity and had resisted the ravages of time with considerable success. His eyes were still clear, though he suffered from chromatic aberration. Some investigator had removed the cobwebs from his diaphragms, but this had done little to alleviate the stiffness of his joints. The bubble by which he had kept a level head in his youth had disappeared—I refrained from asking whether E and O had shared the alcohol. Like some of his other secrets, he guarded it well.

It was at the close of the interview that he showed himself a true member of the family. There was only one of him, and one box, but there were more ways than one that he would enter his conveyance, many more, and but apparently only one that satisfied the

* See appendix, and plate.

dictates of comfort. It may have been his perversity that caused this disagreement, but more probably it was his strange environment, surrounded as he was by a Tavistock Theodolite, a topographical stereoscope, and a bundle of red tape.

APPENDIX.

DESCRIPTION OF INSTRUMENT.

Maker.

Robinson, 38, Devonshire Street, Portland Place, London. Date of manufacture not shown.

Circles.

(a) *Horizontal.*

Silver $3\frac{1}{4}''$ diameter, A, B and C verniers reading to 1′.

Graduations 0°–360° clockwise. No reading glasses provided.

Vernier arms provided with 360° swing when unclamped, and 3° on tangent screw. Lower plate 7° by tangent screw only.

(b) *Vertical.*

Silver $3\frac{1}{4}''$ diameter, A and B verniers reading to 1′.

Reading glasses provided. Graduations 0°–90°–0°–90°.

Circle readily fixed to vertical column. Slow motion 3° by tangent screw.

Telescope.

External focussing. Aperture 0·5″.

Transits either end up, with diagonal eye-piece fitted.

No sun or dust cap, but wire guard (?) in front of O.G.

Diaphragms upright cross of web, collimation adjustment provided.

Bubble.

One, on vertical plate, not graduated, but provided with sliding indices.

Accessories.

(u) Low-power telescope, fitting in either vertical axis (1) or horizontal axis (2).

(v) Platform on ball and socket joint, fitting in same axes, possibly to support a compass or reading glass.

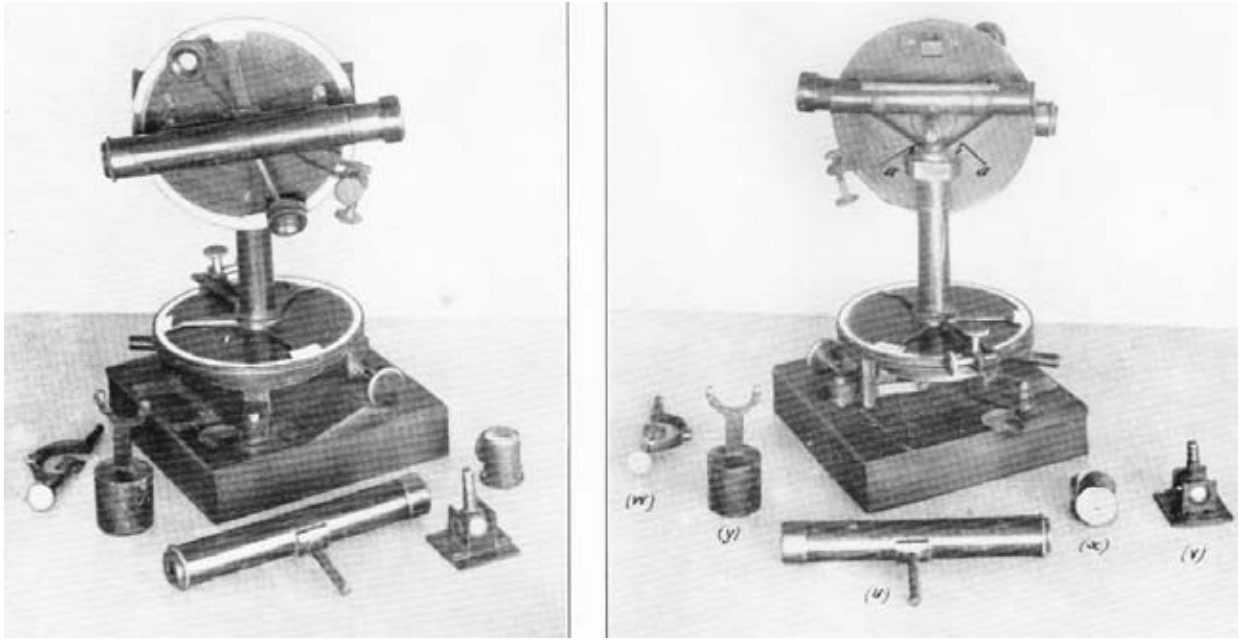
(w) Purpose unknown, fits in same axes.

(x) Diagonal eye-piece, provision made for screw-on dark glass, which is missing.

(y) Balance weight, engaging with holes a.a.

The instrument was used in the survey of the field of Waterloo by General Yule,* R.E., and he gave it to Major James Wilson, R.E. The latter gave it to the father of the present owner, Brigadier W. H. Scott, C.M.G., D.S.O., V.D., of Melbourne, to whom are due the sincere thanks of the author for his kindness in allowing the preparation of this paper.

* Presumably Maj.-General Patrick Yule. 2nd-Lieut. 1.5.1811. Retired as M.G. 9.10.55. Died 10.3.73.—[EDITOR, *R.E. Journal.*]



A veteran theodolite

TWO FAMOUS SAPPERS.

By MAJOR J. N. CASH, M.C., R.E.

KITCHENER and Joffre. It has been said that, in 1915, " the juxtaposition of these two names was the nearest approach to solidarity reached by the allied armies and peoples."

There is a remarkable parallelism between the two careers, which must often have been noticed, but which has not, I think, ever been worked out in detail. To do so would need a new Plutarch, and this short sketch only seeks to draw attention to some of the more striking resemblances.

In August, 1914, these two Engineer officers found themselves at the head of the military effort of their respective countries. The difference between their positions, as Minister for War and Commander-in-Chief, was little more than nominal. Joffre, in command of the mobilized armies of France, with a war minister who looked on himself as little more than an assistant, held a position of immense and undivided responsibility. Kitchener's post was of equal importance. The B.E.F. owed its presence in France to his decision, and, however great its token value, it was, intrinsically, only the smallest of Joffre's armies. Thirty and, later, seventy divisions were being raised in England, and Kitchener was often regarded as the military superior, as well as the political chief of Sir John French.

Is there any resemblance between their experience up to this point ? Perhaps more than may be generally realized. In 1870, they are both in the French army. Joffre, after two years at the Polytechnic, is an Artillery officer, defending Paris. Kitchener, two years older, has completed the course at the " Shop " and is in Chanzy's Army of the Loire, as a volunteer. But for an illness, he might well have found himself an Artillery officer, too, as another in a similar position did. This seems to give the Frenchman a slight lead.

In 1885, the Englishman has got ahead. He is a brevet Lieutenant-Colonel and has surveyed Palestine and Cyprus and served in Zanzibar and Egypt, while Joffre is still in France and only begins his colonial service in this year.

When he does get abroad, he soon begins to make up his leeway. He serves in China, Tonkin and Formosa, and in 1894 carries out a celebrated march to Timbuctoo, about which he writes a book. Is it fantastic to compare this with the Omdurman campaign of 1898 ?

It is, of course, on a very much smaller scale, but Timbuctoo is more than the quaint cacophony it appears to be to an Englishman. It is a centre of considerable importance and, at least, as difficult of access as Khartoum.

Joffre's foreign service ends in 1901, after a trip to Madagascar, where he fortifies Diego Suarez. Against Kitchener's command and high commissionership in South Africa he can only set the appointment of Director of Engineering, which, in England, might not be considered on the direct road to high command.

He has not, however, wasted his smaller opportunities, and, in 1905, when Kitchener is commanding in India, we find him the youngest Divisional General in France.

In 1910, by a curious coincidence, Joffre becomes a member of the Supreme Council of War, and Kitchener of the Committee of Imperial Defence, and in the following year, when Kitchener's military career seems over, Joffre has reached the top of the ladder. He is C.G.S. and will command in the War, now clearly imminent.

In 1912, his warning to the French of a coming war of endurance may be compared with the other's dictum in Australia, two years earlier: "It is the last and not the first million . . . that will give us victory."

Of their achievements in 1914, I think it may safely be said that each rendered services to his country which could have been rendered by no other man.

All Kitchener's prescience, prestige and power of organization and improvisation were needed to make possible the raising of the Army which was called by his name. Joffre's title to fame rests on the victory of the Marne, which, whatever claims may be made as to the inception of the plan for the final stroke, was only made possible by his patient preparation and the confidence he was able to inspire in all concerned. Who else could have drawn from a month of unrelieved defeat and disaster such a reputation for fortitude, constancy and clear thinking—"The life-buoy, the thing that wind and waves cannot harm," as Foch has called him.

After the climax of 1914, we see a gradual falling off in the authority and prestige of both. By October, 1915, Joffre can be spared for a mission to England, from which he returns to find a change of government and a new War Minister, of a very different character. In the following month, Kitchener leaves for the Dardanelles, his departure is followed by the formation of the War Council, and, when he comes back, his control of operations is transferred to the C.I.G.S.

The position of both now depends on the loyal support of others. Kitchener's on Robertson, his C.I.G.S., and Joffre's on Gallieni, once his superior, in Madagascar, under him at the Marne, and now Minister for War.

In June, 1916, ten days after the death of Gallieni, Kitchener starts on his fatal journey to Russia. From this time Joffre's position becomes increasingly difficult, and, before the end of the year, we see him still nominally commanding on all fronts, and promoted to Marshal of France, but deprived of his staff and taking no further effective part in the direction of the War.

It may, perhaps, be said that the causes of the decline of both, ostensibly military, were really political.

Both were, inevitably, called military autocrats, and both were charged with absurdly contrasted heresies. Joffre, in invaded France, was said to be a "Westerner." He would not see the necessity, so apparent to every political Frenchman, of forming an independent command in the East to exalt, or get rid of, a political General. Kitchener, in sea-faring England, was said to have a weakness for oriental adventure. He wouldn't send every available man and gun to the Western front.

As to the remaining charges, shell shortage, methods of recruiting, nibbling tactics, defences of Verdun, we can already see some indications that the verdict of history will not be unfavourable to the accused.

On the other hand, it seems probable that Kitchener's difficulties, outside the struggle with a War Cabinet of twenty-three, were really due to the political aspects of compulsory service. His views as to the necessity for its introduction were not in doubt, but his political colleagues could never forgive his refusal to take off their shoulders the onus of a decision of such doubtful electoral value.

Joffre, in spite of his correct republican views, would seem to have been a victim of the Left, which exercises such a mysterious power in French politics. Besides this, his responsible post forbade him to propose those short cuts to victory, which his rivals were free to advocate.

In conclusion, can it be said that these two great men had in common some of those qualities which ought to distinguish every engineer?

They both took long views, made decisions deliberately and were not easily led to change a decision once arrived at.

Neither was to be deterred by the mere magnitude of a task or the apparent inadequacy of the means available for carrying it out. Both were habitually taciturn, though able to speak very much to the point on occasion.

Both showed exceptional resolution, patience, perseverance. . . . But to make the list too long would be to claim that our trade is the mother of every military virtue.

THE FASTNET RACE, 1930.

By ANON.

THIS sixth Fastnet Race will long be remembered by those who took part in it, for it was held in weather which was almost, if not quite, as bad as that which prevailed in 1927. In the latter year two yachts alone succeeded in staggering round the course. This year four out of nine succeeded in rounding the Fastnet, and eventually arrived at Plymouth after just about a week at sea.

There is a great deal to be said for this ocean racing. At 3 a.m. on a cold wet deck after 48 hours' beating into the short seas of the English Channel with every stitch of clothing wet through and the prospect of another 24 hours of the same kind of thing, the average "hand" swears solemnly that nothing on earth will ever induce him to make the trip again. Cooking has become well-nigh impossible; the Primus is chasing the kettle all over the foc'sle, and the last attempt at lighting it has only resulted in the spilling of about half a pint of methylated spirit. The smell, which a prematurely extinguished oil stove alone knows how to produce, has filtered aft and is driving on deck all but the hardiest of the watch below. In fact, the life is anything but a picnic: even in retrospect it is misery, and yet, we all want to go again.

On the evening of August 11th the following nine sturdy little craft were moored off Cowes—no less beautiful in the eyes of their owners than the more graceful racing yachts which had been competing in the Royal Yacht Squadron Regatta the week before:—

Recall No.	*Name.*	*Thames Tonnage.*	*Owner.*	*Rig.*
1	*Lelanta*	50	Mr. Ralph St. L. Peverley (U.S.A.)	Schooner
2	*Maitenes II* ...	25	Lieut. W. B. Luard	Bm. Sloop
3	*Ilex*	20	Royal Engineer Yacht Club ...	Yawl
4	*Jolie Brise* ...	44	Mr. Robert Somerset	Cutter
5	*Neptune*	62	Lt.-Col. G. L. Chambers ...	Cutter
6	*Ariel*	—	M. Baldenweck (France) ...	Cutter
7	*Amaryllis* ...	37	R.N. College, Dartmouth ...	Yawl
8	*Viking*	39	Lieut. R. Lindsay Fisher, R.N.	Cutter
13	*Magnet*	34	Dr. W. Frothingham Roach ...	Schooner

All except one, *Lelanta*, were wooden ships, and two at least, *Ilex* and *Amaryllis*, were built in the last century. France, U.S.A. and Great Britain were all represented. The weather was unpleasant, and we had seen little of the sun for three weeks; the barometer was

low, the forecast was discouraging, *Ilex* was not quite ready, and it was with the prospect of plenty to do before the race the next morning that the crew of nine turned in for their last undisturbed night's rest for a week. The morning of the 12th did its best to make us optimistic. The sun shone at intervals, Carter's eggs and bacon were better than usual, and the odd jobs still left to be done were soon finished. By 10 a.m. we were under way and were soon showing our paces in amongst the others on the Royal Yacht Squadron starting line.

The course for the Fastnet Race is 615 miles long. From Cowes it leads down Spithead, round the Isle of Wight and down Channel to the Longships; then across the Irish Sea to the Fastnet, which is left on the starboard hand and back to Plymouth Sound.

The prevailing winds are from the S.W. quarter, veering occasionally to N.W. with the result that the race generally develops into three definite stages. First a 48 hours' beat down Channel to the Longships, then a 48 hours' reach across to the Fastnet, followed by a 48 hours' run home to Plymouth. All very fine in theory, but at about this time of year the controller of winds appears to take a holiday and to hand over the reins of office to a tribe of devils. They generally contrive to flaunt the wind in our teeth throughout two of the stages instead of one, and then blow us home so hard on the last lap that it becomes rather more exhilarating than its predecessors. This year the devils took charge in earnest—but more of that anon.

The starting gun found us some distance from the line, and we were three minutes late in crossing it. Opinions differ as to why we got away so badly, but the skipper was very preoccupied. There was a nasty-looking thunderstorm coming up fast, there were many obstacles to negotiate in addition to the competitors, in the shape of yachts of all sizes at their moorings, and we were all arguing hard about the setting of the spinnaker. Anyhow, the stop watch was forgotten, and we were soon gazing at the sterns of our chief rivals—*Jolie Brise* and *Maitenes II*. Running down Spithead the wind was on our starboard quarter, and spinnakers began to appear one after the other. Ours, however, remained on deck for a long time, and was only set for about the last quarter of an hour before we turned south for the only bit of reaching we were to have throughout the race.

Directly we got out of the shelter of the island and began to approach St. Catherine's point it became obvious that we were in for a hammering. The short seas off that headland are notorious, and *Ilex* was soon plugging into it close-hauled as our course became south-west. *Jolie Brise* appeared to be revelling in it, and until darkness fell we could see her mast standing up as straight as a church steeple as she drew steadily away. Some of the others, however, were very unhappy. *Maitenes* was seen taking in a reef, while the schooners

appeared to be losing ground fast. We kept company with *Amaryllis* all the afternoon, and saw her again at midnight as she passed close under our stern on the other tack. The sea was much less unpleasant than it had been, but the wind was in our teeth, and it became obvious that we should have to make the annual choice between the mid-channel and the inshore courses. The tides decided us, and we stood out towards the south, as did *Jolie Brise* and *Amaryllis*. As it turned out, we probably did wrong, for *Maitenes* passed the Lizard about eight hours ahead of us, having benefited by the smoother water inshore and by a northerly slant in the wind which contrived to make its appearance when we started to head north-west for the Longships. Wednesday night left its mark upon us. The breeze had freshened considerably, and had kicked up a typical short Channel sea. Our bows hit each wave with a thump which made sleep out of the question. Until midnight we drove into it under all plain sail, but eventually it became necessary to reef, and a most unpleasant job it was, as several of the crew had not yet got their sea legs and had very little food inside them. About dawn, however, there was a lull and the reef was shaken out. Thursday morning broke fine and clear, but the breeze was freshening again and the signalman at the Lizard, who reported the sea as "moderate" when we passed later in the day, was an optimist. The thumping went on all through the morning, and for hours the Lizard seemed to get no closer. When we did reach it the skipper decided to run under the lee of the land and prepare for the worst. About 2 o'clock in the afternoon we hove to in calm water just east of the Signal Station and made *Ilex* really snug. When two reefs had been taken in and a storm jib set, we started off again and headed for the Longships. As we passed Lloyd's Signal Station we made our number and followed it up with a two-hoist signal, "What ships have passed?" This sounds easy, but pennants, code flags and ensigns became so inextricably mixed that it is a wonder that the long-suffering signalman understood what we were getting at. Anyhow, he made the somewhat startling reply in two hoists, which we interpreted, after a feverish search in the book of words, as:—"The Channel fleet has passed twice"! Now this might mean several things. The most pessimistic member of the crew suggested that the others had all passed on to the Fastnet and returned, and the optimistic that they had all poked their noses round the Lizard and run back for shelter from the stormy blast.

However, someone discovered that "twice" might be two, and we eventually decided that we must be third. As a matter of fact, we were fourth at that point, as *Jolie Brise* had passed out of sight well in mid-channel. *Maitenes II* was in front, but had to put into Newlyn for minor repairs sustained during Wednesday night, and lost several hours.

We had an uneventful passage to the Longships Light, which was abeam about 1 a.m., and the breeze dropping considerably, we were able to set all plain sail and start on the second or " reaching " stage of the journey. We were to be disappointed. The wind headed us more and more, and not an inch could we let out our sheets. All Friday we plugged along, and in the setting sun we saw about five miles ahead a sail which we thought might be *Maitenes*. The barometer had been rising—it had been very high ever since the race started—and once the wind began to drop it wasted no time. It is extraordinary how quickly the sea goes down in these parts, and Saturday morning made life and ocean-racing worth while once again.

To begin with, there was not a cloud in the sky, which meant that we should be able to dry everything, secondly, there was a flat calm which meant a bathe and some sleep, and thirdly, R100 elected to come right over us about 800 feet up—a wonderful sight as she glided eastwards into the rising sun.

As the light grew stronger, the sail we had seen the evening before appeared again, but this time, to our great delight, it was on our beam and well away to leeward. *Maitenes* it was, and there she stayed all day as we dawdled along with every stitch of canvas set.

The scene on deck was a great contrast to what it had been. The most weird garments began to make their appearance in the rigging. Four or five well-known rugger clubs were soon represented by their colours flapping lazily in the drying breeze, while the hatches were strewn with the inevitable army sock, shrunk almost beyond recognition. The gramophone made its appearance and exhorted us repeatedly to drink to everything under the sun in the words of the Stein Song. The ship's wag—a gentleman of vast proportion, who had previously sat on one of the skylights with disastrous results—directed a flow of badinage at the carpenter, who was doing his best to mend it. An attempt was even made to get something out of the wireless set, but an occasional squeak was the only result. The skipper arrived on deck with the sextant, and Carter emerged from the foc'sle after many hours of misery. The only fly in the ointment was the discovery that practically all the fresh meat had gone bad and would have to join our remaining kippers in the Irish Sea. However, we were warm and dry and Wednesday night was forgotten.

Towards evening the Irish coast made its appearance, and the light airs we had been enjoying died away. The weather became " safter and safter " as we approached land, and we were soon enveloped in a damp mist which cut down the visibility to three or four hundred yards. We were getting right into the fairway, and foghorns all round us started to make the night hideous. At least two big liners passed close to us, making their way into Queenstown at a snail's pace. Just as we were getting resigned to flapping sails and

the rattling of the sheet-blocks, we had a great stroke of luck. A grand shore breeze suddenly sprang up, and for three or four hours we bowled along at about six knots. *Maitenes* was unfortunate enough to miss it, with the result that we rounded the Fastnet three hours ahead of her. The lighthouse keeper appeared delighted to see us. Armed with semaphore flags, he perched himself precariously on the very top of the lantern, and carried on an animated conversation with our very inefficient yeoman of signals. After a succession of "Repeats" and "Whats" we eventually discovered that only *Jolie Brise* was ahead of us, having passed nearly twelve hours before.

It was now Sunday—an uneventful day, but the wind was trying hard to get round to the south-west, and by the evening it had succeeded. It even condescended to blow from the north-west by Monday morning, and freshened considerably. We were due for some excitement, and we got it. We were soon logging a steady eight knots with the wind almost dead aft. The sea got bigger and bigger, and eventually reached the stage at which dealers in hyperbole begin to call it mountainous. We careered along on top of some of the waves for so long that it behoved us to shorten sail. Down came the spinnaker, and up went the wind. Reefing was out of the question, so we scandalized the mainsail and hoped for the best. By now there were two men at the helm pushing and pulling as we skidded from one sea to the next. Sitting on deck in the sunshine, it was hard to believe that there was almost a gale blowing. We were on an even keel, and the wind was scarcely felt, yet the surface of the water was swept by terrific squalls which would have been even more unpleasant than those of Wednesday had we been going in the opposite direction. A gybe is unpleasant at the best of times, but in a high wind with a scandalized mainsail it is apt to be a little frightening. I shall not forget the helmsman's face as the boom came over and then swung back again, almost wrenching the main sheet cleats from the deck. This was not good enough, and down came the mainsail, to be lashed securely to the deck. In its stead, we rigged up our various headsails one after the other as trysails and spinnakers. At one time the Yankee jib was out to port trying to tear itself against the shrouds, and the reaching staysail was out to starboard. Long hoist jib topsails, working staysails, jibs, and topsails all took their turn in sundry unaccustomed positions. I do not think it made much difference which sails were set, we tore along at somewhere between 8½ and 9½ knots. There is nothing like running before the wind *ventre à terre*, and it was over far too soon. Before dark the Longships was on our quarter, and the Lizard light was clearly visible on our port bow. The wind had dropped a bit, but was still almost dead aft, and preparations were made to inform Lloyds that we were on our way home. We had almost given up any hope of attracting attention with an electric torch when suddenly there was a succession of

answering flashes from the signal station mast. "*Ilex* returning from Fastnet answer slowly for the love of Mike what ships have passed," went the message. "*Jolie Brise* at half past noon," came the reply and we knew that we should arrive second. At dawn we passed Plymouth breakwater, and so to our moorings within a stone's throw of Drake's Island. Before we had been there ten minutes we were recognized by a passing tug, which informed us that *Jolie Brise* had arrived at 6.30 the evening before, and was now at Saltash preparing for Santander. Were we to be second, or would *Maitenes* show up before the time we had to give her had expired? Unfortunately she beat us. It was not long before her unmistakable rig showed up round Brame Head, and she crossed the line only 2½ hours after us. We soon learnt that we had no one else to fear, as only *Amaryllis*, the scratch boat, was left in the race, and about mid-day she came in.

Ashore, seven days' growth of beard was soon removed, and after several hours in the very comfortable armchairs of the Royal Western Yacht Club, we were all ready for dinner. The cups were presented, and each skipper had to stand up and describe some of his more lurid experiences. We heard how a man had gone overboard in a big sea, only to be hauled in again by one leg, and how a valuable set of dentures had reached its grave in the ocean. One skipper told us that half his crew had been across the Atlantic and Pacific under sail, but that, tough as they were, he hadn't been able to get round the Fastnet! A veteran of good old windjammer days, who had several times weathered the Horn, thought a trip round the Fastnet almost as exciting.

Admiral Backhouse gave away the cups, and none of us will ever forget the applause which greeted his very generous remarks about "the smallest boat in the race—a boat which we one and all admire —*Ilex*." She had indeed done well, and the carrying away of a runner block was the only casualty she sustained. The skipper replied with a modest speech in which he gave all the credit to *Ilex* herself, but it is largely due to his skill and labour that she achieves these triumphs.

May they work together for many years to come!

Order of finishing and times:—

Order of Finishing.	*Name.*	*Handicap.* H. M. S.	*Corrected finishing time.* H. M. S.	*Place.*
1.	*Jolie Brise*	5-48-30	12-28-47 Aug. 18th	Winner
3.	*Maitenes II*	14-21-00	18-29-56 Aug. 18th	2nd
2.	*Ilex*	7-20-45	22-49-31 Aug. 18th	3rd
4.	*Amaryllis*	Scratch	12-46-37 Aug. 19th	4th

The others gave up.

WORKING STRESSES IN SOFTWOOD TIMBERS FOR USE IN THE FIELD.

By CAPTAIN O. L. ROBERTS, R.E.

INTRODUCTION.

Object.

This article is written with the object of determining working stresses of the more common softwoods suitable for use in the field. Any mention of uncommon types of timber has purposely been omitted for the sake of brevity and clearness. The article makes no pretension of being a complete treatise.

Reasons for Writing the Article.

Timber has been used for constructional work for centuries. Yet there is no agreement as to its strength.

Again and again the writer has been told that the stress values given in various text-books err very greatly on the side of safety, and more particularly in regard to the values of shear stresses. Since the War, several factors have affected the world timber supply, such as the decrease in Russian exports and the opening up of new country in British Columbia.

Since the War, too, much study has been devoted to the question of timber strength, and up-to-date tables of working stresses have been prepared, based on thousands of tests made by the Forest Departments of Canada and of the United States, both before and since the Great War. The results of these tests are not generally known in Great Britain. The writer feels, therefore, that there is some need for the application of the latest information to military use. Hence this article.

CLASSIFICATION.

Timber is generally classified into two main classes—softwoods and hardwoods. The characteristics of these two classes are well known and may be found in any text-book. From the point of view of field construction, it is worth recalling a few of the more important characteristics of softwoods.

Softwoods are relatively strong and tough in resisting cross stress, but weak and yielding in resistance to shear stresses. They are soft when subjected to crushing across the grain. Softwoods can be readily distinguished from hardwoods, since the former contain no pores or vessels.

Minor Classifications.

The various trees from which timber is obtained have been given so many names that anyone wishing to study the subject is apt to be confused from the outset. In many cases the same name is applied to two or more different trees. In addition, the same tree grown under varying climatic conditions possesses varying properties.

These variations due to climate, however, are not, as a rule, sufficiently marked to merit separate consideration for our purpose. Timber merchants, also, have their own method of classifying timber. They usually specify baulk timber of the coniferous varieties shipped from the European ports as Red Fir and White Fir, and when converted, as Redwood and Whitewood; though many term these Yellow and White Deals.

American timbers are distinguished as United States or Canadian Pine and Spruce. Carpenters and joiners class these timbers as Pine (the American Pines), Yellow Deal (European Pines), and White Deal (European and American Spruces). Baltic timber is a term used generally for all timber from Baltic Sea ports, but does not indicate quality or kind.

The following are the more common softwoods that are likely to be met with under service conditions in Europe or America. Asiatic and Australasian timbers have not been considered. In each case the alternative names in general use have been given.

British Columbia Pine (B.C. Pine).

Also known as:—Douglas Fir, Red Fir, Yellow Fir, Oregon Pine, Douglas Pine or Douglas Spruce.

Possesses features common to both spruce and pine. Hence the confusion of names. Recently imported into this country in increasing quantities.

Northern Pine.

Also known as:—Baltic Pine, Norway Pine, Scotch Fir, Swedish Fir, Red Fir, Baltic Fir or European Redwood, and when sawn, as Red Deal or Yellow Deal.

Covers all the pines shipped from the Baltic ports. Considerable variation in quality.

Red Pine.

Also known as:—Canadian Pine or Norway Pine.

Though not the same tree as the true Norway or Northern Pine, only an expert can distinguish the difference. Grown in the east of Canada.

Longleaf Pine.

Also known as:—Georgia Pine, Pitch Pine, Southern Pine, or Southern Yellow Pine.

The heaviest and strongest of all the pines, and has a high crushing resistance.

Several other pines are cut and shipped as Pitch Pine, though they are really of inferior quality.

Shortleaf Pine.

Also known as:—Yellow Pine, Southern Pine, or Carolina Pine.

Sometimes also wrongly called Pitch Pine, though not nearly as strong.

Loblolly Pine.

Also known as:—Virginia Pine, Shortleaf Pine, or Southern Pine.

White Pine.

Also known as:—Yellow Pine, America Pine, or Weymouth Pine.

Siberian Yellow Pine has similar properties.

Hemlock.

Also known as:—Alaska Spruce, Prince Albert Fir, Hemlock Spruce, or Western Hemlock.

Recently brought much more into use. About half-way between a spruce and a pine. Western Hemlock is superior to Eastern Hemlock.

Spruce.

There are many varieties of spruce, but since they all possess very similar properties, it is proposed to consider them under one head. Some of the varieties in common use are:—

White Spruce or Canadian Spruce, and sometimes also called White Pine.

Sitka Spruce, Giant Spruce, Silver Spruce, Alaska Spruce, Canadian Spruce, American Spruce or Western Spruce.

Black Spruce or Eastern Spruce.

Spruce Fir, Norway Fir, White Fir, or when sawn, White Deal. This is the European-grown spruce.

Larch.

Known in America and Canada as Western Larch in the west, and Tamarack in the east.

The European and American Larches have similar properties and may be considered under the same head.

Quality of Timber.

Defects.

Timber is subject to many defects and naturally its strength varies accordingly to a very great extent. A piece of timber of structural size will not show the same strength-resisting properties under test, as will a small test piece.

It is with structural sizes that we are concerned, but the values recommended in Table I are based on tests of both structural sizes and small test pieces. Of recent years increasing importance has been attached to the correct grading of timber. Since there are at least twenty different defects that may occur in timber, and since these defects themselves may vary greatly in their nature, any accurate grading rules are necessarily very complicated. Every officer should have a working knowledge of the effect of the more serious defects, sufficient for field purposes. The following rough grading rules for common structural timber are suggested as a guide, but they are necessarily very rough, and no such rules can take the place of practical experience. For more accurate grading rules the reader is referred to the publications mentioned in the bibliography at the end of this article.

1. *Knots.*

The mean diameter of a knot should not exceed a quarter of the width of the face in which it occurs.

The sum of the mean diameter of all knots within the centre half of the length of the beam should not exceed the width of the face in which they occur.

Knots should not occur in clusters.

2. *Shakes and Checks.*

The depth of a shake or check measured at the end of the timber should not exceed one-half of the width of the face of the timber.

Note.—The depth of a shake should be taken as the length of its vertical projection measured on either end of the timber.

3. *Slope of Grain.*

The angle of grain should not exceed 1 in 12.

4. *Sapwood.*

Sapwood may be allowed in all temporary structures.

Seasoning.

Most text-books state that green timber is very much weaker than seasoned timber. This is true, so long as the timber is efficiently seasoned. Unfortunately this is rarely the case. During the process

of seasoning nearly all timbers develop shakes, and a piece of so-called seasoned timber may well be considerably weaker than the original green timber.

Further, timber absorbs moisture and tends to return to the green state. The stresses considered in this article apply to green or partially-seasoned timber.

STRESSES TO BE CONSIDERED.

Text-books contain a multiplicity of terms for the various stresses, and confusion is the result. Considering bending, for instance, any of the following terms may be used: transverse strength, strength in bending, modulus of rupture, extreme fibre stress, etc., and these do not all mean the same thing.

For our purpose, and for most purposes, we require only to consider four types of stress, extreme fibre stress in bending, compression parallel to the grain, compression perpendicular to the grain and shear parallel to the grain.

Extreme Fibre Stress in Bending.

When a beam is subjected to bending, the upper fibres are in compression and the lower fibres are in tension. In theory, failure will commence as soon as the limit of compressive strength is reached. But at the moment when failure is about to occur, the lower fibres in tension tend to take more than their share of the load. Practical tests show this to be the case. As a result, a separate figure for extreme fibre stress in bending is required, which will be greater than the figure for compression parallel to the grain.

Compression Parallel to the Grain.

Timber is stronger in tension than in compression, but the difficulties of making a joint to take this tension are very great. As a result, timber is hardly ever used in tension, and there is consequently no need to consider a separate tensile working stress.

Compression Perpendicular to the Grain.

Timber crushes very much more easily when loaded across the grain than parallel to the grain. The figure for compression parallel to the grain covers any case of end grain loading, but a separate figure for cross grain loading is obviously necessary.

Shear Parallel to the Grain.

If there is shear stress set up in any one plane, there is also a stress of equal intensity at right angles to that plane. Timber is much stronger to resist shear across the grain, than along the grain.

But for any shear stress across the grain, there will be an equal stress along the grain. A figure for shear along the grain is therefore the only figure necessary, and this figure must not be exceeded by the maximum intensity of shear stress. Experimental results have shown that, for its size, the shearing strength of a small test piece of timber is much greater than that of a piece of timber of structural size. This is due to the presence of defects in the timber. Since defects will always exist, we should only consider the results of tests on pieces of timber of structural size. This is sometimes referred to in text-books, as longitudinal shear in beams, and it is with this that we are concerned.

Working Stresses.

In preparing the table of working stresses for field use (*vide* Table I), the writer has studied the results of tests and the recommendations contained in upwards of a dozen text-books. To give a summary of all these would make this article excessively long. Two extracts are, however, given.

Table II is an extract from the United States Forest Service Bulletin No. 122. The tests were made on green structural timber with ordinary defects.

Table III is a table of working stresses recommended in *Timber Design and Construction*, by H. S. Jacoby and R. P. Davis, published in 1930. These stresses are for green structural timber used in the construction of highway bridges and trestles and cover an allowance for live load.

Factor of Safety.

The factors of safety employed to obtain the figures shown in Table I are approximately as follows :—

Compression parallel to the grain and extreme fibre stress in bending :—

one-quarter of the ultimate breaking load,

or

one-half of the elastic limit.

Compression perpendicular to the grain :—

one-half of the elastic limit.

Shear parallel to the grain :—

one-half of the ultimate breaking load.

In considering the latter, a factor of safety of only 2 appears to be very low. But it must be remembered that, over and above this, allowance is made for the maximum intensity of shear stress, for

defects in the timber and for impact. Further, failure will never occur by shear alone, but by a combination of stresses set up by the bending of the beam.

Practical experience shows that this low factor of safety is justified and the figures for shear strength thereby obtained correspond to those recommended by most authorities.

HARDWOODS.

In this article only European and American timbers have been considered, since they are the only softwoods in common use in this country. Most of the hardwoods are obtained from Asia, Africa and Australasia, and it is proposed to deal with timbers from these continents in a later article. There are, however, four European and American hardwoods in common use. Recommended working stresses for these have been included in Table I.

NOTE.

The writer is greatly indebted to the President of the Forest Research Institute, Dehra Dun, for many valuable suggestions.

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TABLE I.

RECOMMENDED WORKING STRESSES EXPRESSED IN POUNDS PER SQUARE INCH.

For green or half-seasoned structural timber with ordinary defects.

Species.	Extreme fibre stress in bending.	Compression.		Shear parallel to the grain.
		Parallel to the grain.	Perpendicular to the grain.	
Longleaf Pine	1900	1700	400	170
British Columbia Pine ...	1800	1400	350	130
Shortleaf Pine	1600	1300	250	160
Loblolly Pine	1500	1200	300	150
Northern Pine	1500	1200	300	130
White Pine	1300	1100	220	100
Red Pine	1200	1000	220	130
Hemlock	1600	1400	300	130
Spruce	1500	1200	260	100
Larch	1400	1100	300	130
English Oak	2000	1900	600	200
White Oak	1600	1400	500	140
Ash	1900	1700	300	130
Elm	1600	1600	400	200

TABLE II.

AVERAGE OF TESTS USING GREEN STRUCTURAL TIMBER WITH ORDINARY DEFECTS.

Expressed in pounds per square inch.

From U.S. Forest Service Bulletin 122.

Species.	Bending.			Compression parallel to the grain.		Compression perpendicular to the grain elastic limit.
	Fibre stress at elastic limit.	Modulus of rupture.	Horizontal shear.	Compressive strength at elastic limit.	Crushing strength at maxm. load.	
Longleaf Pine	3734	6140	353	3480	4800	568
British Columbia Pine ...	3968	5983	166	2770	3495	570
Shortleaf Pine	3237	5548	332	2460	3435	351
Loblolly Pine	3040	5084	335	2050	2940	500
Red Pine	2492	3864	232	2065	2555	—
Hemlock	3516	5295	288	2910	3400	465
Western Larch...	3325	4918	288	2674	3509	456
Tamarack	2813	4556	261	2400	3230	—

TABLE III.

UNIT WORKING STRESSES FOR GREEN STRUCTURAL TIMBER EXPRESSED IN POUNDS PER SQUARE INCH.

For highway bridges and trestles.

Allowance for impact factor is included.

Species.	Bending, extreme fibre stress.	Shear.		Compression perpendicular to the grain.	Compression parallel to the grain.
		Parallel to the grain.	Longitudinal in beams.		
Longleaf Pine	1625	225	150	325	1625
British Columbia Pine ...	1500	212	137	387	1500
Shortleaf Pine	1375	212	162	212	1375
White Pine	1125	125	87	187	1250
Red Pine	1000	162	125	187	1000
Hemlock	1375	200	125	275	1500
Spruce	1250	187	87	225	1375
Larch (Tamarack)	1125	212	125	275	1250

MECHANIZATION AND DIVISIONAL ENGINEERS.

By

BREVET LIEUT.-COLONEL N. T. FITZPATRICK, D.S.O., M.C., *p.s.c.*, R.E.

PART I.

DURING the past two years the writer, as O.C. of the Mechanized and Experimental 17th Field Company, has been called on to deliver a number of lectures which have been illustrated by photographs and slides. The demand for such lectures in the various Commands has prompted him to put together something in article form, with a view to giving those who have to mechanize Sapper units in future the benefit of experience gained in the past.

I.—HISTORY OF THE MECHANIZED FIELD COMPANY.

The mechanization of field companies commenced in the 17th Field Company in 1927, when the establishment of Lieut.-Colonel Martel's Horsed Company was mechanized, and various bridging vehicles were at the same time also attached to this unit to enable it to experiment in addition with the mechanization of bridging equipment.

During 1927 and 1928, under Martel, the unit acted mainly as the Sapper Company of the Armoured Force, a formation which remained in being until the winter of 1928–1929, when it was disbanded to become, more or less, the present experimental 7th Infantry Brigade. During 1929 and 1930, the Company has been employed, under the writer's command, as a Mechanized Company in the 3rd Division, working with the 8th and 9th Infantry Brigades as well as with the experimental 7th Brigade.

Throughout this time a good deal of experimental work has been carried out in many spheres of activity of mechanized Divisional Engineers; much experience has been gained, many reports have been written, and it is recognized how greatly the efficiency of a field company may be increased by mechanization.

As regards Establishments: a Peace Establishment is laid down in *Peace Establishments*, 1931, a provisional War Establishment will be found in "Mechanized and Armoured Formations, 1929" (*The Purple Primer*), and the War Establishment is now under preparation. At present, still only one mechanized field company exists, but it is expected that at least one more field company will be mechanized in the near future.

As regards equipment. The rapid development of to-day in many kinds of engineering equipment in the civilian world, makes it difficult for the military engineer to keep fully in touch with all the possible means of carrying out field engineering; experiments are, however, continuously being carried out with the gear likely to meet military requirements, and from time to time decisions are made to incorporate certain types of plant in the field companies of the future.

After this brief introduction, it is now proposed to describe in the present article the vehicles and new equipment available in a mechanical unit, and also to give some examples showing what advantages can be gained by greater mobility and improvements in equipment. A second article will deal with mechanization and bridging work, and a third article will conclude the series with some notes on the training of personnel in a mechanized unit.

II.—Vehicles.

The following is an outline of proposals recently submitted for the War Establishment of a Mechanized Field Company:—

Outline of M.T. in a Mechanized Field Company, R.E.

Vehicle.	*H.Q.*	*Each Section.*	*Total.*
Reconnaissance car (light 6-wheeler)	1	–	1
Light cars (such as Austin 7) ...	1	1	5
Motor-cycles	1	1	5
Personnel light 6-wheelers ...	2	4	18
Light 6-wheelers:			
Technical equipment and stores	3	1	7
Office and Officers' mess ...	1	–	1
Mech. cooker (trailer)	1	–	1
Mech. water cart (trailer) ...	1	–	1

It will be seen that the light six-wheeler forms the basis of our mechanization and in consequence the outstanding points of this vehicle may be of interest.

The 14·9 h.p. Morris light six-wheeler, as shown in Photos 1 and 2, costs approximately £500, and has an estimated life of some 50,000 miles. Our experience in this company is that the H.P., combined with the gearing, is just about right for the engine to haul the 30-cwt. load along any route by which we may reasonably expect to march with M.T. There are two gear-boxes; the bottom speed in the low reduction provides a gear of 81 (104 in reverse) in which the vehicle climbs exceedingly well as long as

there is a grip, whilst running in " top " of the ordinary gear-box, the individual vehicle can travel along at 30, with an average of 15 m.p.h. ; petrol consumption 6–10 m.p.g., according to circumstances.

As regards tyres and tracks. The presence of eight wheels in the back axle has obvious advantages, but in spite of these many wheels to the coach, all tyres require constant attention and a punctured wheel allowed to spin round for any length of time will often result in an inner tube being reduced literally to ribbons. " Looking round " at halts remains as important as ever. About tracks ; one cannot help feeling that these are, as they say in modern histories, " a bad thing." Cumbersome to carry and often awkward to fit, they are very apt to wear out the walls in the tyres by chafing. It is thought that any big military demand for this type of vehicle would see tracks replaced by some form of fixture, permanently carried on the wheel and easily " set " to produce an increased grip, but without damaging tyres. Some arrangement on these lines would be a great improvement.

For loading, the Morris light six-wheeler, like others of its class, works to the following data :—

	Tons.	*Cwts.*
Front axle loaded	1	0
Back axle loaded	3	4
Total loaded...	4	4
Total unloaded	2	11
Load	1	13

With the seats and racks, as shown in Photo 2, each vehicle takes 13 completely equipped men ; rifles can be stored in the rack on the cab, each man sits on his blanket and the packs go into the compartments under the seating.

The tonneau body will only accommodate 10 men and the allowance of 3 for the front seat is apt to prove quite a tight fit, owing to the central gear levers and control ; in other words, the standard complement of 13 fills the vehicle with maximum of men it can be made to carry on the march.

The total weight, however, with 13 up comes only to 3 tons 14 cwt., which is 10 cwt. less than the permissible load and gives a corresponding amount in hand. This reserve of carrying power would enable one in an emergency to take a fair quantity of stores in the well of each personnel lorry ; it might also come in for hauling light trailers, and in many ways it should be a most useful reserve to have on service.

Section Tool Lorry.

The next vehicle in order of importance is the section tool lorry shown in Photos 3 and 4.

Except for additional winding arrangements described below, we have here the same chassis and engine as in the personnel vehicle. The derrick, winding gear and body work weigh 10 cwt., which leaves 1 ton for tools. At first sight this may seem none too much, but as a matter of fact the old double tool-cart only took 1,860 lb., and the technical equipment and blankets of a section used to overflow, with authority, into L.G.S. wagons carrying 963 lb. apiece.

As regards transport of tools, the compartments seen in the photographs should perhaps be regarded rather as a "mock up." The actual body was made of wood, is simple and quite satisfactory, but exact details cannot be fixed till the new War Establishment is issued.

Besides providing for the transport of equipment, this lorry provides also the means of supplying power to assist with field engineering. Working through the low reduction gear-box, the engine can be made to drive a 16-in. drum, taking about 100 feet of $\frac{3}{4}$-in. wire rope, which can either be led out straight to the rear or else be passed over the fixed derrick. The direct pull allows of the vehicle being used, without preparation, either as a holdfast or a winch taking $2\frac{1}{2}$ tons. The derrick provides a 9 ft. 6 in. lift, which again is available without preparation for weights up to 15 cwt., and after placing a sprag under the tail of the chassis it is capable of lifting weights up to $2\frac{1}{2}$ tons.

The sprag in question can be seen in Photograph 4 and can be placed in position in a matter of minutes.

The ease with which this lorry can be made to work as a holdfast, winch or derrick, and the adaptability and mobility of the whole arrangement gives the field company section, in certain circumstances, very great advantages.

H.Q. Technical Tools.

Photographs 5 and 6 show the H.Q. vehicles for technical tools, *i.e.*, light six-wheeler carrying power tools and light six-wheeler carrying compressor.

These lorries are normal light six-wheelers and replace G.S. wagons. A proportion of the tools carried will be the same as in the present equipment and the remainder will be power tools of the type seen in the photos and described later in more detail.

Reconnaissance Car.

The reconnaissance car (Photo 7) forms the Company Commander's horse, mobile office and home.

This again is a light six-wheeler, differing only from the ordinary vehicle by a slightly higher gearing which gives a road speed of 35–40 m.p.h. Petrol consumption 9 m.p.g.

An excellent affair; one's only criticism is that it can be a bit dusty and draughty and is awkward to sleep in, but these

minor matters would soon be put right in the field. The mobility and cross-country capabilities of the Company H.Q., its protection from the elements, and the availability of electric light whenever required, are all very great advantages.

Section Officer's Car.

Next comes the Section Officer's car, which in our case is the military model of the Austin Seven. (Photo 8.)

Something fairly fast of this kind is essential to enable the section officers to do their reconnaissance work and have time to think out the plan of work before the men, in their personnel light six-wheelers, arrive at the site. The military model is geared slightly lower than the civilian pattern, and also has larger tyres for cross-country work, but the machine remains quite speedy. Maximum road speed about 35 m.p.h. and in our kind of work the Austin's petrol consumption works out to be about 33 m.p.g.

In the writer's opinion, the military body of the vehicle could be improved. One of the features of this type should be that the subaltern is able to jump in and out of the machine really quickly. With the present body this is not by any means the case. The body is awkward to get into at the best of times, but in bad weather, with the hood up and one's overcoat on, it is quite impossible to go anything quicker than at a crawl into the driver's seat. Doors on each side (spare wheel at the rear), higher seating and a more serviceable hood appear very desirable improvements.

The original Establishments provided the subaltern with a combination, but these machines are not good enough. They have a poor cross-country capacity, as a result of which the subaltern would often reach a site after his section had already arrived, and in addition the combination is not suitable generally for work in a field company.

Cycles.

In addition to the foregoing, a proportion of solo motor-cycles is essential for long-distance D.R. work.

It is hoped that companies will also retain a few ordinary push-cycles for short distance D.R. duties. The motor-cycle D.R.s are usually going all out during the day, and when one finally moves into camp or billets, several short-distance messages have usually to be dealt with. We have obtained an issue of five push-cycles for trials in connection with the latter duties; distributed out one per Company H.Q. and one per section, they can easily be mounted up on the side of six-wheelers prior to M.T. marches and have proved invaluable. One feels convinced that a proportion of these machines would be found as valuable to a mechanized company on service as they are in peace in the way they save M.T. and M.T. personnel.

Administrative Vehicles.

There remain only the administrative vehicles to be described.

The company cooker appears to be still in the experimental stage. We have had for trial, and found satisfactory as a cooker, a large, four-wheeled trailer cooker, which was designed for 400 men and had to be towed behind a medium lorry. The field company, however, requires a machine to cook only for 250 men, and this type could either trail behind or be mounted up on a light six-wheeler. The requirements will, of course, be met in time, but in the meantime a mechanized field company on manœuvres has often to live cavalry fashion, *i.e.*, breakfast, a sandwich lunch and then a late dinner when one finally camps for the evening: imitation of other arms, even to this extent, is not at all " a good thing " !

The water cart (Photo 9) is, probably, only a makeshift, and an up-to-date vehicle will probably come out shortly.

The last vehicle requiring description is the light six-wheeler for company office and officers' mess. The vehicle should be adequate; the question of loading has not, as yet, been gone into in detail; and a good many fittings may be necessary both for transport and handiness, and in this particular vehicle side loading might be well worth consideration.

III.—Tools and Equipment.

It is now proposed to make a few remarks about tools and equipment and pending the issue of the new Establishment, this is a matter which can only be dealt with very broadly and on the basis of the existing equipment of the company.

To deal first of all with the compressors. Photograph 6 shows a Broom-Aster model, whilst Photograph 10 is of a Reavell.

With the recognition that this type of plant is essential in the modern Divisional Engineers, it becomes only a question of selecting the most suitable model for military purposes. The 35 h.p. Reavell is an excellent set, but weighing 2 tons and mounted on a four-wheeled trailer, a medium lorry is required to tow the plant and this may not quite suit. The Broom-Aster also does well; 25 h.p. and only 1 ton, it can be mounted on to a light six-wheeler, but this arrangement ties up a special flat body for the transport of one machine. A type of compressor on a single-axle trailer which could be towed behind any light lorry, would have many advantages.

We have repeatedly used compressors in various circumstances and have found them invariably easy to run and most reliable. Compressors, however, like other machines of this type, require constant attention both when in use and when not in use and with proper maintenance they give excellent service.

To pass on to some of the power tools with which experiments have been made with a view to incorporation in field company equipment.

The Rees' Turbo Pump; size 4 ft. 6 in. x 2 in. x 2 in., and weighing only 2 cwt., it can be manhandled wherever required and its two-cylinder engine works on about 2 g.p.h. A handy little plant, and our tests have shown that with a 2-in. intake, the machine can manage a lift up to 14 ft. and will deliver 3,000 g.p.h. at a 100-ft. head. These tests have only been over a few hours of running and one would like to try out this small plant under the conditions that would appertain on service. The main point, however, is that something of this nature will be provided in future field companies.

As regards water elevators. Experiments have been carried out with various types. We have had an Aquatole giving 700 g.p.m. at 80 ft. and a Boulton and Paul giving 1,300 g.p.m., also at 80 ft. The actual lifting devices of the various types have their advantages and disadvantages for the military user, but again the main point is that plant of this nature will be forthcoming.

Concerning other power tools like power saws. Various patterns are on the market to-day, several have been tried out, and it can be taken that the field companies of the future will be equipped in this respect.

A description has already been given of the power available in the section tool-cart lorry, with its winch and derrick. It is proposed that a proportion of larger machines of this type should be allowed in each field park company for work with Divisional Engineers. These vehicles would probably be frequently used by field company personnel, and in consequence a few details of the "medium derrick lorry" will be given at this juncture.

Here we have very much the same arrangement as in the tool-cart lorry. The derrick being mounted this time on a medium lorry, everything is bigger in proportion and the derrick has to be one which hinges over into a convenient position for travelling.

Engine h.p. in this vehicle is 38, and the cable drum is worked off the bottom speed (39) of the ordinary gear-box. The horizontal pull available in this case is 4½ tons, the only additional preparation being that with this heavy lorry one has to run the back wheels on to properly made steel scotches before taking any big pull of this nature. As regards lift, the derrick can be raised by 6 men in 2 minutes, gives a clear lift of 21 feet and with sprags under the tail (setting up is a matter of moments) one has a lift up to 4½ tons.

An *invaluable* machine—the bottom gearing in the low reduction gear-box is 94, in which this lorry can reach the most awkward sites, and if the drum were worked off the same gear, the power available on the cable would be even greater than with the present arrangement.

Photo 11 shows the derrick in the travelling position. The weight of the whole vehicle as above is 5 tons 12 cwt., the maximum loading of this lorry is 7 tons 15 cwt., so one has 2 tons available for stores—and it is surprising what can be stored on board this vehicle, in spite of the derrick members. Photos 13 and 14 are examples of the derrick lorry at work with its hauling and lifting tackle.

IV.—Advantages of Mechanization.

The following few examples show the advantages in the mobility of a mechanized field company.

The construction of a concrete structure, such as shown in Photo 12, looks a humdrum affair, but as a matter of fact it became an exceedingly good example of the value of field company M.T.

The work had to be carried out half-way up the side of a steep hill with no hard road approach; the nearest water was half a mile from the site, which in turn was six miles from our particular barracks. In all, some 12 cubic yards of concrete had to be laid and the war equivalent might have been a pill-box or an O.P. for an organized defensive position; the site being some distance away from company billets. As things went, a subaltern carried out the reconnaissance, together with his other work, during the first day. On the second day a party of 1 N.C.O. and 10 men (1 lorry) commenced work, and went out daily from barracks with the M.T. shown in Photograph 12, which had also to take all stores to site. At the end of the fourth day the foundations and floor were laid, and the walls were half-way up, and the job was completed very shortly afterwards.

With H.T. alone, the job would have taken considerably longer, and it would certainly have entailed a detachment camping near the site.

A test of a mechanized company's mobility over a period of days was carried out during the reconstruction of the Tidworth railway bridge. (See the *R.E. Journal* of December, 1930.)

The task was to demolish completely the old bridge and build a new bridge as quickly as possible, thus subjecting railway and road traffic to the minimum of interference.

We undertook to do the job in 96 hours, and to test out questions of mobility, we decided to continue sleeping and feeding in barracks, 5 miles from the site, and lorry over two 8-hour shifts, which alternated continuously, to and from their work.

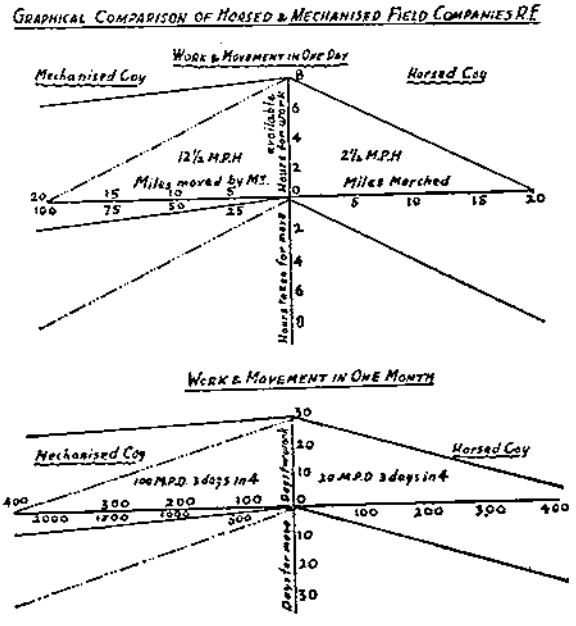
In spite of the very trying weather, the whole operation went admirably, the completed bridge carried its first train in 96 hours almost to the second, and the example shows how mechanization can increase a field company's radius of action for continuous effort.

The advantages in marching sappers by M.T. are well brought out in our recent moves to Wyke. For two years in succession the Company went down to the Bridging Camp at Wyke as an independent unit. On each occasion our hands were full both before departure and immediately on arrival and in consequence marches had to be carried out as expeditiously as possible. Distance 63 miles.

Each year we left Bulford at 8 a.m., reached Wyke by 12 noon, had dinner on arrival, and then put in a very full day's work to complete.

It takes an H.T. company four full days' marching to do the same morning's run.

To sum up the question of mobility, an attempt has been made to arrive at a graphic comparison in the matter. For the purpose of argument the working day is taken as being one of eight hours, and the following shows what may in certain circumstances be the gain in a mechanized field company's working power as a result of M.T.



V.

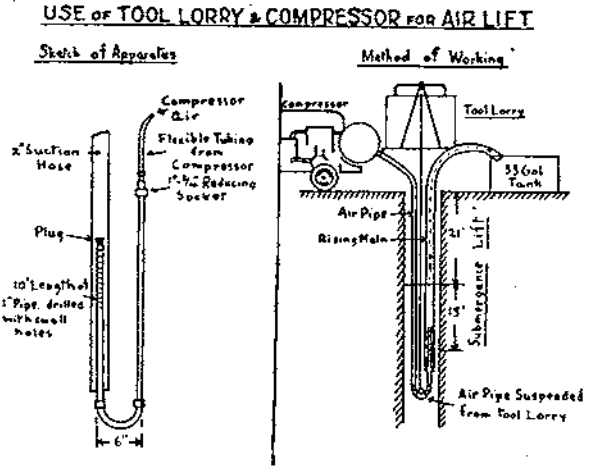
To turn now to some examples of the value of the modern equipment.

Photo 15 shows a compressor proving its value at a normal field works job. In this instance the compressor opened the ball by demolishing old concrete, after which the machine carried on working

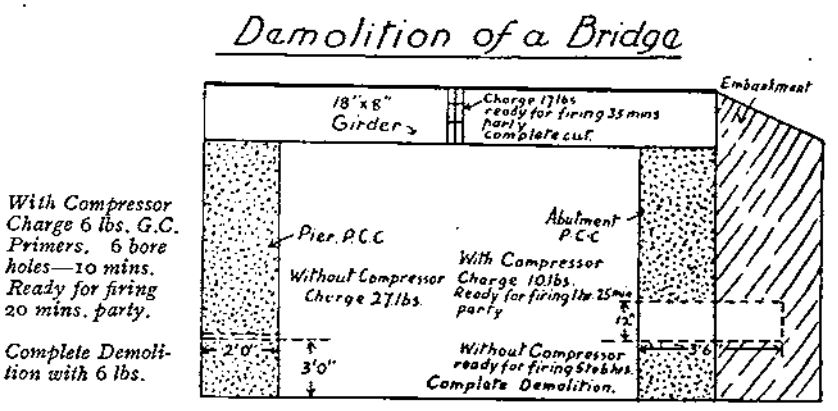
continuously, and ended up finally by enabling a couple of men with a pneumatic auger to drill in a very short time all the spike holes for the guard rails ($\frac{3}{4}$-in. holes through 12-in. oak at the rate of one a minute).

We have also found the compressor most valuable in hasty road clearing. For this kind of work the machine enables one to deal with rock outcrop without any of the delays which are unavoidable in blasting, whilst in hard soil, a spade point tool used as a pick will keep four shovels going "all out."

The following figure shows how a compressor can be harnessed up as an air lift, and requires no further comment.



The concluding examples of compressor work deal with demolitions.



The diagram gives dimensions at a pier and abutment made of the best concrete: the pier was 10 ft. long.

The demolition party consisted of 10 men, who tackled the pier

by drilling 6 holes, which with two tools worked from the same compressor, took in all nine minutes to drill. The drill holes were then filled with primers, giving a total of 6 lb. as against 27 lb. by the formula $\frac{2}{3}BT^2$. Alternative methods of firing were laid, and the party was ready to fire in 20 minutes from arrival at site.

Although only four charges went off (faulty cordeau) the entire length of pier was cut clean in half.

To tackle the abutment we decided to drive two holes 12 in. x 12 in. horizontally to a depth of 3 ft. 6 in., and here again we had the same party of 10 men, working two compressor tools. The men were ready to commence laying at the end of exactly an hour's excavation, and the charges were ready for firing at the end of a further half-hour's work; total 1½ hours. Without a compressor, the job would have been one taking several hours, whichever way one might have set about it.

As regards road craters. The prospect of being called upon to carry out rapid cratering of modern heavy roadways is regarded with concern and we experimented to see what could be done with a compressor on six inches of reinforced concrete road, laid on 9 in. of graded rubble.

The concrete breaker, with a special tool for the steel in the reinforcement, was used to work through the top skin, and subsequently an auger and miner's pick were used in conjunction.

We were through the concrete in 15 minutes and down to 2 feet in 30 minutes; we were down to 6 feet in 65 minutes, and the mixed charge of 36 lb. of guncotton and ammonal was laid and ready for firing at Z plus 1½ hours.

The crater was 18 ft. in diameter and 6 ft. deep.

Demolitions of this nature, well sited and contaminated, might be well worth the doing, and methods such as the one described above should be practicable even in hasty demolition work.

As regards data for drilling through concrete, we have had several cases where rates have worked out in the nature of 1 foot in 1 minute and 6 feet in 30 minutes.

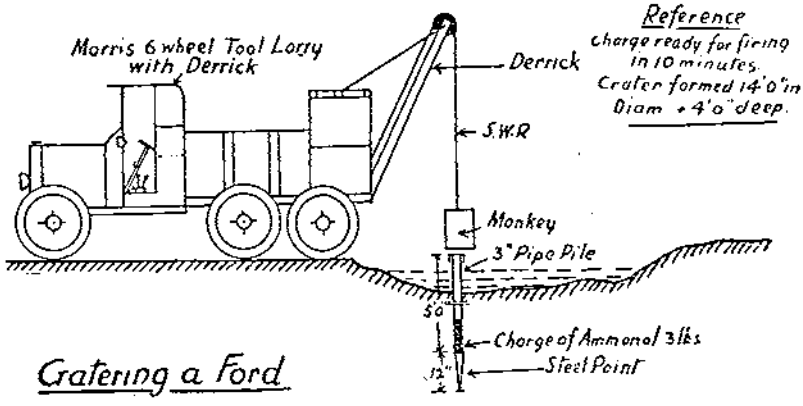
As regards drill holes, we have often been asked whether any difficulty was experienced in drilling the holes straight and our answer has been in the negative. We have found that compressor drill work is well within the compass of the normal man of ordinary good physique, and as regards the straightness of drills, we have repeatedly tested them with a broom handle and found them quite satisfactory. Drill points require particularly careful maintenance, but again it is considered that this task is well within the capabilities of field company personnel.

From demolitions one turns to another type of obstacle, the construction of which has come about through mechanization.

Owing to "river lines" becoming of increasing importance on

account of their power of stopping armoured fighting vehicles, we were called upon to try to devise a quick method of making fords impassable for mechanized forces.

There might have been various ways of attempting to solve the problem on an assumption that heavy material would providentially be available at site. Besides the unreality of such assumptions, however, it was felt that a supply of heavy hawsers or chains, would, as a matter of fact, hardly provide one with the means of blocking a ford effectively for any length of time. In consequence, we decided to rely on explosives and devise a means of cratering in fords.



Cratering a Ford

The diagram above gives our solution, the simple article of store being a 3-in. pipe fitted with a point and cap.

In the actual experiment, this pile was driven home four feet in a matter of minutes, by using the tool-cart derrick as a pile-driver. The watertight cap was then taken off and the prepared 3-lb. charge of ammonal was dropped down the pipe; earth was run in from a sandbag and the whole charge was ready within ten minutes of arrival.

Conditions give perfect tamping, and the experiment produced a crater 14 ft. wide and 4 ft. deep.

Pipes such as these could easily be made up beforehand by the unit and a series of charges could be rapidly laid by some means as described with the use of a light six-wheeler. The work appears to come well within the hasty demolition category and at the same time it should provide an effective obstacle; it is felt that fords, properly " treated " as above, should become impassable for any A.F.V.

To touch now on the question of pile-driving.

Developments in the civilian world in this respect lead to consider-

ing the use of new plant for military purposes and various experiments have been carried out with an internal combustion pile-driver, manufactured by Messrs. H. Johnston & Sons, Ltd.

Photo 16 shows an internal combustion pile-driver mounted on a lorry. An ingenious and efficient machine, weighing in all about 400 lb., the engine a simple two-stroke affair, burning benzole for preference. 40 blows a minute ; 15 cwt. kinetic.

The stand supplied by the makers is a light and workmanlike tripod, which carries the guide seen in the photograph, and it is with the apparatus thus supplied that one would normally work. To test, however, the military possibilities of the arrangement, we tried the plant on a medium pontoon raft, where we found it worked admirably, and we also rigged the guide and pile-driver on the lorry, as in the photograph ; here again we found that it worked excellently.

The whole arrangement seems a first-class example of mechanization and may prove very useful for military purposes.

Messrs. Johnston also make smaller models, weighing 200 lb. and 140 lb., with which we have also been experimenting ; these models may be of value as light pile-drivers and power picks for excavations such as those in signal permanent lines.

To turn now to an example of a normal field works job to show the advantages of a mechanized company's power of lifting and hauling, one can hardly better the instance of the work at Tidworth Bridge.

During all the demolition work, and reconstruction which involved launching heavy trestles and girders, we did not make a single picket holdfast or use a single ordinary derrick. All the work was done by one medium derrick lorry and two section tool-cart lorries ; these machines proved themselves first-class winches, holdfasts and derricks and at the same time showed the great advantages obtainable from their mobility and handiness.

As regards night work. It is amazing the speed at which field company M.T. can be led across country at night ; the directing party has to remain on foot and special arrangements have to be made for the M.T., but still a mechanized company, even during night operations, seems likely to retain much of its superior mobility.

A further asset at night in an M.T. company is the manner in which ordinary lorry headlamps can be rigged up to illuminate a job.

The normal lamp can be focussed up to give quite a good illuminated area 40 yd. x 5 yd., the four lamps on a lorry will give 80 yd. x 10 yd. Four bays of medium bridge come to some 30 yd., and allowing 20 yd. on each bank of construction, we get a total of only 70 yd., which gives one an example of the possibilities of one light six-wheeler in this respect.

A point in this connection which seems well worth investigating is

Photo 1.—Personnel Light Six-wheeler—side view.

Photo 3.—Section Tool Lorry—side view.

Photo 4.—Section Tool Lorry—end view.

Photo 2.—Personnel Light Six-wheeler—end view.

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Photo 5.—Light Six-wheeler loaded with Power Pump, Power Saw, Water Elevator, etc.

Photo 6.—Light Six-wheeler. Loaded with Compressor Plant.

Photo 7.—Company Commander's Reconnaissance Car.

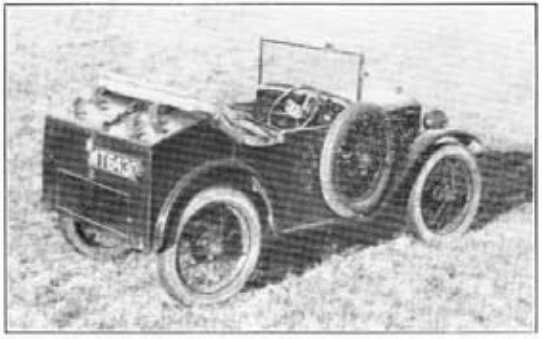

Photo 8.—Section Officer's Austin 7.

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Photo 9.—Water Lorry.

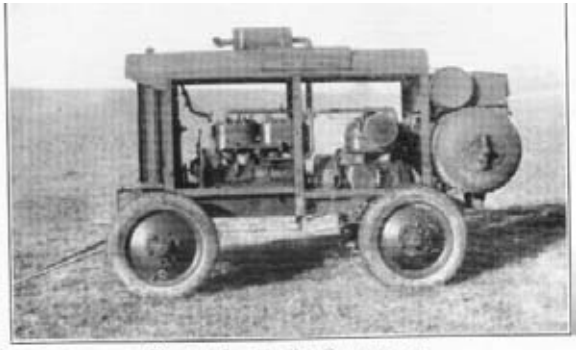

Photo 10.—Trailer Compressor.

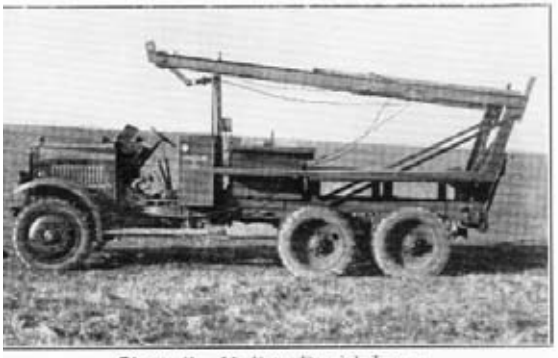

Photo 11.—Medium Derrick Lorry.

Photo 12.—Concrete Hut.

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Photo 13.—Medium Derrick Lorry—lifting tackle.

Photo 14.—Medium Derrick Lorry—hauling tackle.

Photo 15.—Medium Derrick Lorry—at work.

Photo 16.—Internal Combustion Pile-driver.

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the replacement, in certain circumstances, of normal lighting by blue-coloured light. The Royal Navy use this shade of light considerably, and from the few experiments we have done, the matter seems worth following up, both for lamps and torches in the forward area and also for sidings and such places in the rear.

VI.

To conclude these notes on the mechanization of field companies, it is thought that some observations on the subject of money and man-power would be of interest.

As regards finance. A party of Australian officers who were recently attached to the Company, were good enough to work out a comparison between raising and maintaining a horsed and a mechanized field company. The personnel in both units was taken as being the same, and the following figures were arrived at :—

	Capital Cost.	*Annual Cost.*
Horse transport	£25,350	£18,700
Mechanical transport	£26,550	£20,200

The Australians reckoned that, even apart from the advantages of mobility, the advantages in the technical possibilities of a mechanized unit were so great as to make the mass mechanization of all field companies " a sure thing " one day.

As regards numbers. The advantages of mechanization might at first be held to justify some reduction of man-power, but as a matter of fact this is by no means the case. The advantages in question are undoubtedly great, but it is equally certain that they only occur in certain circumstances and on many occasions requirements will only be met by having a sufficiency of sappers working in the ordinary way with ordinary tools. The needs of a modern army are steadily increasing in many directions, and one can see how the demands in field engineering will inevitably rise to meet domestic, tactical and strategical requirements of the future. In spite of this, however, and also the recommendations of the Rawlinson Committee, there have been no increases in the strength of Engineer formations, and, moreover, the pioneer battalions in the Home Establishment have been done away with.

In the face of the foregoing, it is felt that the mechanization of all the existing Engineer resources within the Division will be the only means of meeting the engineering requirements of the future.

(To be continued.)

SURVEY SIDELIGHTS.

By CAPTAIN J. C. T. WILLIS, R.E.

II

THE manager of the Sungei Barankali Rubber Estate had no social ambition. This was perhaps as well, for his opportunities of gratifying it were limited to the society of his assistant, a somewhat self-centred youth with a passion for stamp-collecting. And anyway, when you have known a man intimately for about three years, you do begin to feel that his best stories and most carefully selected anecdotes have lost their original savour and that the listener's attention is occupied only in gauging the extent, if any, of the departure from his original or authorized version. To the manager the game of bridge was at once a hobby, a vice and a religion, and his ever-recurring hope was to assemble three other people to play with him. This bridge was not the same game that you and I play, where the sexes intermingle, where all is friendly chat and the backs of the cards are apt to exhibit to the qualified observer a variety of cuts and stains which he who shrewdly scans may read, and having read aright may win; but real hard deep-thinking bridge.

It is obvious that, if it takes two to make a quarrel and four to play bridge, the manager's opportunities for envy, hatred, malice and all uncharitableness were far more numerous than his games of cards. Such were his troubles, and now his character. Nature had in the first place made him vague and absent-minded, and Fate through the monotony of countless rows of rubber trees was continuing Nature's work effectively. Of this constantly increasing vagueness he was well aware, and deliberately set himself to overcome it by instituting a vigorous time-table for each and every hour of the day, so much so that, having originally regulated his actions by his watch, he was now in a position to reverse the procedure and for all practical purposes could dispense with his timepiece altogether.

Month followed month, punctuated at rare intervals by the visiting agent and by the infrequent calls of the Inspector of Forests, who never failed to look in at the little *attap*-roofed bungalow when his duties brought him to that neighbourhood and to retail to the manager those humorous stories, reputed to emanate from the Stock

Exchange, which are legal tender for payment for hospitality received. On such occasions the assistant was summoned, the resources of the establishment in food and drink were taxed to the uttermost, the Chinese boy worked overtime and finished up the remains, and "an enjoyable evening was had by all." But no bridge. For to the bridge enthusiast the cut-throat variety of the game fills the soul with nausea and the mind with hatred of one's fellow-man.

There was one visit of the Inspector, however, which differed from all its forerunners, though it began much as usual. At about 6.30 in the evening the Inspector was seen walking up the drive to the bungalow. The manager, clad in a sarong which would have made Joseph's coat look like a badly-cleaned blackboard, was sitting on the verandah. On his visitor's approach he kicked a second chair into a convenient position, let out a yell of "B-o-o-y" and relit his pipe. The boy produced another bottle of whisky, an extra glass and a tin of cigarettes, and retired to double the quantity of soup with the aid of the cook-house tap, and to arrange his master's meat course into two separate heaps, which, garnished with a slice of boiled egg and a sprig of unidentifiable greenery, would serve as an entrée. He then started out with a large knife to catch, kill, pluck and cook whichever of the unconscious chickens straying around the compound was least able to take care of itself in an emergency.

Meantime, the manager and the Inspector fell to discussing what little news either had to exchange, raising their voices at intervals above the terrified squawking from outside which told only too clearly that *poulet* would once again figure inevitably on the menu.

So far, everything had followed the usual routine, when at this juncture a new figure, a stranger, was seen picking his way between the beds of *kannas* in the rapidly falling night. He also mounted to the verandah, explaining that he was a surveyor wandering in the neighbourhood in search of hills suitable for trig. stations. Again the boy produced an extra glass, and disappeared to wonder how much more water the already pallid soup would stand and to lament over the extreme youth and consequent small stature of the chicken which had fallen a victim to his previous onslaught.

The manager had only one question on his lips: "Do you play bridge?" The surveyor admitted it, and with a shout of joy, a coolie was dispatched to the assistant's bungalow bidding him come and dine, for there was at last a four for bridge. He came at once, another glass was produced, and it was broken to the boy that there would be four to dinner. This news he received with outward calm, the more so because he realized that, if the assistant was dining with the manager at short notice, there would quite obviously be one dinner already half-prepared which would not now be required, and could be hastily co-opted. He produced more whisky, an extra glass

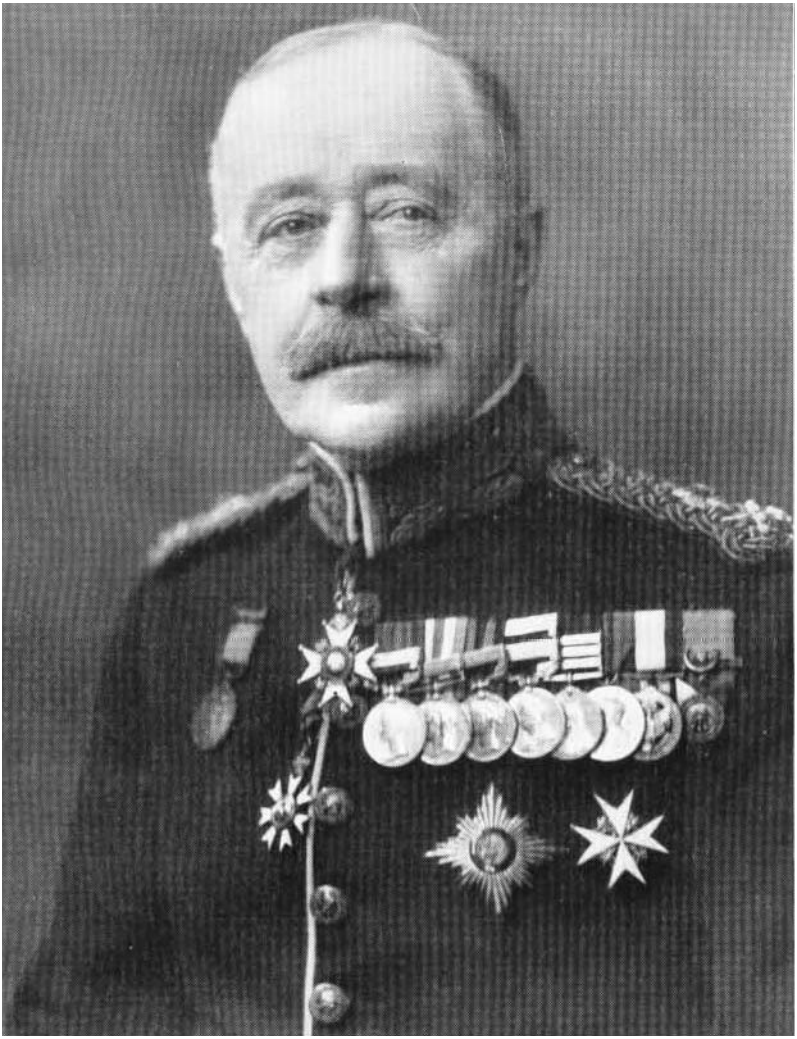
in case of emergencies, and disappeared in the direction of the assistant's bungalow, hoping that the blend of whisky would be sufficient to stifle any criticism of the strange blend of soup that was likely to be provided for the guests.

Half an hour later, dinner was served in the centre of the bungalow, a gloomy ill-lit room where the creaking punkah served only to stir the hot air and to produce fantastic dancing shadows on the damp walls. The four white men rose, bringing with them the bottle and their glasses, and seated themselves at a table, adorned, as is that of every bachelor in Malaya, with a bottle of Worcester sauce and an egg-cup full of toothpicks. To the surveyor it was almost a feast, for most of his previous meals had been eaten off the edge of a camp table in a tent in which it was impossible to stand upright. To the manager, his general vagueness accentuated by whisky, it seemed much the same as he had eaten every night. While to the assistant it was a source of wonder that two soups, each presumably quite pleasant in themselves, should combine to produce so foul a mixture.

Conversation did not flag and dealt, not with coolies and rubber trees and trigs., but, as often when exiles meet, with Piccadilly and long-forgotten musical comedies. The manager did not join in much, feeling vaguely that something was amiss. His routine had been thrown out of gear and he became vaguer still. Dinner came to an end, as must even one composed largely of a chicken which had but one hour previously discovered to its cost that it was appreciably less active than a Chinese boy. In solemn state the bridge table was produced in the verandah, and they settled down eagerly to the long-denied game with a cheerfulness that even their host's steadily increasing abstraction could not damp. Hands were dealt and the manager was dummy. He laid his cards upon the table and wandered dreamily off to his bedroom to collect his pipe. On his dressing table, there lay the pipe, and beside it his watch—a quarter past ten. The manager stared dreamily at it, wondering vaguely how it had come about that he was a quarter of an hour later than usual in going to bed. Such a thing had not happened for a long time; his well-worn routine had been rudely disturbed. However, he thought, as he brushed his teeth, climbed into his pyjamas and got into bed, it must not occur again. If he didn't keep to some sort of routine, he would be all over the place. Nothing like regularity of habits, nothing—like—he was asleep.

* * * * * * *

The hand was played, the scores were marked, the next hand dealt, and the guests patiently awaited their host's return. After some discussion the assistant was commissioned to investigate. Even on the threshold deep regular breathing told its own tale. Routine had triumphed. To this day the manager is still looking forward to the day when he can at last get together a bridge four.



Major-General Sir Francis George Bond, KBE, CB, CMG

MEMOIR.

MAJOR-GENERAL SIR FRANCIS GEORGE BOND, K.B.E., C.B., C.M.G.

FRANCIS GEORGE BOND was born 10th August, 1856; educated at Marlborough, Wimbledon and R.M.A.; commissioned August, 1876. He was originally intended for a naval chaplain, his father being a clergyman and the son of an Admiral; but in deciding eventually for the Army he chose, perhaps instinctively, the profession best fitted for the exercise of his many fine, indeed outstanding, qualities. His equipment for a soldier's career was ideal.

He was fortunate in his parents, in his upbringing and in the gifts of nature.

As a schoolboy and cadet he is thus described by his contemporaries: "A very bright, good-looking boy, who won general admiration by his mental and bodily superiority. Above these gifts, however, stood out that fine character which distinguished him throughout life, and which was an incentive to good to many with whom he came in close contact." "From his charming manner and disposition he was popular with all in his class. . . . I should say the smartest U.O. of his time at the R.M.A." "One of the smartest cadets of his time."

He passed third out of Woolwich in a good batch, which was a sufficient certificate of brains. Arrived at manhood, he was of strong physique and strong intelligence. He had played Rugby football for the Shop, and Association for the Corps at a time when our eleven was almost at its best. He was a powerful oar, and a strong and accomplished horseman; a good shot with gun and rifle. With his strength he had great endurance. Naturally quick-tempered, he had learnt to control himself. As a young officer he was the best of companions, popular in all society and taking life cheerfully as a young soldier should.

His selection for the Telegraph Troop at Aldershot on leaving the S.M.E. proved that he had already made his mark, and was the commencement of a career of such varied interest as perhaps only falls to the lot of a Sapper. To follow it in detail would take up space that can be more usefully employed; but it may be said at

once that, like so many of our brother officers, what his hand found to do, he did it with his might.

He took part in the Zulu Campaign of 1879 and the Egyptian Expedition of 1882, and then became Adjutant at Aldershot.

Of that period he left these impressions on his brother officers. . . . "Friendly kindness combined with smartness and efficiency." "Not only a very delightful personality, but an extremely smart and efficient officer, with whom it was a great privilege to serve."

He had the good fortune to see three more campaigns: Hazara (1891), Tirah (1897) (wounded) and South Africa (1901-2). Apart from the last of these, almost all his service after he was promoted Captain was in India.

In 1887 he was selected by Sir Bindon Blood for the Bengal Sappers and Miners, then being re-organized, and remained with that Corps until 1891. Then followed some successful spells of civil engineering, broken by a short term of home service. During this, as commander of A Pontoon Troop, he earned the Humane Society's Bronze Medal for saving the life of a Sapper.

In 1896 he became Superintendent of Instruction at Roorkee, where, says one witness, "he was the moving spirit, expanding his own branch of the work, and giving a wide outlook to the whole Corps."

Then he was appointed C.R.E. of a Frontier district, but Sir Bindon had not lost sight of him, and when the General went to South Africa in 1901, Bond followed him, becoming D.A.A.G. of the 4th Division.

When Sir Bindon returned to India, Bond remained as Chief Staff Officer in the Eastern Transvaal. There he first came into close touch with Lord Kitchener, with whom he was in constant communication; and it was afterwards a legitimate source of pride to him that, when General Fetherstonhough arrived to succeed Sir Bindon, the new General told him that the C.-in-C.'s instructions had been, "Don't interfere with Bond"; which instructions he cheerfully carried out and gave his Staff Officer a free hand.

He was then a senior Major, and at the end of the campaign was strongly recommended for a brevet colonelcy, but was given a C.B. instead.

We next find him Commandant of the Q.O. Madras Sappers and Miners; and in 1904 A.Q.M.G. Punjab Command under Sir Bindon Blood. He was then largely responsible for the successful concentration and review of four divisions, before his present Majesty King George V.

In 1906 he became D.Q.M.G. at Army Headquarters, Simla, and renewed his acquaintance with Lord Kitchener, who in 1908 selected him as Director-General of Military Works.

In the matter of army promotion, luck was, however, once more

against him. Just at that time, the appointment of D.G.M.W. was graded as that of a Brigadier-General, and Lord Kitchener's recommendation of local rank as Major-General was refused.

In 1911 he was appointed to command the Southern Brigade with Headquarters at Wellington, Madras. Sir O'Moore Creagh, then C.-in-C., sent home a strong recommendation for his promotion to Major-General, but it came too late, and in August, 1913, he reached the age limit and retired.

Two months after the outbreak of the Great War, Bond was called to the War Office as Assistant Director of Quartering. He was recommended by the Selection Board for the command of one of the first eighteen divisions of the New Army to proceed overseas, but to his intense disappointment Lord Kitchener decided that he could not be spared from his job at the War Office. In October, 1917, he became Director of Quartering and continued to hold the appointment until March, 1919.

That is merely a broad outline of Frank Bond's military career. To give a full account of all his many activities would need the scope of a book. Here I can only attempt to describe the man. What manner of man was he, of whom all his old friends write now in superlatives, and use the word "affection," not too common among us to-day?

The keynotes of his life were service and sacrifice. Apart from his army work, which was done with characteristic thoroughness and left him little enough time for amusement, all his life he was working for others and trying to help them.

Of his self-sacrifice two instances must suffice. When he first went to Aldershot he was a cheery companion who thoroughly enjoyed a pipe and a glass and a social evening, and had not the suggestion of a fad about him. But he took the blue ribbon, in order that he might be able to talk more effectively to his men about temperance; and in those far-off days it required some strength of mind. Many years later, it is known to the writer that he refused a high decoration in order that it might be given to a brother officer who had suffered a disappointment.

It was in the early days at Aldershot that that strong sense of religion developed, which had hitherto been partly dormant, but which was to become the leading impulse of his life. He never obtruded it. An ordinary Gallio might share a day's shooting with him, or spend a long evening discussing all sorts of topics, without knowing what were his religious views. Moreover, he was very broad-minded and perfectly tolerant of other men's opinions. But his own path was quite plain to him, and he spent very much of his time in trying to help others on what he felt to be the right road.

One who was a Chaplain at Aldershot in the days when he was Adjutant writes, "He was a thoroughly spiritually minded man,

without any 'cant,' and as far as I know did not employ what some of us called the 'button-hole system' in dealing with others in spiritual matters. He was a thorough sportsman and was always planning for the comfort, welfare and amusements of his men."

Another, who was a curate at Simla when Bond was D.G.M.W., writes, "It was my privilege to get to know him well. His amazing kindliness and sympathy, combined with his knowledge and understanding, made him at once a personality whom all men loved and revered. His look and manner of speaking to one, his splendid appearance—I share with many of his friends the memory of these things and the certainty that we are the better for having known him. . . . Early impressions of people on a young man in a new country are of immense importance, and I know that I owe to Francis Bond more than I can ever write in words."

Of his many activities at this time it is sufficient to mention that he was an active lay-reader of the Lahore Diocese, the holder of high office in the District Grand Lodge of Freemasons of the Punjab, a member of the council of several institutions and a strong supporter of the Boy Scout movement, of which he became the Chief Commissioner for India.

Let us turn to consider him again as a soldier.

An old friend writes of "his wonderfully attractive personality. . . . How quick he was to see the humorous side of a situation and how down on the slacker and the fraud."

Many of those who served under him in the early days in India have since earned high distinction and their words have weight. One says: "He was a smart officer, with great tact and *savoir faire*. He was always a charming companion. He was very human, and never rubbed in his views, but he undoubtedly always had a good influence on those who were serving with him, in a quiet way. . . . He was a fine soldier and a good man, and I am proud to think that we were friends long ago."

Another writes: "He possessed, in a pre-eminent degree, all those qualities which make a man esteemed and looked up to by his fellowmen."

And yet another: "He made the Company a very happy family, and his patience was wonderful. I learnt many lessons from him which were of the greatest value . . . and I shall always remember with admiration and affection his courteous manner, quiet but thorough efficiency, and absolute firmness in doing what he considered right."

One of his Staff Officers in later times writes: "I may say that his judgments always struck me as being exceedingly sound, and he took the big view of things. . . . He was the most courtly gentleman I have ever met."

General Sir Bindon Blood writes that he first noticed Bond as a promising youngster in Zululand, and met him again in Egypt in 1882, when he was selected to organize and equip a mounted detachment of Sappers to accompany the cavalry to Cairo after the battle of Tel el Kebir. The cavalry covered some 60 miles in 24 hours or less, and Frank Bond and his Sappers were "all there" when Cairo was reached and occupied. He tells how Bond as A.Q.M.G. Northern Command took his full share in the management of the Rawal Pindi manœuvres of 1905. "Not only did the manœuvres, in which over 62,000 men took part, come off without a hitch, but at their conclusion, at noon on a certain day, with the troops scattered over the country from 12 to 20 miles from Rawal Pindi, they were all got into prepared standing camps round that station the same evening, their full-dress uniforms were served out to them the same night, and they were ready for the Prince the next morning, over 55,000 strong, at 10.30. On that parade my staff also managed, without rehearsal, the march past of four Divisions, complete in all arms, in masses of some 12,000 men each—a performance that had a most imposing effect and, so far as I know, remains unequalled. . . . I have watched Frank Bond's progress and his many important and brilliant services to the country, including his work in the Great War. To the end he was the same as always—a soldier and a gentleman, a pattern to us all."

Concerning his services in the War as Director of Quartering, there is room to quote only two extracts. The C.-in-C. of the American forces, in offering him their Distinguished Service Medal, wrote, "As Director of Quartering you performed important duties with exceptional distinction. Met at every turn by new difficulties, you acted aggressively and with discretion, surmounting all obstacles and achieving a brilliant success."

The D.G.M.S. wrote, "What we should have done without you as D.Q. I do not know. Whenever I have become anxious and depressed, I have had the consoling thought that *you* were the one man who could steer us clear of a breakdown as regards hospital accommodation."

Finally it is important to note that Lord Kitchener thought highly of his judgment. On one occasion during the War, the S.-of-S. sent him some papers, asking him to write an opinion on a question of strategy of the highest importance. He begged to be excused, pointing out that the question was not in his province and that he was not in possession of enough information. K., however, insisted, and Bond, having considered the papers, wrote a strong minute, advocating a course which was not in accordance with that proposed in a very high quarter. K. said he quite agreed and decided accordingly. It remains to add that the event justified his opinion.

For his services in the War, Bond received the honorary rank of

Major-General, and was created successively C.M.G., K.B.E., and a Knight of Grace of the Order of St. John of Jerusalem.

After the War he joined the Ministry of Pensions, with the duty of organizing hospitals for the care of the disabled. This appointment he resigned in December, 1919, and retired to Camberley. Thenceforward until his last illness he gave his whole time and energy to a variety of Corps and local interests. Notably as regards the Corps, he undertook the Hon. Secretaryship of the Corps Charities in April, 1914, and held it with intervals until 1921, remaining a member of the Committee until 1928.

In February, 1928, a severe heart attack obliged him to relinquish all his activities, and after a long illness, borne with characteristic cheerfulness, he died at Camberley on the 15th of August, 1930.

He was married in February, 1881, to Alice Maud Vivian, who survives him. He leaves two sons, both now serving in the Corps: Lt.-Col. L. V. Bond and Major R. L. Bond. His eldest son died while an undergraduate at Cambridge: his youngest, Frederick, as a Lieut. in the R.F.A., was killed early in the Great War.

L.J.

ERRATUM.

IT is regretted that an error was made in the Memoir of Sir Gordon Guggisberg published in *The R.E. Journal* of March, 1931. The last paragraph should read "Guggisberg married first Miss Way," and not as given in the Memoir.

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

MARÉCHAL FOCH.

Mémoires pour servir à l'Histoire de la Guerre de 1914–1918. Two volumes. (Paris: Plon. 60f.)

THE MÉMOIRS OF MARSHAL FOCH.

Translated by COLONEL T. BENTLEY MOTT.

(Heinemann. 25s. net.)

(Reprinted, by permission, from *The Times Literary Supplement.*)

Fifty years ago the nephews of Field-Marshal Graf Moltke suggested to him that he should write a true account of the Franco-German War of 1870–71. He raised objections; the nephews, who were his heirs, were persistent; at last the old man said, "Put the Official History on my table." Thenceforward nearly every morning he was seen writing; but he locked up the manuscript carefully in his desk. On his death his nephews found that he had merely compiled a careful précis—now long forgotten—of the official work.

M. le Maréchal Foch was not so wise. A note tells us: "In the course of the "year 1920 Marshal Foch, yielding to the insistence of those about him, decided to "write his reminiscences of the War. He directed his staff officers to collect the "necessary documents and to draw up a strictly objective recital of the events in "which he had taken part." Between 1921 and 1928 the Marshal used this recital "as a framework, which he considerably altered and enlarged," for his narrative, adding his personal reflections and recollections; and we are informed that the reader has before him "the thoughts of the War's great victor exactly as he set them "down." The insistence of those about the Marshal has at any rate resulted in his composing a foreword of nineteen pages summarizing his life and education, and a shorter preface dealing with the outbreak of War and the fallacies of the French General Staff doctrine, "limited . . . for all ranks to one magnificent formula: the "offensive." Both foreword and preface are deserving of close attention. The body of the book is not, however, the memorial one would like to see of this great French soldier. He was obviously little interested in, perhaps would gladly have forgotten, the earlier part of the War, before he received the strategic command; for his share in it was far from brilliant. The narrative of it is in many places inaccurate and remarkable for what it leaves out. The account even of the later period, which properly takes up more than half the book, betrays an old man's vanity, an inclination to attribute too large a share of the final success to the French, and a desire to exhibit M. Clemenceau in an unfavourable light.

It is necessary to go into some detail in order to show the character of the memoirs. The first chapter, concerned with his command of the XX Corps, is a bald military précis, and, no map having been provided, it is, as it stands, most unintelligible. By the aid of the excellent French and Bavarian Official Histories, we can, however,

follow what happened. Deceived by the planned German withdrawal, the XX Corps on the northern flank of the Second Army (Castelnau) was hurried forward by its commander into the trap of Morhange; held in front and attacked heavily on its carelessly guarded flank, its divisions retired with precipitance. The Marshal is inclined most unfairly to lay the blame for the disaster on the Army commander, but also on the Germans for having marked the ranges by putting up posts!

The account of the share of his command, the Ninth Army, in the Battle of the Marne is a remarkable exposure of his failure, both at the time and afterwards, to realize the situation. His conception of the way to carry out Joffre's instruction "to cover the right of the Fifth Army [Franchet d'Esperey, the flank of the offensive left wing]" was to advance. He was, as at Morhange, surprised; as he puts it, the enemy "succeeded in massing his infantry only a few hundred yards from our "position . . . suddenly . . . without any artillery preparation, these masses were "launched to the attack. . . . I asked for aid from the armies on my flanks." So vehement were his appeals for help that Franchet d'Esperey, whom he should have protected, lent him a whole corps. Thus the French Fifth Army was crippled, and stretched to the east instead of the west; this probably accounted for its not getting in touch with the B.E.F. on its left. It had, at any rate, the consequence that Sir John French, his right flank thereby exposed, went forward across the Marne with hesitation—and Kluck escaped. Further, Foch missed the chance of smashing Bülow, who was trying to wheel to face Paris. There is the wheel reported in Foch's own words although he could not see it: "The [French] left . . . had broken up "the enemy's advance [Bülow had swung his right back]; the centre had held its "own; the right had again given way." Foch's reply was not to fall on the flank of the German Second Army which was being presented to him, but only to fill a gap in the centre and order a general advance. Although the German retirement, due to the British having pushed across the Marne, began at 2 p.m., Foch describes the battle as still raging on his front at 6 p.m., when he hoped that "by spending "the last drop of our energy we might break the unstable nervous equilibrium and "incline the balance in our favour." He then relates the advance to the attack of the 42nd Division and the IX Corps. The commanders of these formations, Generals Grossetti and Dubois, years ago destroyed this legend: the 42nd Division arrived too late to do more than fire a few shells at the retiring enemy, and the IX Corps did not advance. The Germans, too, have told us that they retired unhindered, their rearguards of the right holding the causeways of the St. Gond marshes until 7 a.m. next day.

The account of the fighting in Flanders has been given in full in the British Official History. Foch, who was sent to the north as the representative of General Joffre to co-ordinate the operation of the Allies, appears to know even less about the battles of the Yser, and of the First and Second Battles of Ypres, than he did of the Marne. The Belgians may be left to discuss the Yser. What he says of First Ypres, October 31st, 1914, cannot be allowed to pass unchallenged. He states that the British were "unable to hold Gheluvelt . . . the line was broken and in the middle of the after-"noon flowed back upon the woods of Hooge and Vedhock [*sic*, it is elsewhere "spelt Velchock; perhaps this and other mistakes are the fault of the editor]," and that when Sir John French met him at Elverdinghe in the afternoon they discussed "the proposed decision to retreat, which was on the point of being executed ". . . the troops were in full retreat towards Ypres . . . it was the beginning of a "defeat." To put it shortly, Gheluvelt was certainly lost, and a small gap made in the British front for a time; the rest of the front held, the 1st South Wales Borderers still hanging on to Gheluvelt Château and grounds. The local counter-attacks of portions of four battalions of the 1st Division, under General Landon, and of the 2nd Worcestershire recovered Gheluvelt and filled the gap again. This had all happened and Sir John French had been informed of it before he saw Foch. Yet the latter claims that orders he issued during the visit restored the situation.

The fact is that on this occasion, as on others, the Marshal issued orders after the fair—"*pour l'histoire*" as a French general said of one of his own; at no time was much attention paid to him or them by the fighting commanders near Ypres, least of all by the French commanders.

This was notoriously the case at Second Ypres, when in spite of Foch's promises to retake the half of the Salient which the French had lost, and his orders to that effect, no serious attempt was made to do so. Again, in this battle he has to admit that his troops were surprised, but he omits to mention that this was due to his own neglect to take notice of the three separate warnings—also ignored by G.H.Q.—of the impending gas attack which the French Intelligence received. It is mere untruth to state that when the French fled before the gas attack "the British left (Canadian "Division) retreated to St. Julien," and ludicrous to claim that General Putz, with "aid furnished by the British and Belgian," saved Ypres.

The two years of trench warfare, 1914–16, with the two battles of Artois and the Somme, so uncongenial to his offensive spirit, are passed over very quickly without much comment; in fact, it would appear from the "Note" at the beginning of the book that, as for events in 1917, the text is only the "recital" of his staff; the Marshal, we are told, "was able to finish only the account of events in which he "participated during 1914 and 1918." There is no explanation of his insistence on there being one French corps north of the Somme in July, 1916, which not only embarrassed Sir Douglas Haig by its presence, but refused on more than one critical occasion to co-operate. Foch was blamed for his methods of attack in 1916 by the French Government, and superseded. Powers then passed to the heroes of Verdun.

The account of 1918 does not add much which is new to our knowledge of that period, about which so much has been written, except as regards the personal movements of the Marshal. We learn that it was Sir Douglas Haig who first proposed—to the C.I.G.S. and before the Doullens Conference—that Foch should be made Commander-in-Chief. The Field-Marshal himself, in referring to this, said that he did so because Foch would fight and Pétain would not. The share of the British commander in modifying Foch's plans is generously admitted. Foch judged that Haig was wrong in suggesting that easy terms should be offered to Germany, overlooking that the best German divisions, and the largest number of them, were concentrated in front of the British. The important new item is a superbly patriotic letter from M. Clemenceau to Foch, dated October 21st, 1918, on the situation, with special reference to the "marking time" of the American Army. In this the President of the Council says: "Nobody can maintain that those fine troops are unusable; "they are merely unused." Foch's comment is that the letter "had in view nothing "less than to effect a change in the Chief Command of the American Army." It seems almost possible that the appreciation of Marshal Foch by his contemporary at the École Polytechnique, the military publicist, Colonel Mayer, is not very wide of the mark. The chief command suited him because he was not precise and it only required the formulation of general ideas, of which after his experience as a professor at the Staff College he had plenty. He could not work out plans in detail, any more than he could finish his sentences. Foch was in his right place as commander at the close, just as Joffre was at the beginning.

Colonel Mott, who was American liaison officer at Foch's headquarters, has made a somewhat free translation, which does not always do justice to the original French; he does not seem to know the exact equivalent of French military terms—"movement "of conversion" is not, we think, even the American for "wheel"—and his footnotes are not always accurate. We learn that Sir *John* Robertson was our C.I.G.S., and Foch at the end of 1917 "Chief of the War Department Staff." We must, however, be grateful to him for his sketch of the Marshal, who "lived and worked "in an atmosphere that was stifling even for an American . . . he was brief in "matters of business and liked others to be so. . . . No external sign of anxiety "was ever seen to mark his countenance or his gait." He went to church every

morning to say his prayers. Clemenceau arrived unexpectedly when the Marshal was thus absent; the old heathen would not have him called away saying, "Do not "interrupt him for anything in the world—it agrees with him too well." The book, except for its binding, is not so well got up as the French original. The photographs are fewer and not so well selected; the maps fewer and less well reproduced (the French version contains a Morhange map, of the absence of which in the English translation we have complained); and the descriptive page headlines of the original are missing.

OFFICIAL HISTORY OF THE GREAT WAR.

Military Operations in Egypt and Palestine from June, 1917, to the end of the War. Compiled by CAPTAIN CYRIL FALLS, late R. Innis. Fus. and General Staff. Maps compiled by MAJOR A. F. BECKE, late R.A., Hon. M.A. (Oxon). Volume II in two parts. Price £1 net. Case of maps 10s. net extra.

(Published by H.M. Stationery Office, 1930.)

Volume I of the History, covering the period of defence in Egypt, the re-conquest of Sinai, and the operations in southern Palestine up to, and including, the Second Battle of Gaza, was reviewed in the *R.E. Journal* of March, 1928.

Volume II, also issued in two parts for convenience, is compiled by a different writer. Written more on the lines of the Official History of the War in France and Belgium, there is less obvious evidence that participants in the operations have had an opportunity of "explaining what happened." Captain Falls' narrative is well written and can be followed by the general reader without recourse to the case of extra maps. While calling attention to failures, he generally leaves it to the student to discover the causes and think out for himself whether and how things might have been done differently.

Thanks to Major-General Sir M. G. Bowman Manifold and Colonel A. P. Wavell we already know a good deal about the campaign. It is only necessary, therefore, to direct attention to the additional information Captain Falls has been able to obtain from official sources and from the reports and writings of Turkish and German officers who took part in the fighting.

The assumption of the command of the E.E.F. by General Sir E. Allenby, on June 28th, 1917, was coincident with the appointment of General (Marshal in the Turkish Army) Erich von Falkenhayn to the command of "Yilderim," or "Army Group F," of the Turkish forces in Syria, Mesopotamia and Palestine. "Yilderim," meaning "thunderbolt" or "lightning," was then the name given to the Sultan Bayazid I. after he had destroyed with lightning rapidity the forces of the so-called "Last Crusade" at Nicopolis in 1396. The role assigned to Yilderim by the Turkish Supreme Command was to prevent the British advancing into Syria and getting astride of the Turkish communications with Mesopotamia, and to direct operations in both theatres of war. The Turkish plan was to recondition the Sixth Army under Halil in Mesopotamia and the Eighth Army under Kress von Kressentein in Southern Palestine, and to form a new Seventh Army under Mustapha Kemal at Aleppo, and move it south along the Euphrates to Hit, 90 miles north-west of Baghdad, in support of the Sixth Army, leaving the Fourth Army in Syria under Jemal, one of the triumvirate (Enver and Talaat being the others) who brought Turkey into the War. Jemal was Turkish Viceroy of Syria and Palestine; he, too, sorely needed reinforcements for his army, but he did not want Yilderim and much less Falkenhayn over him. He, therefore, asked that a Division of the Seventh Army should be sent to Riyaq, north of Damascus, to serve under his orders and act as a reserve for the Palestine front. This was refused by Enver. Mustapha Kemal, who also disliked the Germans, refused to serve under Falkenhayn, and was replaced by Fevzi Pasha.

Yilderim included the newly formed German "Asia Corps" (Pasha II.) as well as the Sixth, Seventh and Eighth Turkish Armies. The Corps consisted of only three battalions but it included a very large number of machine-guns and trench mortars, besides artillery and motor transport, and was more than equivalent to a division in fire power. The personnel consisted of reinforcements specially recruited, and specially trained in Silesia, and it was organized so as to provide three self-contained "groups" of all arms capable of working independently of each other. It proved to be an admirable form of stiffening for the ill-trained Turkish troops.

Falkenhayn's arrival caused a fundamental change in the Turkish plan. Although he had failed to satisfy the German Supreme Command while Chief of the Staff of the German Field Armies in Europe, he was admittedly a fine strategist and had re-established his reputation in Rumania. He speedily came to the conclusion that the Palestine Front was of vital importance and that it was threatened by a British offensive. After visiting Southern Palestine he decided that it was possible to assume the offensive there before the British could resume their advance, and by attacking their right and getting behind them drive them back into the desert. Eventually he induced Enver to allot the Seventh Army to Palestine instead of Mesopotamia, and break up Jemal's Fourth Army, leaving Jemal as C.-in-C. in Syria and Northern Palestine.

Jemal was no soldier, but he was the only man in the country who had the will and the power fully to exploit all the resources of the theatre of war. This had been fully realized by Kress, and Liman von Sanders in Constantinople was also aware of it; Kress, in fact, was the only German who had managed to get on with him in Palestine. Falkenhayn, in getting rid of Jemal, thereby not only endangered full co-operation with the Turks, but owing to the time spent in negotiating with Enver, he also made it impossible now (September 10th) for the reinforcements, which might have been hurried up to make the Gaza-Beersheba line secure, to arrive in time. Captain Falls compares the respective qualities of Falkenhayn and Liman. It would seem that it would probably have been better for the Turks if Liman had been placed in command of Yilderim in the first instance; for, judging by his energetic action under somewhat similar circumstances when he superseded Falkenhayn five months later, he would not only have worked more harmoniously with the Turks, but would probably have been able to stiffen the Gaza-Beersheba line and get up at least some of his reinforcements before the British struck at Beersheba. In the event, no Turkish reinforcements arrived until after Jerusalem had fallen. Falkenhayn did not know the Turk and his dilatory ways!

Thus, while Falkenhayn was battling with the Turks, General Allenby was left to complete his preparations undisturbed, double the railway, extend the pipe line, and reorganize the E.E.F. He had been fortunate in finding the outline of a plan of campaign ready prepared for him by General Chetwode, to whom he has given full credit, and was able to approve and adopt it without material change and *without delay*. He had, however, to wait for his promised reinforcements till the end of September, and defer his advance till the end of October, trusting to luck to complete the first phase of operations before the rainy season set in. Some rain was to be expected in Southern Palestine in mid-November, but the heavy rains of winter do not usually set in in full force till the middle of December. General Allenby was certainly favoured by Dame Fortune, but Captain Falls rightly pays tribute to the splendid physique and untiring energy which enabled him constantly to visit every portion of his front and keep in personal touch with his commanders and his troops. His decision personally to command his troops in the field was a great factor in his success.

The C.-in-C. was also fortunate in having the War Cabinet wholeheartedly behind him. The British Government wanted a real victory in Palestine to strengthen the confidence and staying power of the nation at a season when a like success in Europe was improbable, and they were sanguine enough to hope that a victory would induce

Turkey to throw in her hand. Consequently they were willing to assent to nearly all General Allenby's requirements for guns and reinforcements.

It is not always recognized how great the British superiority in numbers was in Palestine, and that the Turkish strength was, in fact, rather over-estimated. The official fighting strength of the E.E.F. on October 28th, 1917, when the advance began, was :—infantry (including Camel Corps) 60,000, cavalry 12,000, and about 400 guns. The total strength was then about 300,000 (including L.-of-C. and troops in Egypt).

The actual fighting strength of the Turks in Southern Palestine was about 33,000 rifles, 1,400 sabres, and 260 guns. This included the well-trained 19th Division, which had arrived with Yilderim, and the 12th Depot Regt., both of which had been moved south in support. The British Intelligence Department estimated the rifle strength at 40,000, but the extent of the wastage from disease and desertion behind the Turkish front had not been fully realized. The advantage in numbers looks large on paper, but cannot be regarded as excessive, taking into account the reputed fighting quality of the Turkish soldier, the very difficult terrain, the dearth of water and the quality of the German stiffening.

The deception practised on the Turks by General Allenby before he struck his blow at Beersheba, on the 28th October, 1917, was only the first of several surprises. Captain Falls describes the various ruses which confirmed Kress and his staff in their conviction that the British must attack the Turkish right flank. The story of the staff officer who dropped the famous haversack containing faked orders is well known, and General Aston has recently supplemented it with further details in his book *Secret Service*. But the ruses would have been useless without the forethought and care exercised in keeping the rapid concentration of the British forces opposite Beersheba from the knowledge of the enemy. Gaza, it is true, had to be attacked frontally by the XXI Corps, but the battle was already won at Beersheba.

The correctness of the decision to attack the enemy's left is ably discussed by Captain Falls, in view of the opinion of some senior officers, the "Gaza School," who held that the failure of the Second Battle of Gaza in no way proved an attack on the enemy's right to be faulty strategy. It is necessary to quote him in full :—

"In discussing the plan adopted by General Allenby there must be a great difference "in our attitude according as we consider it in the light of what actually happened "or in the uncertainty prevailing before the attack. The ruse which has been "described would not have worked the other way. The Turks could be *confirmed* "in their belief that Gaza was the objective ; they would not have been dissuaded "from this belief by any faked plan of attack on Beersheba. Then, it must have "appeared likely that the break-through at Gaza would be a slow and costly operation "and even that the risk of failure was not small. Had all gone well the corridor "opened for the pursuit would have been most uncomfortably narrow and exposed "to artillery fire, being limited by the gardens of Gaza and the long ridge east of the "town. Finally the advance up the coast would have been conducted with an "unbroken enemy retiring on the high ground to the N.E. instead of the beaten "troops whose threats the British were able virtually to disregard. Even if we take "into account our present knowledge, we shall have to admit that there were accidents "in the pursuit by the mounted troops from Tell-esh-Sheria which could have hardly "been anticipated, quite apart from the shortage of water.

"There is no real analogy between the offensive of September, 1918, and that of "October, 1917, because in the Battles of Megiddo the British were able to pin down "the whole Turkish front while they broke the right flank ; whereas if they had "attempted to break the Turkish right flank at Gaza they would not have been "in a position to pin down the Turkish forces on the whole Gaza-Beersheba line."

Captain Falls goes on to discuss the reasons for the partial failure of the British completely to destroy the troops of the Gaza garrison and Turkish right flank. He points out that, had not Major-General Barrow, on the suggestion of Major-General

Mott (53rd Division), ordered the Yeomanry Mounted Division, on November 7th, to march eastwards on November 8th through the Camel Corps, to try and cut off the Turkish forces which were reported to have been seen moving north from the front of the 53rd Division, the Yeomanry would not have been delayed in moving to the support of the tired Desert Mounted Corps in the pursuit. General Mott's telegraphic messages to General Barrow had to pass through General Chetwode's H.Q., and the last-named ventured to intervene and point out that big things were afoot at Tell-esh-Sheria and that it was inadvisable to move the Yeomanry Division across the front eastwards farther from the scene of action on which it might shortly be required to play a part. This is only one instance of General Chetwode's intuition and thorough grasp of the C.-in-C.'s intentions during the campaign. No blame can be attached in this case, because no steps were taken to cancel the move when the "repeated" message ordering it reached G.H.Q., although the C.-in-C. had already, earlier in the day, ordered the 53rd Division to call off another attack which had been prepared against the Khuweilfe heights. We can sympathize with the G.S.O. on duty during the night of the 7/8th November at G.H.Q., whose duty it was to receive the message and decide whether to wake the M.G.G.S. or the C.-in-C.! During the morning of November 8th, G.H.Q. had, as General Chetwode had foreseen, to order the Yeomanry Division to move at once to the support of the Desert Mounted Corps, but the Yeomanry were already in action and did not receive the order dispatched at noon till 1.40 p.m. Retracing their steps they were only able by nightfall to get as far as Tell-esh-Sheria, where they might easily have been many hours earlier had they not been moved eastwards from their original position on the left (south-west) of the 53rd Division. The C.-in-C. had intended to use the whole of the Desert Mounted Corps (ten mounted brigades) to exploit the break-through. Delays caused by water shortage and work on the wells at Beersheba, the hard fighting north of it, and the necessity of forming a covering force under Major-General Barrow to protect the right flank, had all contributed to reducing the exploiting force to only six mounted brigades. Further delay had been caused by the Desert Mounted Corps having to fight to make their own breach in the enemy line; this they failed to effect before the arrival (at dawn on 7th November) of the 60th Division, whose orders had been merely to follow the Desert Mounted Corps. Moreover, if the Australian Mounted Division could have followed the A. and N.Z. Mounted Division through the same breach at Kh. Umm el Bakr, instead of trying to advance through the 60th Division front to the west of the breach, there would have been four instead of only two brigades established on parallel lines to the enemy's retreat twenty-four hours earlier, and infinitely greater opportunities of breaking up the Turkish rearguards would have presented themselves. Later, shortage of water at Jemmame prevented the Australian Mounted Division taking a hand in the pursuit. The result of these unfortunate contretemps was that the A. and N.Z. Mounted Division was the only one able to continue the advance on November 9th, and though its captures of stragglers and exhausted transport were large, the main Turkish forces escaped the pincers.

During the cavalry advance many gallant actions are recorded, but for sheer gallantry the charge of the Warwickshire Yeomanry at Huj, on November 7th, is unmatched. This was the first time that the sword was used in this theatre, with the exception of the charge of the Dorset Yeomanry at Agariya against the Senussi. A few days later, on November 13th, there was an almost classic example of perfect co-operation of cavalry, artillery and machine-guns at Maghar, where the Bucks and the Dorset Yeomanry covered themselves with glory. In both cases the leading of the officers, from brigadier to subaltern, was magnificent. Before the arrival of General Allenby it had been contemplated to withdraw the swords of the Yeomanry to lighten the burdens of the horses on the ground that the *arme blanche* was little likely ever to be used. But the repeated successes of the Yeomanry, and the fact that the Australians (who did not carry swords) were

compelled to make dismounted attacks, thereby causing several opportunities of capturing large numbers of prisoners to be lost, had shown that the sword was still a necessary weapon of the trained cavalryman. At Beersheba, it will be remembered, the Australian 4th Light Horse Brigade charged holding their bayonets in their hands, while later in the day a portion of the same brigade carried out a bayonet attack dismounted. Whatever doubts there may have been as to the value of the sword in the early phases of the campaign, they were dispelled by the Indian Cavalry in the final advance in 1918. It may be argued that the Turks were then demoralized, and that when the horsemen came up against the well-trained machine-gunners of "Asia Corps," they were often held up, it still remains that as long as there are horsemen there will be ample opportunities for the *arme blanche*.

The success of the mounted troops was so general that the occasions on which opportunities were lost, as, for instance, on the 13th November, 1917, when the 22nd Mounted Brigade might have caused "irretrievable disaster" to the Turkish Eighth Army had it pushed forward two regiments to 'Aqir, are the subject of special comment by Captain Falls.

Mention must be made of the daring enterprise of Lieut.-Colonel Newcombe, R.E., on the Hebron road. "British commentators on the battle," writes Captain Falls, "have generally taken it for granted that the Turkish movement eastward after "the capture of Beersheba was offensive, or at least designed to draw the British "into the hills north of Beersheba. All the evidence goes to show that it was dictated "by the enemy's anxiety for his left flank and the Hebron Road." Falkenhayn was afraid of a direct advance on Jerusalem by the only good road north, and was probably more than justified in his fears by what he saw on his situation map. To oppose such an advance he had only the weak 3rd Cavalry Division on a wide front in the hills and the 12th Depot Regt. (consisting of Arab recruits without machine-guns) at Hebron. Two British cavalry brigades had, he knew, moved north on the heels of the retreating Turks, and one infantry division (53rd) had been observed making for Tuweiyil Abu Jerwal. Lieut.-Colonel Newcombe's small detachment was on the Hebron road north of Dhahriye, and showed no signs of any intention to withdraw from this position, isolated as it was. He, in fact, was expecting the British cavalry to move north. By the morning of the 2nd November, he had blocked all communications between Hebron and Dhahriye for forty hours. Captain Falls adds: "Even now, Turkish critics—scarcely comprehending the requirements of "British stomachs as compared with those of their own people—are of opinion that "the British should have moved north on Hebron."

Lieut.-Colonel Newcombe's enterprise, though it failed and resulted in surrender owing to the Arabs failing to rise as he had hoped to induce them to do, did much to convince Falkenhayn and the Turks that General Allenby's attack at Beersheba was a preliminary to a direct advance on Jerusalem. It thus caused a weakening of the centre of the Turkish front, where General Allenby had planned to make his breach, and where the Desert Mounted Corps eventually did break through.

The following points in the attack of the XXI Corps on the Gaza defences deserve notice:—

Eight tanks took part and contributed notably to the success of the attack, but their casualty list was high and in the opinion of some observers, they prematurely alarmed the Turks at the beginning of the second phase which might otherwise have taken them completely by surprise. The two reserve tanks which were ordered to support the infantry north of Rafah Redoubt were loaded on top with sandbags as well as other R.E. material. In the case of both, the sandbags were set on fire and the tanks temporarily put out of action. The tanks were with three exceptions worn and obsolete Mark I machines, and were not employed again.

Casualties on the assault of Umbrella Hill were light, partly owing to the fact that the Turks' H.E. shells were smothered in the sand; but when it came to consolidating the positions won, the 412th Field Co., R.E., found that most of the

surface of the hill was soft sand, and the communication trenches which the Turks had not revetted owing to lack of material had become so shallow as a result of the bombardment that they afforded little cover. The Turks shelled their lost trenches heavily, casualties were accordingly numerous, and in the case of the 7th Scottish Rifles amounted to 103 within 24 hours. In the attack on the western defences, losses were heavy owing to failure of battalions to keep direction owing to a cloudy night, inaccurate maps, sand and dust, and owing to crowding too many men into trenches the shallowness of which after bombardment had not been foreseen. In the coastal belt the soft sea sand was a very different thing from the sand of the desert, and made movement very difficult. The R.E. made considerable use of wire netting on the tracks prepared by them up to the front prior to the battle. Though casualties in the assault had been light, the total from zero hour on November 2nd to evening on November 4th amounted to 2,696 killed, wounded and missing.

Kress reported that the British preliminary bombardment had little material effect, but severely tried the nerves of the garrison. The British gas shell made so little impression that the Turks were not aware that gas had been used. They had no anti-gas equipment, but no mention is made of gas casualties. The evacuation of Gaza was carried out with remarkable completeness and order, only a few worn-out guns being left behind. The C.-in-C. knew the character of his opponent. He was fully conscious of the probability of a counter-attack on his right flank as he pushed his troops northwards on the heels of the Eighth Army, and was prepared for it. The counter-attack was duly delivered, but too late. Carefully prepared and launched with correct direction and objective, it only failed through inferiority in numbers. We cannot but be impressed by the determination of General Allenby not to allow the threat, nor the attack, to influence or interfere with the completion of the first phase of his plan of operations.

The result of the Third Battle of Gaza and the subsequent capture of Junction Station was to cut the Turkish Army in two. The Eighth Army was demoralized and in full retreat in the coast area to the line of the Nahr el Auja, four miles north of Jaffa. The Seventh Army had been driven north-eastwards and cut off from the main railway, leaving it dependent on the Nablus-Jerusalem road for its supplies, except for such as could be brought across Jordan from 'Amman on the Hejaz railway.

A short pause was now necessary to prepare for the advance into the Judæan Hills, during which the only operations that took place were the occupation of Jaffa and a reconnaissance towards 'Amwas on the road to Jerusalem.

It was now General Allenby's intention to contain the Eighth Army in the plain, follow the Seventh Army eastwards into the hills before it could reorganize, and capture Jerusalem. The ease with which the C.-in-C. was able to enlarge the scope of his original plan and proceed, with only a short pause, to the second phase—the capture of Jerusalem—is proof of the foresight with which the whole operation and the supply arrangements had been worked out.

The physical features of Palestine have had a great influence on the numerous campaigns in that country in the past. They were now to render General Allenby's advance into the Judæan Hills a most difficult undertaking, and in part thwart his plans. Captain Falls' description of the country must be read to enable us fully to realize the task allotted to the XXI Corps. There was only one good road running eastward from the coastal plain at this date—that from Jaffa through Ramle to Jerusalem: it entered the hills by the Vale of Ajalon near 'Amwas. The Jaffa-Lydda-Jerusalem road farther north became little more than a bridle path on entering the hills. The movement of guns and transport now became the chief factor in operations always difficult owing to the shortage of water. The advance began on November 19th. The C.-in-C. had decided to cut the Jerusalem-Nablus road (the only north and south road) at Ram Allah and Bire, eight miles north of Jerusalem, to avoid any risk of damage to the Holy City. No German would have allowed policy

to over-ride military necessity! One is almost forced to the conclusion, from what we know now, that the selection of the objective was based on insufficient knowledge of the difficulties of the *terrain* and influenced by misleading air reports as to the direction and extent of the Turkish retreat. It was vital to Falkenhayn that the Turks should hold their ground to gain time for the reinforcements to come up. As soon as the British troops were committed to the hills, Turkish resistance stiffened, and they suffered heavy losses without material progress. Falkenhayn, we now know, was convinced that the British would never reach the Nablus road at Bire, nor until they shifted their attack farther south.

The battle in the hills raged for a fortnight, and it seemed that deadlock had been reached. But on November 25th, the C.-in-C. ordered General Chetwode's XX Corps to relieve the gallant but exhausted troops of the XXI Corps. Chetwode had, like Falkenhayn, realized, but more slowly, that the attack must be shifted further south, if only to get full advantage from the Jaffa-Jerusalem road, which had hitherto been on the British right flank and of little use for artillery and transport. By this time the C.-in-C. had had time to improve his communications, rail and road. Quietly and unobserved he shifted his strength farther south and suddenly attacked the Turkish defences astride the Jaffa road. Thanks to surprise, the British were able to scale the steep-faced ridges, whereon lay the Turkish redoubts forming the western defence of Jerusalem, and take them while their garrisons were only half awake. Simultaneously, the 53rd Division under Major-General Mott, advancing up the Hebron road from the south, threatened the southern defences. On December 9th Jerusalem was occupied, without material damage to the Holy City, having been already evacuated by its garrison, the Turkish XX Corps, who retreated northwards.

Could the same result have been effected in the same way a fortnight or even a week earlier, and the heavy losses of the XXI Corps prevented? On the other hand, if the C.-in-C. had been able to reach his objective at Bire in reasonable time, would he have captured the whole of the Jerusalem garrison? It is an interesting problem and can only be solved by General Allenby himself, for he alone knows all the factors which influenced his original plan and subsequent action. He evidently had intended to use a much larger force in the dash to the Nablus road, but then found it impossible to supply more than the troops which failed in the attempt to reach Bire. Could he, when he knew of the supply difficulty, have abandoned the original objective earlier and used the troops of the XXI Corps merely as a covering force while the XX Corps attacked the city? In this event what would Falkenhayn have done? That he would have counter-attacked south-westwards through the hills is certain; he would also have been able to reinforce the garrison by sending troops down the Nablus road.

The hardships undergone by the troops in bad weather in the Judæan Hills must be taken into account; many units were still wearing khaki drill and shorts; but, on balance, it is probable that, costly as it was in men and animals and despite the loss of valuable time, General Allenby's action pinned the bulk of the enemy's available troops to the hills and made easier the capture of Jerusalem.

Falkenhayn was bound to launch a counter-attack to try and recover Jerusalem. This was anticipated, met and defeated by General Chetwode, who inflicted heavy losses on the enemy. Ram Allah and Bire were eventually occupied by his troops on December 27th.

General Allenby's luck was once again in the ascendant. It was not till just before Christmas, on the eve of the battle for the defence of Jerusalem, that torrential rains set in and made Christmas Day the climax to a period of nightmare for the services of supply. Floods in the Philistine Plain caused repeated breaks in the railways. A storm at sea prevented the landing of stores on the coast. Roads and culverts were washed away and convoys had the greatest difficulty to make their way through a sea of mud in the coastal plain. All animals had to be put on

half rations. It was not till well on in January that work could be resumed on the railways.

It was at this juncture that the Prime Minister brought pressure to bear on General Allenby to exploit his success and deal Turkey the knock-out blow on which Mr. Lloyd George had long set his heart. He suggested an immediate advance to Aleppo, failing which he desired to see the whole of Palestine in British hands! It was evident that in London there was no conception of the difficulties still in front of General Allenby. Captain Falls does not suggest that General Allenby could not have routed the Turkish armies in the spring of 1918, but points out that it was by no means certain that the rout would have at that time induced Turkey to sue for peace. Mr. Lloyd George then sent out Lieut.-General Smuts to Egypt to consult with General Allenby, Rear-Admiral Jackson, and Major-General Gillman, Chief of Staff of the Mesopotamian E.F., as to the best methods of co-ordinating British efforts in the Middle East with the object of eliminating Turkey from the War. General Smuts' mission had the merit of bringing the discussions down to the bed-rock of reality. General Smuts propounded a scheme by telegram to the Prime Minister which Captain Falls describes as "sound but stiff and mechanical, and making transport master, not servant," and returned to England. Events on the Western Front put an abrupt end to discussions about the Middle East. During the ensuing summer, General Allenby so transformed the scheme that it achieved in less than a fortnight what its original would have taken months to perform.

General Allenby now sat down to rail and road construction and the administration of the occupied territory, while General Chetwode prepared a plan for occupying Jericho and driving the enemy east of Jordan, and General Bulfin improved the front of the XXI Corps and brought its right into line with the XX Corps, though a considerable gap still separated the two Corps. Jericho was captured on February 21st, thus making the British right flank secure.

It was at this moment that General Allenby heard that Falkenhayn had been succeeded by Liman. Yilderim had been a failure. Jemal had returned to Europe, and Kress von Kressentein had been superseded by Jevad Pasha, for his failure to anticipate the attack on Beersheba. Mustapha Kemal had returned to the Seventh Army with Liman. Liman knew the Turks and brought with him the prestige of his defence of Gallipoli. He saw to it that his staff was predominantly Turkish. Captain Falls closes a very interesting appreciation of the two German commanders with a note sent him by a Turkish officer, who wrote: "The policy "of Falkenhayn was defence by manœuvre; that of Liman defence by resistance "in trenches." Liman believed in trenches though he was a cavalry general. It was his policy to keep the front closed up, which meant in Palestine that he could hardly ever have a reserve worth mentioning. That policy paid for six months, but only because events in Europe robbed his opponent of the means to attack in strength.

Part I of the volume concludes with the accounts of the two raids across the Jordan in March and at the end of April, 1918, and the Turkish counter-attack on the Jordan bridgehead on April 11th. The objects of these raids were (1) to secure the British right flank, (2) to assist the Arab forces who were engaged in continuous operations against the Hejaz railway from April 11th to the end of the month, (3) to fix the enemy's attention on his left flank and make him believe that when the British advanced it would be on that flank in conjunction with the Arabs. Captain Falls amplifies his narrative with the accounts of German officers who took part in the Jordan Valley fighting in which detachments of "Asia Corps" for the first time faced the British. The Germans, and their machine-guns, undoubtedly contributed largely to the failure of the British to capture 'Amman or hold Es Salt. From May 1st onwards the heat of the Jordan Valley practically put an end to operations in the valley, but on July 14th the Turks supported by a strong German detachment made a determined effort to capture the Abu Tulul salient. It failed completely, with heavy losses both to the Turks and the Germans, who accused the Turks of

letting them down. Writing of this failure, Liman says: "Nothing had occurred "to show me so clearly the decline in the fighting capacity of the Turkish troops as "the events of July 14th." The magnificent dash of the Indian Cavalry on this occasion, their first meeting with the Turks, gained the warm appreciation of the C.-in-C. and a generous award of decorations for gallantry.

Part II begins with a description of the Arab Campaign during the last half of 1917 and the spring of 1918, which was not only a source of constant anxiety to the enemy, but succeeded in completely cutting off the Turkish Hejaz Expeditionary Force at Medina from the armies of Palestine and Trans-Jordan. This force, numbering 12,000 men, included some good battalions which would have been invaluable to Liman at the moment of General Allenby's greatest embarrassment or that of the final offensive. Turkey's German advisers and the most enlightened Turkish officers had again and again urged the evacuation of Medina, but the authorities at Constantinople had always wavered. Bagdad, Mecca, Jerusalem had all gone; it was hard to abandon Medina, the capital of the first Khaliphs. It is probable, writes Captain Falls, that the enemy would have abandoned Medina if his communications had not been completely severed south of Ma'an during April: after that the hazard was too great.

Prior to the German offensive in France on the 21st of March, 1918, the Cabinet had already decided to dispatch large numbers of Indian troops to Palestine, to reinforce General Allenby for the spring and summer campaigns of 1918, which were to give the knock-out blow to the Turks in Palestine. In fact, the Seventh Indian Division had already arrived by the end of January, and it was shortly to be followed by a second from Mesopotamia. All Indian Cavalry regiments serving in France were also ordered to Palestine. The events of March in France resulted in the withdrawal of most of the British infantry and yeomanry from Palestine and accelerated the "Indianization" of the E.E.F., and definitely cancelled for the time General Smuts' plan of campaign.

The Arabs undoubtedly gave the British invaluable aid while largely dependent upon them for their opportunities, and prior to the final offensive probably accounted for well over 25,000 Turks, killed, wounded, or captured.

The summer of 1918 in Palestine was therefore a period of reorganization, expansion and intensive training. As an example of making bricks out of nothing, we are reminded that seven new battalions were formed by withdrawing one company from each of 28 Indian battalions. Each battalion which lost a company then expanded its remaining three companies into four, filling up with drafts from India. Ten British battalions were broken up, on relief by Indian battalions, to provide reinforcements. All the seven infantry divisions left in Palestine with the exception of the 54th (earmarked for France if required) now consisted of three British and nine Indian battalions. General Allenby's anxiety may be well imagined when the Indian troops arrived in Egypt with hardly any signallers, no bombers, and transport drivers with no experience of handling animals. The junior British officers were only half-trained and few of them spoke Hindustani, while the Indian officers were only recently promoted. In one battalion there were only two British officers who could understand their men and only one Indian officer who could speak English. Captain Falls says that, nevertheless, the E.E.F. could not be said to have suffered on the whole, and the Desert Mounted Corps was, for the C.-in-C.'s purpose, now a more formidable weapon after reorganization than before it. But the case of the infantry was different. On July 12th, 1918, General Allenby was in a position to inform the War Office that he hoped to resume operations that year.

It is interesting to know that at this period the War Office was making its plans for the campaign of 1919 in Europe, and offered General Allenby the loan of three or four divisions from France for the winter. But on July 20th the offer was cancelled by Sir Henry Wilson "as all available troops would be required until well

" on in the autumn to give elbow room in front of the strategical objectives in France." After some interchange of telegrams Sir Henry Wilson intimated that he thought British policy in Palestine should continue to be one of active defence. General Allenby's reply to this was that he hoped to gain a decisive victory with the resources already at his disposal.

General Allenby's scheme was to mass the greater portion of his infantry and heavy artillery upon the eight-mile front between the railway and the sea in the coastal plain, attack north-east and thus open a doorway through which his cavalry could pass to cut the enemy's communications by road and rail. Dera' Junction was beyond his reach, and he proposed to allot this objective to the Arab Army. He disclosed his plan to his three Corps Commanders on August 1st, but on August 22nd he surprised them with a much more extended scheme. This was to make his main attack with XXI Corps (five Divisions) and Desert Mounted Corps (three Cavalry Divisions) on the enemy's right flank, while the XX Corps (two Divisions) advanced astride the Nablus road. The objective of the XXI Corps (with one Mounted Brigade attached) was in the first instance a line from Qalqilye on the railway to the mouth of the Nahr el Faliq: it was then to swing up its left and advance north-eastward in the direction of Nablus and Sebustiye. The ultimate objective of the Desert Mounted Corps was El Affule, the junction of the Southern Palestine Railway with that to Haifa—a distance of 40 miles, to be covered by the second day—where it would be only 6½ miles south of Yilderim headquarters at Nazareth. A detachment was then to be sent forward to attempt to capture Liman and his staff.

The scheme was a bold one, because the transport available would suffice to supply the Desert Mounted Corps no farther north than Tul Karm until mechanical transport could be transferred to it from the other two Corps; it had, therefore, to be prepared to subsist for a time on the country after leaving the Tul Karm-Haifa road. After discussing the two schemes, Captain Falls examines the comparative strengths of the opposing forces at this date (end of August, 1918).

The E.E.F. now had in the fighting line 57,000 rifles, 12,000 sabres and 540 guns. The enemy's strength was estimated at 26,000 rifles, 3,000 sabres and 370 guns, not including the troops on the Hejaz railway nor the weak Second Army (5,000 rifles) between Damascus and the sea. Captain Falls considers that these figures were approximately correct, though Liman von Sanders has given a lower figure. He points out that the Turks had 600 heavy machine-guns, as against 350 British west of Jordan, and they had 450 light machine-guns. He recalls the fact that, whereas the whole E.E.F. had a ration strength in Palestine and Egypt of 340,000 mouths, the Turks actually had as many as 247,000 in the theatre of war, and remarks that " it was less man-power that failed the enemy than organization." Incidentally, he mentions the fact that whereas, in 1914 a French infantry division consisted of 9,000 rifles and 24 machine-guns, in 1918 it consisted of 2,300 rifles, 423 light and 72 heavy machine-guns, and there was no question which organization was the stronger. Another interesting fact is that 52 Turkish deserters reached the British lines during the week ending August 19th, 1918, and 49 in the following week. These came from 21 different units of the three armies; 34 Turkish prisoners and 2 German airmen officers were also captured. The Intelligence Department had an easy task!

As regards the Turkish defences, the sector to be attacked near the sea was the only continuous one, but it was also the most vulnerable. As usual, the Turks had insufficient barbed wire to make really serious obstacles.

Once again General Allenby was to outwit and surprise the Turks. The concentration of his striking force on his left was carried out with the same guile, the same secrecy and the same success as at Beersheba. A captured situation map, dated 17th September, proved that the Turk had no idea of the concentration opposite their right flank. To strengthen them in their belief that it was their left flank that

was to be attacked, the Turkish Railway was bombed about Dera' by the R.A.F. on September 16th and 17th. On September 16th, an Arab column, with British armoured cars, suddenly appeared out of the desert after a march of 50 miles, and destroyed a bridge and a section of the railway south of Dera', and the next day another section north of it.

It is not possible to do more than draw attention to some of the salient features of the final operations. As a combined operation, General Allenby's plan was a magnificent conception, only equalled by the excellence of the staff work which enabled it to be carried through with scarcely a hitch. The surprise effected by the secret concentration on the extreme left: the timing of the attack of the XX Corps, launched only when the success of the break-through of the Desert Mounted Corps was assured: the way in which General Chetwode bit and hung on to the Turkish forces on the Nablus road: the clearing of the Jordan Valley by General Chaytor: the co-operation of the Arab Army on the extreme right, and the interdependence of the subsequent moves, remind one of the chess board.

As in his earlier campaign, General Allenby was always prepared to enlarge the scope of his plan if success in the earlier phases justified it, and he did not hesitate to do so. He was fortunate in having under him brilliant cavalry leaders, such as Major-General H. J. M. Macandrew, who could be trusted to use their initiative and judgment when out of touch with the C.-in-C., in accordance with and with full understanding of his general intention.

Captain Falls calls attention to the fact that, whereas the battle losses were small, the losses from disease were serious, and after the Armistice rapidly increased. This was partly due to the Desert Mounted Corps having necessarily been quartered so long in the heat of the Jordan Valley, and to the neglect of sanitary measures by the Turks. Malaria was the chief cause, to be followed by the wave of influenza which swept over the whole world during the last six months of 1918. There was only one case of cholera amongst the British troops, thanks to the quarantine enforced by the German doctors, who had isolated every Turkish unit on its arrival in Syria.

From the Desert Mounted Corps alone there were 1,246 admissions to hospital in Damascus during the week ending October 5th, and 3,109 in the following week. But in spite of pneumonia the death rate was not high, though nearly four times as many men of the Corps died in Damascus as had been killed between the 19th and 30th of September. But the state of the British troops was nothing to the dreadful state of the Turks, amongst whom typhus, enteric, relapsing fever, ophthalmia, syphilis, as well as universal malaria and influenza, were rife. Two thousand cases were admitted into British and 8,250 into Turkish hospitals in Damascus immediately after its capture. In one concentration camp the Turks were dying at the rate of 70 a day, until it could be taken in hand by a British medical officer.

The Turkish losses in the retreat at the hands of the Arabs cannot be estimated. Whatever cruelties they had inflicted on the Arabs were repaid fourfold.

Captain Falls refers to the wonderful way in which the horses withstood their exertions. Out of a total of 25,618, 345 were admitted into the veterinary hospitals, the deaths including battle casualties numbered 1,021, and 259 were missing. Good horse-mastership had a great deal to say to this, that of the 4th Australian Mounted Division being outstanding. The distances covered without watering were marvellous, and show what horses can be trained to endure.

The total of prisoners of war numbered 75,000, of whom 200 officers and 3,500 rank and file were Germans and Austrians; 360 guns and 800 machine-guns were captured, many others being destroyed.

because the official mind was obsessed by the infantry idea. What perplexed this mind was the carriage of the machine-gun and not the defeat of the machine-gun bullets by armour. A solution was attempted by carrying the machine-guns in semi-tracked lorries, when it was as plain as a pikestaff that these vehicles must be shot to pieces directly the battlefield was reached. Then came the Martel light tank, but no, it was a tank, so in place the Carden-Loyd machine-gun carrier was introduced. Colonel Martel calls this vehicle a tank, but it is not a tank, only half a tank, a tank with its lid off, or a chelonian reptile without its carapace, and its introduction in no way solves our main tactical problem, which is not how to carry a machine-gun, but how to eliminate the hostile machine-gun bullet. The existing experimental light tank, of which an excellent photograph faces page 206 of this book, solves the bullet problem tactically and financially but not logistically, unless infantry themselves are to be motorized; for to mix boots and tracks in one organization is as monstrous as to allow, in this age of motor-cars, horsed vehicles to traffic up and down Regent Street or the Strand. In our true English fashion, which is anything but logical, after attempting every means which must fail, we shall get back to the Martel idea of substitution in place of close co-operation, and when we do we can then get down to the problem of infantry reorganization, infantry disencumbered of machines.

This, I think, is the main tactical lesson Colonel Martel's book has to teach us, and the credit of it is almost entirely his. Certainly it will not be lost on foreign armies, and I trust not on our own. Reading between the lines, this book is of as much value in showing us how not to solve our one great problem, namely, that of the bullet and its defeat, as the lines themselves show how ultimately this problem can be solved.

The book is clearly written, modestly written and honestly written, and though in this country its circulation is not likely to prove large, for it is a serious and practical book, it will certainly find its place on the General Staff bookshelf of every civilized army. It is extremely well illustrated, containing twenty-seven plates, and the only error of importance I have noted is on page 57, where the cost of the shells fired in the preliminary bombardment at the Third Battle of Ypres should read, if I remember rightly, "£22,000,000" and not "£465,000." This correction will not, however, solve the problem of the 17,000 tanks, which figure, in the original paper from which these statistics are taken, was based on certain calculations of shell and tank values. In another edition the whole of this paragraph should be re-written. Incidentally, the references in the index to Field-Marshal Sir George Milne are incorrect.

J.F.C.F.

FIVE TACTICAL SCHEMES WITH SOLUTIONS.

By Major S. W. Kirby, o.b.e., m.c., R.E., *p.s.c.*, and Captain J. R. Kennedy m.c., R.A.

(William Clowes & Sons, Ltd., London. Price 3s. net.)

It is perhaps fitting that a work on tactics from the combined typewriter of a Gunner and a Sapper should be reviewed by a member of what a senior Tank Corps official recently called "the obsolete arm."

This pamphlet is the first of a series of tactical schemes which is being written with the object of giving, at the smallest cost, examples of schemes and their solutions to officers working either for the Staff College or for promotion. It therefore merits more attention than its bulk seems to indicate. The authors make the bold claim

that their situations and solutions are such as "either in exams or in practice would "give every chance of success" and with more restraint add that they are "in "accordance with the teachings of the official manuals and therefore with that of the "Staff College."

On opening the pamphlet with due reverence, we find that it deals with the vicissitudes of one force during several days. There are, roughly, some 21 situations and the narrative is easy to follow. It is perhaps inevitable, when using a 1-inch map, that the tactics of small formations cannot be described in any useful detail; at any rate, an analysis of the problems set shows that, roughly, eight are set to exercise the mind of a Major-General, five those of a Brigadier, five more a Lieutenant-Colonel's, while Captains, having hardly any mind, only get three problems which deal with their sort of command. One may say that on the whole the pamphlet will be more useful as a star to which the Staff College aspirant may hitch his wagon, than a dip to light the labours of the modest examinee for promotion. Still, it does give a good idea of the big picture and its staff duties technique is admirable. This technique is very fashionable at present and should be acquired by earnest imitation of the best models.

Since the writers claim that their solutions are normal ones, it is of some interest to see how the manuals are now interpreted in the seats of the mighty. I have certain misgivings about the original plan, which deploys a corps of two divisions on to four roads, with a cavalry division pinned down to protecting the right flank when the corps in question is moving off from an area near Reading, and the nearest enemy are a cavalry division at Portsmouth, and a corps mobilizing in the area Lewes–Brighton–Hove. I also detect a certain tendency to stop the rifle companies on definite lines when the opposition and the ground do not seem to justify their failure to get forward. This may, however, be a question of an individual interpretation of the setting, but in modern schemes we have, I feel, a tendency to tie down the leading riflemen too much in order to bring the higher forces into play. Again, in one situation the authors deal with an attack across a water obstacle and say that, in order to keep the infantryman dry, it is necessary to provide him with an assault bridge, even though the water obstacle is fordable. Personally, I do not believe that a fordable water obstacle is in any way a high-water mark for good infantry, unless it also coincides with a hostile defensive fire plan properly co-ordinated, but even if an assault has to be delivered across such an obstacle, I, as an infantryman, would rather get wet than bother about Kapok in the initial assault, however useful Kapok would be later as a footbridge when the crossing place is defiladed. The pamphlet has an interesting foreword from General Gwynn, the late Commandant of the Staff College, Camberley, in which he observes that "many officers are so circumstanced "that they have never had opportunities to take part in tactical exercises without "troops on the ground or in war games," and he commends the pamphlet as filling a gap between test papers and instructional exercises which has not, up to now, been properly stopped.

The further work of these two enterprising authors will be awaited with interest, provided they do not meet their deaths at the hands of wild crammers.

E.E.D-S.

JOFFRE ET LA MARNE.

By COMMANDANT MULLER.

(Paris. Cree. 20f.)

(Reprinted by permission from *The Times Literary Supplement*.)

Our ideas of Maréchal Joffre have hitherto been mainly derived from the acid description of him by M. Jean de Pierrefeu, who held a minor post at G.Q.G.—after the battle of the Marne—as writer of the *communiqué*, and from the unflattering

sketches of him by his old schoolfellow, Lieut.-Colonel Mayer. The book of Commandant Muller, who was one of his two *officiers d'ordonnance* at the beginning of the War and during the battle, gives us a much closer portrait; for the author was constantly at the Maréchal's side, was present even at the most vital staff conferences, and wrote down his impressions at the time, although he postponed publication of them until Joffre was dead.

In fairness to his hero, Commandant Muller shortly summarizes the troubles through which the French Army had passed in the years before 1914, and the fatal "doctrine" of the *offensive à outrance* and simultaneous on the whole front regardless of protective measures or liaison, which the "Young Turks" of the General Staff had forced on it; and he shows how these theories of peace "were successively swept away by the whiz of the German shells." Joffre's first repercussion seems to have been one of anger; for he ruthlessly removed a number of commanders from their posts. His next was to temporize; and it was now that "the perfect equilibrium "of his temperament which in ordinary times was shown by his power of sleep and "an appetite of a regularity astonishing at his age," exercised the most profound influence on his staff. His other qualities do not take long to enumerate: "an "excellent memory, firmness of character without obstinacy, a love of order—"extending to the smallest details—and a very great command of himself in spite "of a natural sensitiveness to which he declined to give way." On the other hand, he had little imagination, and made use of the ideas and proposals of his staff, ruminating on them "literally for hours" before he came to a decision. Fortunately the members of his staff never seem to have been in agreement, so he always had at least two courses between which to choose.

It is the narrative of what happened at G.Q.G. at Bar-sur-Aube, on September 4th, 1914, which is the most important contribution to history, filling as it does the gaps, due to the lack of documents, in the French official account. Shortly after 9 a.m., General Galliéni telephoned to G.Q.G. a summary of the instructions which he had given to General Maunoury. These were: to have his troops ready to march in the afternoon and commence on the 5th a general movement to the east of Paris. This movement might be either north or south of the Marne. This message is not in the official records, but Joffre's reply to it is telegraphed at 1 p.m.; and he said that of the two proposals he preferred the movement south of the Marne. His staff, as ever, were sharply divided as to what should be done, and argued the question before him. Those in favour of the continuation of the retreat, led apparently by the late General Berthelot, argued that the situation, notably that of the Fifth Army (Franchet d'Esperey), was not sufficiently clear, and that the troops were exhausted. The others were in favour of seizing the opportunity and of taking the risks involved. Joffre temporized by telegraphing to Franchet d'Esperey to ask when he could fight. All the afternoon in the stifling heat of that September day the General-in-Chief sat either in the shade of a large weeping ash in the playground of the school in which the officers of G.Q.G. were established, or astride a straw-seated chair facing a map hung on the wall. "Towards 6 p.m., without waiting for the information he had "asked for, he ordered a draft of a General Instruction to be prepared extending the "local offensive of the garrison of Paris to one of all the Allied Forces of the left "wing." He was told by the staff that it was not possible to carry out such an operation "at a date earlier than the 7th."

During dinner, which began at 6 p.m., an officer arrived bringing Franchet d'Esperey's written reply and suggestions. (That the staff were dining accounts, no doubt, for the fact, which the *Official History* points out, that the two papers have no time of arrival recorded on them, and were put away in a wrong file—that of communications with the British.) "Towards 8 p.m., while the General-in-Chief "was taking cognizance of these documents, he was called to the telephone by the "Governor of Paris." General Galliéni, on his return from visiting British G.H.Q., had found Joffre's 1 p.m. telegram in which he said he preferred an attack south of

the Marne, and now informed the General-in-Chief that Maunoury had already taken measures for attacking north of the river. It appeared to Galliéni impossible to modify the direction, and " he insisted that the offensive should be launched without " any change in the conditions of time and place. Very quickly the General-in-Chief " accepted these suggestions, which fitted in with the combination of which he had " already admitted the eventuality." Having a definite decision, without waiting for written confirmation, Galliéni issued his orders at 8.30 p.m. (Thus the absurd charge that Galliéni falsified the time of his orders in order to get credit for anticipating the G.Q.G. order falls completely to the ground.) Joffre, Commander Muller points out, disliked using the telephone, and this was probably the only occasion on which he gave a decision in this manner; he no doubt departed from his habit because he " had been pondering all day and his mind was virtually made up."

AIR ATTACK—THE LEGAL POSITION OF THE CIVIL POPULATION.

(*La protection des populations civiles contre les bombardements.*)

(International Committee of the Red Cross. Geneva.)

At the end of 1929 the German Red Cross put 10,000 marks at the disposal of the International Committee of the Red Cross to enable the latter to investigate the question:—

> " Is it possible to lay down precisely the rules of International Law protecting the civil population, outside the zone of artillery fire, against bombardments of any sort or to render these rules more effectual? "

Legal opinions were obtained from distinguished jurists who had also experience of military affairs, one from each of the countries of Sweden, Great Britain, U.S.A., Italy, France, Germany, Holland and Switzerland, and their reports are now published without comment. The British consultant was Lieut.-General Sir George Macdonogh, G.B.E., K.C.B., K.C.M.G.

It may be surprising to many to learn that, even on paper, there are no effective rules protecting the civil population in any way, even against gas; less surprising that the consensus of expert opinion is that nothing can be done about it.

Obsolete Conceptions of War.

The development of the air arm has shown up the unsoundness of several long-cherished principles.

The Hague Conventions of 1899 and 1907 were expressly concluded by governments " inspired by the sentiments which found expression in the Declaration of St. Petersburg of the 29th November, 1868 " (which agreed to bar explosive bullets). This declaration begins:—

> " Considering that the progress of civilization should have the effect of alleviating as much as possible the calamities of war;
>
> " That the only legitimate object which States should endeavour to accomplish during war is to weaken the military forces of the enemy. . . ."

This is all in the spirit of the old Continental theory of war. War was an affair of monarchic governments with small professional armies, and civilian participation was mainly confined to the payment of the necessary taxes. In so far as might be practicable, there was no objection to the continuance of private trading between the nationals of two warring countries.

The newer conception of war—some call it the old, barbarous conception—is known on the Continent as the Anglo-Saxon. It is more democratic and it is the necessary corollary of the use of the blockade as a weapon. Every subject of a country is the

enemy of every subject of an enemy country. Trading with the enemy is high treason. As war has become an affair of nations in arms, it is certainly the latter doctrine which has prevailed.

The distinction between combatants and the civilian population is connected with the idea of a " zone of operations." That there can still be such a thing is presumed in the question asked by the Red Cross. No such limitation is, however, possible. No arbitrary maximum range can be laid down for artillery. It cannot be ruled that it is permissible to attack back areas with shells from cannon, but not with shells from aircraft. Nor can it be said that the Germans were justified in bombing Paris, which was within artillery range, but not in bombing similar targets in London. The width of the " zone of operations " is only, in fact, limited by the effective range of aircraft.

The immunity of the civil population came during the last two centuries to be considered as one of the fundamental principles of civilization. It was merely, however, the consequence of the limitations of military technique. Till quite recently the range of artillery was only a few hundreds of yards, and a civilian half a mile behind the line was safe. He came to regard that safety as a right; it was nothing but an accident.

Nowadays, not only is the civilian brought within range of fire from aircraft, but he, or she, is quite probably taking a very definite part in the war. A woman fuzing shells in a munition factory is likely to do as much, or more, harm to the enemy as her son or husband in the front line; and, if the right of self-defence is admitted, the enemy is equally justified in attacking her.

The Principle of the Military Objective.

The nineteenth-century criterion as to whether a town might or might not be bombarded was that of defence. This principle arose out of the methods of warfare of earlier centuries, when wars were a series of sieges with manœuvres pivoted on fortresses. This seeming restriction was quite readily accepted, for on land, with short-range artillery, no sane commander would waste ammunition in wrecking his prospective billets in an undefended town which he could enter without firing a shot.

Conditions at sea were, however, different, for an enemy coastal town could not be occupied in the same way. At the Second Peace Conference at the Hague, in 1907, it was therefore agreed that targets of military importance might be bombarded from the sea if the inhabitants did not themselves destroy the same after due notice. A town might also be shelled if it did not comply with requisitions for supplies. The naval commander was not to be held responsible for damage due to inaccuracy of fire and, further, if the military situation made this essential he might waive the giving of notice to the town.

Against air attack it might be said that towns behind the line were " defended " by the troops at the front, or by their own squadrons, but the point is now immaterial. In all attempts to draw up rules for air warfare the criterion is now that of the " Definite military objective." There seems no need to qualify this, as in the case of naval attacks, by the doctrine of " Military necessity "; it can be left to the tactical commonsense of the attackers to choose the most valuable targets. It is hard, in any case, to think of anything which in time of war cannot be considered as of actual or potential value to a country and so as a definite military objective.

Clearly, many bombs will fall wide of their targets, especially at night. There is not much comfort here for the civil population.

Attempts to Regulate Air Warfare.

Endeavours were made to strangle air warfare at birth. The First Peace Conference, in 1899, prohibited the launching of projectiles from balloons for a period of five years. At that time, heavier than air machines were scarcely thought of,

and any successful development of dirigibles seemed highly doubtful. In 1907, the same convention was somewhat reluctantly re-enacted, but it was only ratified by Great Britain and the United States and was not, therefore, operative in 1914. The delegates were considerably influenced, probably, by the spectacular arrival of Santos Dumont at the Hague in his flying machine while the Conference was sitting. In 1911, the Italians demonstrated the possibilities of the new arm by bombing Arab villages in Tripoli, and so at the Paris Aviation Conference of 1912 a resolution, approving the above declaration, was unanimously rejected.

After the War the question was again raised at the Washington Conference in 1922. Japan and the United States, being themselves geographically immune from attack, were willing to consider a draft code of rules for Aircraft in War, but Italy, France and Great Britain refused, and the matter was shelved by referring it to an international of jurists who were to investigate :—

(1) Whether the existing rules were adequate for the protection of the civil population ; and
(2) What changes, if any, were necessary.

It will be noticed that these questions are approximately the same as those now being considered.

The recommendations of the Committee of Jurists may be summarized as :—

(1) Aerial bombardment for the purpose of terrorizing the civil population or of enforcing requisitions to be prohibited.
(2) Bombing to be restricted to targets of definite military importance.
(3) Outside the immediate zone of operations, the bombing, even of military targets, to be prohibited if this involves the indiscriminate bombardment of the civil population.

Not a single power has, so far, accepted these recommendations.

Impracticability of Restrictions.

Without yet actually entering into the realm of reality, it may be said that two factors have in themselves made it impossible to draft any convention which will in practice restrict the use of any effective weapon :—

(1) The " Si Omnes " clause, and
(2) The necessary authorization of reprisals.

No nation can surrender the use of a weapon which may be used against it. Its consent will be conditional, therefore, on similar surrender by all nations with whom it might find itself at war, and it will claim freedom of action should any nation enter the war which is not a party to the convention. Thus Article 25 of the 1907 Hague Convention, which prohibited the bombardment of undefended towns, was not binding on any nation during the Great War, because this clause did not happen to have been ratified by Bulgaria, Italy, Montenegro, Serbia or Turkey. The use of asphyxiating gases was also, strictly speaking, quite permissible from November 3rd, 1914, onwards, the date of Turkey's entry into the War.

Nor will a nation be restricted by a convention which has been broken by an opponent. Honestly or not, the Germans defended their gas attacks in the Second Battle of Ypres as being reprisals for gas said to have been spread by our H.E. shells. We justified our attacks on the Rhine towns as reprisals for the bombing of London, declared, not unreasonably, by the Germans to have been a point of " definite military importance." The possibility of having to undertake reprisals, moreover, necessitates making full preparation for the use of the forbidden weapon.

The real truth, however, is that no nation will submit to regulations which, in its opinion, threaten its security. The point is very clearly made by Dr. M. W. Royse, the American consultant.

" Rules of war restrict the means and methods of warfare only under the following " conditions :—When a weapon or method has grown obsolete ; when the rule does

" not have the effect of placing one or more States at a disadvantage; when the " weapon or method of warfare is not vital to the military establishments of one or " more States.

" No effective weapon or means of warfare has been restricted or eliminated by " international regulation. On the other hand, obsolete means of warfare have been " condemned, such as the expanding or dumdum bullet, poisoned weapons such as " the poisoned arrow, terrorization by means of pillage, looting and personal violence " to non-combatants. But such practices had long been discarded by the time " they were condemned by international conference. In the second place, with the " obvious exception of neutrality laws, no restrictions adversely affecting a Power " or group of Powers have ever been imposed on warfare. Thus the only restrictions " affecting the hostile action of belligerents were limited to practices of equal con- " venience to both belligerents, such as the rules dealing with sick, wounded and " prisoners of war, the rule banning live mines loose upon the high sea, the rule " prohibiting ' no quarter the rule,' safeguarding hospitals and hospital ships, and " the rule dealing with flags of truce and military uniforms. No effective operations " of the military establishments were here restricted. The rules deal rather with " matters of convenience affecting both belligerents alike, and which had previously " been enforced by customary usage. In the third place, restrictions have been " applied to non-essential means of warfare. Thus the declaration forbidding the " use of explosive bullets lasted only until aerial warfare gave them an importance " previously lacking. The Balloon Declaration banned aerial bombing when it was " non-existent, but the restriction was lifted once aerial bombardment became " practicable. Mines were prohibited, when no longer effective such as when afloat " on the high seas, endangering neutral shipping. Bombardment was restricted to " defended places, if military necessity did not call for drastic action. Later, when " the increased range of artillery fire made possible the reaching of so-called military " objectives in non-defended centres of populations, the earlier restrictions were " removed."

Gas.

For the present, at any rate, the restrictions on the use of gas are only an apparent exception.

Article 171 of the Treaty of Versailles reads: " The use of asphyxiating gases . . . " *being prohibited*, their manufacture and importation are strictly prohibited in " Germany."

It cannot, however, be said truthfully that the use of gas had in effect been prohibited in 1919, and it was for this reason, presumably, that fresh agreements were attempted in 1922 and 1925. Of these, the Washington Treaty is only binding on the five participating powers, while the Geneva Protocol has so far been ratified by 23 only out of the 45 signatories.

Considering facts rather than theory, it will be seen that at present every power is making preparations for the use of gas, that the French are employing it in their colonial wars in Africa, that aerial manœuvres have in some countries included the exercising of a portion of the civil population in anti-gas measures and that almost all military writers take its use in the next war as a matter of course.

There may be some initial manœuvring in attempts to prove that the other side began it.

Actually, the Geneva Protocol may be considered as having legitimized the use of gas, for it envisages its employment against an offending state and so, logically, requires signatories to be prepared to undertake gas warfare if called upon to do so.

Further Proposals for Regulation.

Various suggestions have been put forward for rules which would protect the civil population, but none appears to be practicable.

(*a*) Bombs might be restricted in size, so that while sufficient to destroy a military target, they would not wreck the whole of the surrounding neighbourhood. It has not been stated what should be the size of bomb to destroy an unnamed target.

(*b*) Incendiary bombs might be barred. Even if this were accepted by any air power, it is clear that the first fire caused by enemy attack would be declared due to the use of an incendiary bomb and that the way would be free for reprisals.

(*c*) It was seriously proposed at a meeting of an international Red Cross commission in Rome, in 1929, that the preparation of poison gas should be made a penal offence against the criminal code of every country. This at least recognizes the hopelessness of trying to forbid the use of gas while allowing every nation to manufacture it in peace-time. It is conceivable, however, that the staff at Porton might be acquitted by a British jury! This would lead to diplomatic representations and even war!

(*d*) The "Si Omnes" clause might be expressly omitted from future conventions. Actually, it is not included in the Geneva Protocol, a possible reason for the many signatures which still await ratification.

(*e*) Bombing in order to terrorize the civil population should be forbidden. But such terrorization need only be an incidental result of attacks on railways, factories, power houses and other such things which are now fully recognized as legitimate targets of definite military importance.

(*f*) Certain areas might be marked off which contained no legitimate targets and which should therefore be immune from attack. These would have to be very clearly designated both by day and night. They would be invaluable to enemy navigators at night and would draw attention to permissible targets. Some form of international control would be required to guard against abuse of their immunity. It is doubtful whether any great power would agree to this infringement of its sovereignty.

(*g*) This last remark applies still more strongly to the suggestion that reprisals should be forbidden unless authorized by some international body, which should pass judgment after examining all the evidence of an alleged breach of a convention.

(*h*) Lastly, there are "sanctions," so attractive to logical minds. Let all civilized nations agree to take international action against any nation which breaks its word. Suppose, however, that Poland is alleged to have used gas in repelling a Russian or a German attack. Will France be ready at once to pour troops into the Dantzig Corridor for an attack on Warsaw? Would Great Britain, for similar reasons alone, enter a Russo-Turkish or an American-Japanese war?

Conclusion.

There is, in fact, no hope of regulating the use of any effective weapon. The objective in war is the bending of the will of the enemy, and three-dimensional warfare has now enabled nations to strike directly at each other. Hitherto, the civil population has been able to wave flags, and its politicians to start wars and make speeches, with reasonable assurance that all dangers and hardships will be borne by the young men whom they have paid to provide a fence between them and the enemy. Should the fence be broken, peace is made.

Nowadays, the protection of the civil population is dependent mainly on the preservation of peace. The renunciation of war has been proclaimed in the Kellogg Pact, but such renunciation must be more than a negation. A substitute for war is still to be found.

In the meantime, the Red Cross may be encouraging a false sense of security in attempting to regulate, and so legitimize, new arms. It might render better service by impressing on all countries the inevitable accompaniments of future wars, so encouraging politicians and voters to maintain peace, not for the sake of their high ideals, but in terror for their own skins.

J.S.B.

THE BATTLE OF DORA.

By H. E. Graham.

(William Clowes & Sons, Ltd. Price 5s. net.)

The author of *The Defence of Bowlers Bridge* has produced another best-seller, which can safely be recommended to the whole military hierarchy, from army councillor to drummer. In it he deals with the composition and action of an armoured force and compresses a whole world of instruction, entertainment and provocation into 75 pages and 6 maps. His preface is a masterpiece of disarmament of criticism and the two final chapters "résumé" and "mobility" present in ten pages some valuable remarks on "surprise" and a summary of the mobility situation as it is now, in comparison with the mobility obtained by the Asiatic master-movers of the past. Literally, one cannot put the book down. The ideas are alive and the situations are alive—far too lively for the unfortunate infantry "meat" involved as targets in his armoured battle. As for his characters, well, Brigadier John Carburettor speaks for himself, while his Brigade-Major Sparking Plug manages to combine efficiency and high spirits with a temperament which does not unduly confuse morale and morals. He is, in fact, a cavalier with a taste for dubious limericks. Fortunately for the Puritan in our midst, the Brigadier invariably stops his B.M.'s untimely flippancy before it gets into print. The remainder of the cast are equally strong, Colonels Carden, Loyd, Vickers and Armstrong, R.A., are all that Colonels should be. I have my doubts about Colonel Hyde from G.H.Q., but, after all, a Staff officer cannot help his name; "they also serve. . . ."

H. E. Graham launches us into a war in which Anglia, highly mechanized, meets, at the orders of the League of Nations, Martia, bellicose but obsolescent.

The terrain is imaginary and the place names include *inter alia* the towns of David, Ramsey and Stanley, cheek by jowl with Waterloo, Blenheim and Dora.

The story tells of the Armoured Brigade's part in the operations which precede the decisive Battle of Dora, and in that battle itself. The author is not solely concerned with making our flesh creep about armoured fighting vehicles, he manages to teach us a lot of good knockabout tactics and on occasions he even tilts at "staff duties," respectfully, of course, but he tilts. It is all first-class fun, first-class sense and first-class instruction and perhaps the only people who could possibly object to the fun are the Martian Infantry, who have it poked at them with lots of other things, and Major Girder who commands the mechanized field company and doesn't get a show. Still the Sappers are handsomely conciliated in the long run. The author frankly admits that he has loaded the dice pretty heavily against the Martians, but he says that it serves them right for not moving with the times, and there is a delightful letter from a Martian subaltern with an advanced guard battalion, the only Martians who made anything of a show, which explains how his battalion was captured by a company of light and a company of medium tanks, although it had four A.T. and six field guns to help it. Well, well, I suppose somebody must be butchered to make a Tanks Corps holiday, and infantry are cheap. Since reading *Bowlers Bridge*, I have been wondering who this cheerful author may be; he gives us a clue this time; he is undoubtedly an Irishman, only a Hibernian could achieve the bull which follows: "For three hours without a break a constant stream of bombs, "light, medium and heavy, were dropped (by the enemy) upon the empty woods. "An Air Force officer who was *sleeping* with Brigade Headquarters estimated that "at least 2,000 bombs were dropped and at least six squadrons must have been "employed." Some sleeper that, or perhaps R.A.F. officers woo Morpheus by counting bombs dropping as a modern variant of sheep through a gap. Jesting apart, this is one of the most valuable contributions to a military library produced since the War, and it is so absolutely sane that one is tempted to quote it in all its manysidedness, if only that didn't spoil the story.

Any keen soldier who doesn't get this book and analyse it page by page deserves to be transferred to the Martian Army and led away to captivity, escorted, as a final insult, by two light tanks per 1,000 prisoners.

E.E.D-S,

LE DANGER AÉRIEN ET L'AVENIR DU PAYS.

By LIEUT.-COLONEL VAUTHIER.

(Berger-Levrault. 1930.)

This is definitely an interesting book. Lieut.-Colonel Vauthier is an officer of anti-aircraft artillery and is well known in France as a writer on war in the air of the future. In developing this subject, so full of possibilities, he has vied with the late General G. Douhet, prematurely lost to the Italian Army last year. The object of the book is, of course, to bring home to the French people the danger of air attack in any future war: not only to the military forces, but to every section of the population of France, and especially of large towns such as Paris.

The author treats his subject with meticulous French logic in three parts: (1) the nature of the aerial danger, in order to define its essential features; (2) a study of the means of defending the country (France) against this danger; (3) an investigation as to the possible means of organizing the country in order to reduce that danger. In the first part, the technical capacity of the latest aircraft of all nations is measured against their probable objectives: actual air attacks of the past are analysed and opinions of leading foreign authorities as to the future are quoted. The features of air attack are summarized as: (1) rapidity of action; (2) varying method of attack, viz., by incendiary, gas, high explosive bombs, or by gunfire; (3) flexibility of manœuvre. The subject of defence against air attack is studied under the headings of intelligence, the power of aircraft to meet air attack, means of ground anti-aircraft defence, " passive " means of defence (evacuations, education of the people, shelter), and the organization of defences in general. Under each heading the author's analysis and ideas are followed by a review of foreign opinions or practice on the subject. In the third part of the book, the author develops his ideas with regard to the future of town-planning and city building, of the organization and control of traffic, and of the organization of industry and commerce. He concludes by the deduction that the life of France in the future depends on the realization of the inevitable dangers of attack by air which threaten the whole country, and on the measures gradually taken in peace to reduce, as far as may be possible, those dangers.

The book contains matter of great interest for officers of every branch of the Corps, and not only for those directly interested in anti-aircraft work. The future of fortification, town planning, construction, the handling of traffic and of crowds, industrial organization, are all subjects treated in a way which encourages much thought. It is a very " readable " technical treatise and by no means a " scare " book, written to appeal only to the general public. A book written on similar lines to deal with conditions in the United Kingdom and adapted to the psychology of the British character would be of great interest.

K.J.M.

HANDBOOK OF MILITARY LAW.

By CAPTAIN R. J. WILKINS and W. S. CHANEY

(William Clowes & Sons Ltd. Price 12/-)

No more suitable individual could be sought to review this book than one who has obtained the precise minimum requisite to qualify in two examinations, to wit, Promotion and Entrance for the Staff College.

The acid test of the value of such books as this seems to be to apply some definite

difficulty that has come within the reviewer's ken and see whether this book is of any value in helping to reach a solution.

Take first the question as to the admissibility of the evidence of a child, and what exactly is a " child " in the eyes of the law.

Page 42 of this book states: " The unsworn evidence of a child of tender years " must always be corroborated."

Now what precisely are " tender years "? Is an amorous spinster of 40 " of tender years "?

Turn again to page 36. " Facts not requiring proof. These are matters of universal " knowledge."

Fortified by this dictum one might well find a soldier guilty of losing by neglect a pair of boots, it being a matter of universal knowledge that soldiers do wear boots. But unless proof is supplied that the soldier once had boots, you will be surprised to find how quickly the J.A.G. will quash your verdict.

In fact, this book, like all other short cuts, may slightly dispel the gloom but cannot pretend to elucidate the M.M.L.

R.H.A.

THE INTELLIGENCE SERVICE WITHIN THE CANADIAN CORPS, 1914–1918.

By MAJOR J. E. HAHN, D.S.O., M.C., Late General Staff, 4th Canadian Division, C.E.F.

(Toronto: The MacMillan Company of Canada, Ltd., at St. Martin's House. 1930. Price $2.63.)

As this book may not be generally accessible to English readers, it is proposed to give a brief review of it here. It does not profess to describe the sensational side of the intelligence service, but describes the methods by which every description of intelligence was collected, summarized and mapped. In the latter, perhaps, will be its greatest interest for R.E. readers.

One of the interesting points is that a " Hostile Shelling Map " was kept, which indicated the enemy's daily artillery activity and showed against what portions of our front this activity was directed.

The shelling was plotted on a 1/20,000 map of our front. A different colour was used to represent the different calibres of enemy shells, usually covered by his three smallest guns, the 77-mm., the 4·1 howitzer and the 5·9 howitzer.

One dot of the colour indicating the calibre of the round was marked on the map at the place reported. The map was kept for a week and then a new one used.

In this way, if it were noticed that a certain number of rounds were being fired for several days against a small section of trench or wire, this might indicate a slow wire-cutting prior to a projected enemy raid. Again, fire covering the divisional sector and directed against trench junctions and communications generally, may indicate normal harassing activity or may be interpreted as a possible registration of new guns. Any increase of the general volume of fire directed against the divisional front was at once apparent from the map.

A map showing " Hostile Trench Mortar Activity " was kept and any unusual activity indicated by the map which might be construed as wire-cutting resulted in the unit being warned and precautions taken against a possible raid.

In addition to these, maps showing " Enemy Work," " Routes of Approach and Centres of Activity," " Enemy Dispositions," " No Man's Land," and a " Raid Map " were kept at divisional headquarters. At Brigade Headquarters were kept a general map showing the enemy defences, a wire map and an O.P. map.

The number of draughtsmen required is considerable, as in the office of G.S.O. 2, (I.)

three draughtsmen are required, in each brigade office two, and at each battalion headquarters one aeroplane photo- and draughtsman.

Details are given of the distribution of a map accompanying harassing fire orders, they are:—

C.R.A.	45 copies.
D.M.G.O.	6 ,,
62nd H. A. Group	16 ,,
7th Canadian Inf. Bde.	8 ,,
8th Canadian Inf. Bde.	8 ,,
9th Canadian Inf. Bde.	8 ,,
4th Canadian Division	1 ,,
63rd (R.N.) Division	1 ,,
Canadian Corps	2 ,,
C.C.H.A.	1 ,,
A.D.C. to G.O.C.	1 ,,
1st Canadian Division	1 ,,

A very interesting summary of intelligence on the Cambrai front of about the 10th September, 1918, and an account by which the intelligence was obtained, is given, and many intelligence summaries covering various periods. Great stress is laid on personal observation and methods are indicated for use in open warfare.

The book is well illustrated by maps, plans and aeroplane photos, but wants an index, a serious defect in a book of this nature; however, the book will repay perusal.

The price in Canada is $2.63, probably about 10s. 6d. to 12s. 6d. in England.

H.E.G.C.

SURVEY OF INDIA HANDBOOK OF TOPOGRAPHY.

Published by order of BRIGADIER R. H. THOMAS, D.S.O., Surveyor-General of India.

(1) TRIANGULATION AND ITS COMPUTATIONS. Chapter III. 4th Edition. Price 1s. 9d.

(2) SURVEYS IN WAR. Chapter VIII. 2nd Edition. Price 1s. 9d.

This handbook was originally published as a single volume, containing ten chapters, dealing with almost every possible situation in which the topographical surveyor could find himself. Now, however, each chapter has been bound up to form a separate pamphlet. This has the advantage of reducing the amount of literature the surveyor has to take with him into the field, and further, it admits of the revision and reprinting of chapters separately as required.

For the information of those concerned with survey operations which, indeed, since the War have become of even more importance than before, the following are the titles of the chapters of this useful handbook: Chapter I, Introduction; II, Constitution and Organization of a Topographical Party; III, Triangulation and its Computations; IV, Theodolite Traversing; V, Plane-Tabling; VI, Fair Mapping; VII, Forest Surveys and Rectangulation; VIII, Surveys in War; IX, Geographical Mapping; X, Map Reproduction. From among these the surveyor engaged on any particular class of work can select the appropriate chapters to take with him into the field. A certain amount of reference from one chapter to another is almost unavoidable; he should, therefore, be careful to see that he has all the necessary pamphlets in his possession.

(1) Important alterations and additions to this edition of Chapter III are indicated in the usual way by a vertical line down the margin. One of these is a useful and simple method of computing the errors of any given series of topographical tri-

angulation. " It would be a very sound thing to take out these quantities while the " work is in progress and if they indicate errors greater than permissible, steps should " be taken to raise the standard of observations, by increasing the number of measures " of angles, using a more precise instrument, and better signals, or even a better " observer." Very good advice.

(2) While military surveying does not differ in principle from any other kind, owing to the limitations of movement which are imposed on the surveyor under war conditions, special methods have sometimes to be employed which would not ordinarily be used. This pamphlet deals largely with these.

This chapter must, of course, be read in conjunction with the *Field Service Manual* and *War Equipment Tables of a Field Survey Company*.

The development of aerial photography has been responsible for the introduction of much new matter relating to the details of air survey compilation.

A great deal of useful information is given regarding the rapid reproduction of maps in the field by various processes.

The handbook is the result of the accumulated experience of a large, highly organized survey department, engaged in every class of topographical survey and responsible for the mapping of a great country.

H.L.C.

THE MAP READING " INSTRUCTOR."

By Captain C. A. Wilson, A.E.C.

(Sifton Praed. Price 5s. 6d.)

Few of the numerous books written with the object of simplifying or condensing the *Manual of Map Reading* have succeeded in materially improving upon the Official Manual, either as aids to instruction or as books of reference. The author of *The Map Reading Instructor*, however, makes no apology for adding to the already long list of works on the subject, and his confidence is amply justified. His book should prove of considerable value, either as a self-contained manual with a definitely limited scope, or as a supplement to the Official Manual.

The author gives as his objects " (i) to deal with the subject in such a way that it " can be grasped by the soldier of average intelligence, working with or without an " instructor; (ii) to suggest to the officer or N.C.O. instructor a method of teaching " the subject in a simple and logical manner; and (iii) to omit all that which does not " come within the scope of practical every-day map reading, where rapidity is more " essential than meticulous accuracy."

His objects, therefore, differ little from those of his predecessors. As regards his treatment of the problem, his practical and constructive suggestions, his clear and simple explanations and admirable sketches, make his book a valuable addition to the existing literature on the subject.

The book is divided into three parts. Part I deals, in logical sequence, with the minimum requirements for straightforward practical map reading. Short chapters are devoted to Conventional Signs; Measurement of Distance; Map Reference; Relief and its representation; and Enlargement; each chapter being followed by suggestions for simple exercises on the map and on the ground.

Part II develops the subject in the same logical order, but in greater detail. Its arrangement corresponds chapter for chapter with Part I. For example: the chapter on Measurement of Distance in Part I deals simply with the meaning and representation of " scale " and the *use* of the divided scale line. The corresponding chapter in Part II covers the actual *construction* of scale lines, a knowledge of which is not considered essential for practical map reading purposes. Relief is dealt with

in a similar way. In Part I the chapter devoted to the subject contains merely the methods of representing Relief; elementary problems on Visibility; and the recognition of the commoner ground features; while the corresponding chapter in Part II covers the representation of the less common ground features, such as escarpments, plateaux, watersheds, etc.; visibility diagrams; and gradient problems.

Parts I and II together cover the requirements of all army map reading examinations.

Part III is entitled "Field Sketching" and forms a valuable addition to the chapters on the subject in the Official Manual. The making of rough sketches, with or without an enlargement as basis, is clearly described, and the practical use of such sketches is illustrated by an example, in narrative form, describing the reconnaissance of an outpost position. Compass Traversing and Panorama Drawing are also included in this part.

No reference is made to Plane Tabling, which is considered to be beyond the scope of the work.

The book is generously illustrated throughout with excellent sketches, which should be of the greatest value both to the student and to the instructor, since they are, for the most part, sufficiently simple to be copied with ease on to a blackboard.

The author has obviously had considerable practical experience in his subject, and the results of his experience embodied in his suggested methods of instruction, in addition to the many useful sketches, plates and examples with which the book abounds, should prove an ample return for the comparatively low price (5s. 6d.) at which the book is published.

A.C.S.

FOXHUNTING.

By SIR CHARLES FREDERICK, Bart., M.F.H.

(The Lonsdale Library. Vol. VII. Price 25s.)

The editors of the Lonsdale Library are doing for us what their predecessors in the Badminton Library did for our grandfathers; in their seventh volume they have just failed to produce a magnificent book on foxhunting. If it did not aim at so much, it might have succeeded in being a great book.

The editor of this volume is Sir Charles Frederick, for many years Master of the Pytchley, and the list of his assistants who have written chapters on various subjects on which they are experts is an imposing and authoritative one; an example, taken at random, "The Huntsman in the Field," by I. Bell, M.F.H., shows that the best living experts have been called upon to expound their own subjects. Those subjects on which the editor himself writes are interestingly and lucidly explained, but many, too many, of the collaborators are not ready writers and their contributions would have been vastly improved by pruning and re-shaping.

The Badminton book on foxhunting is disappointing in that it leaves out so much. The Lonsdale book is very much more exhaustive and many of its more interesting chapters are those on more remote subjects, such as "Hunter Shows and Trials" and "Following Foxhounds on Foot," the latter being an exceptionally interesting description of a sport which many people could take up if they knew anything of its delights, and were not afraid of being cursed for being in the way of the hunt and its mounted followers.

To few of us is given the pleasure of being engaged in the management of a hunt, but all of us who follow, or hope to follow, hounds mounted or afoot will find our enjoyment enhanced by knowing more of the duties and difficulties of the master and his staff; these are well explained in the opening chapters.

Colonel Geoffrey Brooke contributes an able and condensed chapter on horses, which would be improved, at any rate for the novice keen on learning what and how to buy, by a diagram showing the points of a horse.

In the middle of the book, the powder in the jam, are two chapters on accidents to men and horses; these chapters are separately indexed for quick reference, presumably in emergency, but the book itself is rather heavy (it weighs 2½ lb.) to carry in a hunting coat.

The chapters which follow, on the details of hunting in various parts of Great Britain, are disappointing. Too many of them read like articles for a newspaper, or are concerned with detailing lists of coverts and their owners. Few would inspire the traveller from Mars, or the U.S.A., with enthusiasm to sample the delights they describe. An exception is that on hunting in Wales, in which Captain Evans, M.F.H., has much that is interesting to say on the Welsh hound, to which many English breeders have been paying much attention in recent years.

In the midst of so much that is interesting it may appear querulous to note and deplore any omissions, but chapters on stable and kennel management, including details of feeding both horse and hound, and notes on dress in the hunting field would have rounded off the volume as the complete treatise on its subject. An appendix, 16 pages long, of hound names might have been spared if space were required.

There are a number of admirable photographs, reproductions of old prints and action snapshots of modern packs at work; many people will be relieved to know that a diagram of Tom Smith's "All-round-my-hat" cast has not been omitted.

Reference is made here to two amusing errors, on pages 157 and 211, in the hope that precisians (of whom the Corps is perhaps over-full) may be induced to make a search for them, for assuredly, whether they like the feel of a rein or a steering wheel, they will find in the reading of this book enjoyment and profit.

J.E.C.M.

THE FIGHTING KINGS OF WESSEX: A GALLERY OF PORTRAITS.

By G. P. Baker.

(G. Bell & Sons. Price 15s.)

When we were young, English history started with 1066. There was a backward glance at one Edward the Confessor, whose soubriquet always struck us as strange, and at Harold, who died at Hastings from an arrow in his eye. Before that there was a welter of strange names and confused happenings. Research in the last few years, however, has enabled the historian to unravel an ordered story throughout these centuries which can now be studied as part of the history of the evolution of the England we know to-day.

This book is No. 1 in "Studies in English Kingship," and the Preface is not the least interesting part of the book. Mr. Baker says that what civilization cannot survive is economic disaster—the slaughter of millions of men was not the really serious feature of the last war. The period dealt with in this book is that from the fall of Rome to the death of Harold—a period which saw the new civilization rising after the economic breakdown of the old. Not only is the birth of the new civilization studied, but the book has been written "to illustrate a limited thesis: namely, that "the Kingship of England is not an organ of the State, created by a pre-existent "body-politic to fulfil diverse functions of government, but is the original force "which created the body-politic." In this study of the English Kingship appear such persons as Hengist, King Arthur, Charlemagne, Roquar Lothbrok, King Alfred, Archbishop Alphege, Olaf the Holy, and Knut the Great, a mighty company indeed and a guarantee of the interest of the story. It is a good corrective study in these days when people shut their eyes to facts and proclaim ever more insistently that "democracy" is the only way of salvation.

There are many matters of military interest in the story—for instance, the mounted infantry raids of the Danes, and the way the Roman roads determined strategy.

P.H.K.

THE VIOLET CROSS.

(La guerre des gaz. Comment nous défendre ?)

By CAPTAIN S. DE STACKELBERG, Ex-Attaché of the Military Mission of the Imperial Russian Embassy in France.

(Published by the Violet Cross at Lausanne.)

Captain de Stackelberg, formerly a Russian engineer officer, now on the staff of the *Revue Militaire Suisse*, contends that, although future wars are inevitable and will be largely aero-chemical, the civil populations need be much less alarmed than might seem to be necessary at the prospect of enemy gas attacks, provided the required measures are taken for their protection.

Gas is a far less terrible weapon than is commonly imagined. The mortality rate among British casualties caused by gas shells during the last year of the War was only 1 per cent. Of those wounded by gas only 9½ per cent. were sufficiently disabled to need a disability pension of any kind, as against 26 per cent. in the case of those wounded from other causes. A cloud attack is somewhat more deadly, but this is not practicable away from the front.

A concentration strong enough to cause the death of persons unprotected by masks would need about 25 tons of gas per square mile. Allowing for the weight of the bombs themselves, this would need about seventy heavy bombers. Only a proportion of bombers can be expected to get past the defending squadrons and through the anti-aircraft barrages. Only a certain proportion of an air force is made up of heavy long-distance bombers. All important towns are many square miles in area. Any real drenching with gas of a large industrial area is, therefore, out of the question, for it would require air armadas of impossible size.

Aero-chemical warfare has brought us back to conditions like those of the Middle Ages, when every burgher carried arms and slept behind walls; practised, in fact, passive defence as a matter of course.

In many countries, particularly in Eastern Europe, the importance of such passive defence is already recognized. The civil population is made to take some part in air manœuvres. In France the work has been entrusted to the Ministry of Commerce and Industry; funds are raised by means of lotteries and a sum of four hundred million francs is said to have been accumulated already.

An efficient system of air raid warnings is required. The civil population need never suffer from surprise, as troops must on occasion, and there should be no excuse for panics, more dangerous probably than enemy gas.

All must be supplied with masks and instructed in their use.

Refuges must be provided in public buildings, tube stations and such places. These must be gasproof and have a supply of pure air. (This is likely to be impossible for financial reasons.)

The police and the fire brigades must be trained and equipped for neutralizing gas.

To aid the anti-gas defence of all nations, Captain de Stackelberg has founded the international institution of The Violet Cross, organized somewhat similarly to the Red Cross and with its headquarters at Lausanne. Its chief work will be the encouragement of medical and chemical anti-gas research and the dissemination of information, and it will endeavour to induce nations to enter into international agreements in order to spare the civil population unnecessary suffering.

J.S.B.

MAGAZINES.

REVUE MILITAIRE FRANÇAISE.

(*October*, 1930.)—*La défense des frontières : leçons de maîtres disparus*, by Colone Doumenc. This article points out how the elder Moltke viewed defence on the Franco–German frontier, and how it was regarded by certain French generals, including Foch. The writer gives his conclusions, which point to a general preparation of the frontier on the lines laid down by Moltke in 1857. Three main questions govern frontier defence, namely, the power of manœuvre, the strength of armament and permanent defensive organizations. Of these, the power of manœuvre has always been the most important and the other questions are subsidiary to it. Colonel Doumenc shows, however, that the appearance of aircraft, tanks and poisonous gases are bound to have a great effect on defensive organizations, and that, unless they are improved in peace-time, it will be too late in the event of another great war.

Le 20e corps à Morhange, by Commandant Lefranc. This article reads partly as an explanation of Foch's action, in command of the 20th Corps, in August, 1914, and partly as an explanation of the severe French defeat in the "Trouée de Charmes." Apparently the Germans did not deliberately draw the French 1st and 2nd Armies on to difficult country and then counter-attack them, but the German advance actually produced an encounter battle, in which the French were severely defeated. It seems clear that Foch was more successful than the other Corps commanders, but the superiority of the German forces does not seem to account altogether for their success.

Commandant Delmas completes *La manœuvre de contre-attaque* in this number. Here he deals entirely with the deliberate counter-attack carried out by one or more battalions. The first part of the instalment is rather like an expansion of our *F.S.R.*, II ; every detail being brought out with care. The writer does not, however, indicate the probable size of the counter-attack ; it will occur to a good many readers that a company for an immediate counter-attack and a brigade for a deliberate one is not a bad rule. The article concludes with the description of certain counter-attacks and a final word on the necessity of these attacks and the care to be adopted in framing them.

Capitaine R. Michel completes *Monthyon* in this number. The first part describes the efforts of the 55th and 56th Reserve Divisions of Manoury's Army to drive back the Germans early in September, 1914. The description is rather long-winded, except for anyone who took part in the action ; but it is interesting to see how troops on both sides were rushed northwards and each feared great danger from the other. Captain Michel completes his article with some useful comments. What stand out especially are lack of reconnaissance by the cavalry and the precarious state of communications. If the cavalry had given themselves a wider scope, the French commanders would have known more, and losses (such as those of the 55th Division's valiant attack on Barey, which was never really successful) might have been avoided. As regards communications, we are still struggling to improve them ; but the problem in the forward area is one of the most difficult in modern war.

(*November*, 1930.)—Commandant Larcher begins *Le 10e corps à Charleroi* in this number. This is another of the descriptions of part of the French Army at the outbreak of the Great War, preceded by observations about the training of that army.

We are all used by now to the idea of the offensive, so pushed to excess in France in 1914; but the writer points out how this idea varied to a certain extent in the different formations. This instalment then goes on to the early stages of the campaign and the first contact between the French and the Germans.

La journée du 9 septembre, 1914, à la gauche de la 9e armée, by Général Réquin. This is again a detailed description of another part of the front at the beginning of the Great War; but the writer's admiration for Foch (who commanded the 9th Army) and his method of description cannot fail to make the article interesting. Foch's determination to attack, his method of doing so, and the way in which his subordinates supported him, cannot be read too often. Although almost unheard-of calls were made on the stamina of the troops, the army attacked with success and incidentally gave the Germans a great surprise, as they thought that the French soldiers would be unable to "rebound" so quickly. Général Réquin actually saw most of the operations described and was in a position to discuss them with Foch afterwards.

L'effort militaire de la Grande-Bretagne en 1914–1918, by Capitaine Cammas. At first sight, one expects a Continental view of the British efforts during the Great War, but Capitaine Cammas is perhaps too kind to us. He starts by describing the various phases of the Great War, how Kitchener formed the various divisions, how service was at first voluntary and finally became compulsory, and how it took nearly three years for Great Britain to develop her full strength on the Continent. He realizes that our real strength was on the sea, and that the production of a great army was really subsidiary, but one cannot help feeling that we might have attained universal service earlier than we did and that this would have appeared obvious to a Frenchman. His description is, however, very clear and should be of value to Frenchmen wishing to know exactly what Great Britain achieved.

Général Vanbremeersch begins *L'hiver* 1925–1926 *au Maroc dans un secteur du front Nord* in this number. This article is really a continuation of previous articles in this *Revue* and deals with the preparation for further advance after the cessation of the offensive in 1925. General Vanbremeersch selects the 256th Infantry Brigade, who held part of the sector for a long time, to illustrate his narrative. This instalment deals with proposals made by this Brigade, followed by a sudden order from the 128th Division to be prepared to advance.

(*December*, 1930.)—*La combinaison des armes*, by Général Brossé. The writer considers the effect of combination between the various arms at different periods throughout the Great War and points out that nowadays the different arms must combine or the operation will not be a complete success. The different stages are well known to those who served in France during the War and need not be repeated here. What does stand out, however, is that General Brossé still regards the infantry as the finally decisive arm in battle. This is doubtless still true for the French conscript army, but for us, with our mechanization, this may not be always so. Although the infantry will always be required to occupy any captured town or position, it may be that we shall be able to convey them there in vehicles after the decisive fighting has been carried out by mechanized vehicles.

Colonel Loizeau begins *Succès stratégiques, succès tactiques* in this number. In 1915, Falkenhayn, considering where to attack, said that tactics must give way to strategy. In 1918, Ludendorff, on the same subject, said that tactics guided him to a certain extent. The writer's object is to consider these two conflicting views with reference to the Great War. He begins with the Schlieffen plan and points out how, in both the 1905 and 1912 plans, tactics is entirely subordinated to strategy. Schlieffen's first idea was an envelopment *via* Belgium; he later considered an actual piercing of the allied front in Belgium. In such event, however, tactical ideas do not in the least affect his determination to bring off the strategical success of crushing the French Army.

Commandant Larcher continues *Le 10e corps à Charleroi* in this number. The instalment deals mainly with an unsuccessful attack of the 19th Division followed by

an attack of the Zouaves of the 37th Division, which partly restored the situation. General Bonnier, of the 19th Division, was under the impression that his troops had made more progress than had actually occurred, and he asked the 37th Division to attack as well in order to drive the Germans back over the Sambre. The most interesting part of the instalment lies in the attack of the Zouaves of the 37th Division with no information and no co-operation, but carried out with great gallantry. In fact, the Germans showed signs of retiring, in spite of neither of the French attacks being really successful. The instalment closes just as decisions are to be taken for further action by the French.

Général Vanbremeersch completes *L'hiver 1925–1926 au Maroc* in this number. The instalment is almost impossible for the ordinary mortal to read, owing to the mass of detail and the various orders given; it is more for the promotion examination student. The lack of maps and the peculiar names increase the difficulty, at any rate for the Englishman. When places in France are familiar, names like "Dhar-el-Kbir-des-Bon-Korra" are apt to frighten the reader away. Actually the first part of the programme laid down was carried out during the winter with comparatively small losses, the second part had to be delayed till later.

(*January*, 1931.)—Général Gamelin and Commandant Petibon begin *La 9e division en 1918* in this number. After the Great War, General Gamelin was Chief of the French Mission in Brazil, and he instructed Commandant Petibon to prepare a series of lectures on the 9th Division, of which the two writers had been G.O.C. and Chief of Staff. General Gamelin starts the article with a preface, in which he points out that this Division went through a great variety of operations, and considers that even now its operations might be worth reading. This instalment is devoted to the German attack of March, 1918, in which the 9th Division was rushed up to the Noyon area, on account of the British front being broken. After taking up positions the Division was successful in beating off the German attacks, but had to retreat owing to the front going back elsewhere. These operations were carried out successfully but with difficulty, and the instalment closes with Divisional headquarters established in Noyon.

Colonel Loizeau continues *Succès stratégiques, succès tactiques* in this number. The instalment is devoted to Moltke's control of the German Army at the outbreak of war. The writer traces very clearly how Moltke gradually broke away from Schlieffen's plan by strengthening the German forces in the east, allotting more troops to Alsace-Lorraine and maintaining his double idea of a success in Lorraine apart from the enveloping movement by the north. It was the existence of these two ideas that brought about Moltke's downfall, as neither were actually successful. As stated by Ludendorff, Moltke had a keen military perception but had insufficient energy; in fact, he failed to command the German Army.

Commandant Larcher continues *Le 10e corps à Charleroi* in this number. This instalment is devoted to the attack of the 20th Division in support of the 19th. The fog of war apparently had descended considerably on both General Boë of the 20th Division as well as on the 19th. There was a mist which prevented the German artillery from being seen, communications in front broke down to a large extent and the Divisional Commander had little definite information on which to make up his mind. As a result, he ordered a vigorous attack by his Division, but really he knew nothing of what was happening in front. The instalment closes with the infantry of the Division falling back, much to the surprise of the Staff. In the next instalment the writer proposes to consider what had actually occurred on its front.

Colonel Grasset begins *Bailen* (*21 juillet*, 1808) in this number. This is, to an Englishman, an interesting but not well known part of the Peninsular War. The difficulties the French had to contend with are very clearly described. General Dupont, one of their best commanders, was trying to reach Cadiz from Madrid, but everything in the country was against him. Everyone was hostile, roads were bad, no food was available and his troops were ravaged by dysentery. The writer

describes how Savary, who was really controlling the operations from Madrid, under Murat, could not agree throughout with the Emperor's plans, and how Dupont found himself, half-way to Cadiz, isolated and short of food. The Spanish concentration of troops is then described and the instalment concludes with Dupont concentrating at Bailen and the Spaniards preparing to attack him. The article describes the situation in great detail, but without too much explanation of the positions of the smaller units.

(*February*, 1931.)—Général Gamelin and Commandant Petibon continue *La 9e division en* 1918 in this number. The operations at Noyon are completed and General Gamelin gives his conclusions. The description is interesting as the varying organizations wanted in defence are used in turn. At one time the 9th Division was under command of the 1st Division; at another a "Gamelin Group" was formed with more than two Divisions in it. At one time a British Cavalry Division took part under the orders of the 9th Division. General Gamelin's conclusions are also of interest. Besides pointing out various features of the defence, such as the necessity to retire almost always at night, he explains how much luck affects these operations. By being able to bring the artillery of the Division into action at the same time as the infantry, by shooting down an aeroplane having orders for the next German attack, the Division was able to offer a determined resistance and helped to bring to an end the German advance in the Noyon sector.

In continuing *Succès stratégiques, succès tactiques*, Colonel Loizeau now considers Falkenhayn. His difficulty was partly the continual pressure from Hindenburg and Ludendorff to seek a decision in the east; while Falkenhayn saw clearly that, sooner or later, a decision must be attained in the west. Unfortunately, he was unable to quell Ludendorff when necessary, and his operations, though well thought out to begin with, lacked the necessary number of men to carry them through. In fact, Falkenhayn, like Moltke, did not possess the divine spark of the great strategist.

In continuing *Le 10e corps à Charleroi*, Commandant Larcher now describes the true situation on the front of the 20th Division. The different regiments were engaged in isolated combats, with no direction from above, and no general attack whatever occurred. It was not till General Boë saw wounded men coming back that he realized that all was not as it should be on his front. At the same time the Zouaves of the 37th Division were retiring, largely owing to their being absolutely exhausted. Fortunately, the Germans did not follow them up and at the same time the 10th Corps Commander arrived and took complete charge of the operations. The front was withdrawn to a certain extent, in view of General de Laurezac's orders and the Divisions got an opportunity of carrying on the defensive action expected by the 5th Army.

In the second instalment of *Bailen*, Colonel Grasset describes the various moves of the French troops while the Spaniards were preparing their attack. This does not mean that the French were moving hither and thither while the Spaniards were developing a well-organized offensive. This is far from being true; but the French certainly showed considerable hesitation in their various movements while disease and starvation were doing their worst. General Dupont showed a surprising lack of decision, in spite of his great reputation. The instalment closes with the Spaniards ready to begin a combined attack while the French forces were very much reduced by disease and scattered.

(*March*, 1931.)—Général Gamelin and Commandant Petibon continue *La 9e division en* 1918 in this number. This is a very interesting instalment, describing the beginning of the Allied counter-offensive. The 9th Division was rushed up to the 5th Corps (under General Pellé) and attacked with complete success on 18th July. This attack was just north of the Marne and had not the great depth of the main offensive farther north, but it held the Germans from sending reinforcements. What is interesting is the preparation made for the counter-attack, particularly as the Germans were continuing their own offensive at this time, and it was only by

the energy and efficiency of the commanders of the regiments that General Gamelin was in a position to take part in the blow of 18th July. The whole of this article is written with not too much detail, but yet sufficient information is given to bring out clearly the important points.

Colonel Loizeau's fourth instalment of *Succès stratégiques, succès tactiques* is of real interest, as it describes the early stages of the great German offensive of 1918. Ludendorff had quite clearly the correct plan, to roll up the British from their right while keeping the French at bay, but difficulties began to show themselves from the start. There was a tendency among the army group commanders to consider a vigorous threat to Paris as part of the operation, and the means available were not really sufficient. The writer sums up the instalment, counting the various considerations preceding the great attack, the execution being left to the following issue.

Capitaine H. Morel begins *Empire britannique*, 1930, in this number. The first instalment is devoted mainly to a description as to how the British Empire started, how it was built up and what is its present situation. The writer then describes the 1930 Imperial Conference and points out how the economic part of the Conference failed. He concludes the instalment by a forecast that in the future white *versus* coloured races will be the great problem and the British Empire will consequently become more important than ever. The article is set out clearly and without too much detail and may be of interest to Englishmen as well as to Frenchmen.

The fifth instalment of Commandant Larcher's *Le 10e corps à Charleroi* deals with the retreat of this Corps before the German attack. The 20th Division were holding their own with difficulty when their General was severely wounded; and orders were soon issued for the action to be broken off. The Corps Commander found that he was forced to issue similar instructions to the 19th and 37th Divisions; in spite of great difficulties they were all successful in getting away from the Germans.

The third instalment of *Bailen*, by Colonel Grasset, describes the Spanish attack on different parts of the front and the moves of the various French generals. The whole affair is complicated to follow, as the French had a number of generals at different places and they all seemed to move rather regardless of each other, while the Spaniards' attack was, as usual, quite well thought out but badly executed. Colonel Grasset has drawn an excellent picture of these operations, but it is one which takes a good deal of patience to follow. The accompanying sketch maps are useful.

H.A.J.P.

REVUE DU GÉNIE MILITAIRE.

(*June*, 1930.)—"Bridging Equipment in the large formations of Modern Armies," by Colonel Baillis. At the outbreak of the War in 1914 the bridging equipment of a French Army Corps of two divisions consisted of the following:

1. 16 pontoons in which 320 men could be ferried at one time;
2. Material for constructing 120 m. of 3-ton bridge or 60 m. of 8 ton 6 cwt. bridge;
3. Habert bags by means of which small parties of infantry could be ferried; with a few extra bags in each division;

whilst an independent division carried about half that amount of material.

The equipment carried by a German Army Corps was roughly double that of a French Corps, being sufficient to allow of the passage of all arms and vehicles of the Corps over rivers of at least 100 metres in width, that is to say all rivers which might be encountered between the north and north-east boundaries of France and Paris —a fact which must have contributed to the rapidity of the German advance from Liége.

At the eve of the Armistice the equipment of a French Army Corps was the same as at the beginning of the War, in spite of the enormous growth of armaments and transport, which was such that the corps of 1918 took up double the road space of the corps of 1914. Whilst throughout the War there was a progressive change in the nature and quantity of the weapons of all the other arms, no such development took place in the material resources of the Engineers as field units; the engineer apparatus of all kinds, such as sawmills and excavators which were used in great quantities in the back areas, tending rather in the direction of stabilization than of mobility.

In considering the question of bridging material for the large formations, it is assumed that at no time must the development of the battle and the exploitation of success be jeopardized by a lack of communications.

Experience has shown that, of the various obstacles which armies may encounter, watercourses 20 metres or so in width with firm banks and slow current rarely form an obstruction capable of stopping for several days *all the large units* comprising an army. On the other hand, it frequently happened in the course of the War that armies were stopped for days, weeks and months by obstacles only slightly greater, though some of the large units were able to form bridgeheads without, however, being able to debouch therefrom easily and rapidly. So it happened with the 5th and 6th Armies on the Aisne in 1914, and with the 4th, 5th and 10th Armies on the Vasle and on the Aisne during the operations between August and November, 1918.

Certainly a large river will be able to cause a halt to several armies for several days, and material from the general reserves will have to be provided, involving time and special methods. But the equipment for the division and the army corps should be such as to allow in a war of movement of the passage of all obstacles of average size without recourse to the general reserves.

The problem is presented in its most acute form when an offensive is being developed against an enemy whose mission is to retard the progress of its adversary by every means. The assailant will find all culverts and bridges demolished, and though infantry will not in general be stopped, the supporting artillery will be unable to advance steadily without the help of sappers, and as many of the obstacles will be dry it follows that the equipment of a division should include trestles. The infantry and artillery will soon be followed by heavy artillery, signal cars and lorries, equivalent to 9-ton loads, and assuredly the Engineers should be able to insure their passage without the help of the corps. The experience of 1918 has shown that there will be a sufficiency of time for such bridging operations, in that the daily progress of the assailant in the presence of an enemy on the defensive will not exceed about 4 kilos, with occasional days of complete stoppage.

There are, however, certain obstacles, such as unfordable waterways more than 20 metres wide, which even the infantry will not be able to traverse easily, but which may have to be crossed without delay if the battle is to be continued. This makes it necessary that the division should possess the means of crossing without having to resort to improvisation.

What equipment then must the division carry to insure the smooth development of the infantry attack and the progressive advance of all elements of the division?

Time after time during the War delays occurred in the pursuit of the enemy owing to lack of the material required to take the infantry quickly over a waterway; so it was at the Aisne in 1914 when sappers and infantry had to use improvised material in order to pass over the river the first elements to protect the construction of a bridge.

To meet this need the 2-ton assault bridge was introduced shortly after the War, as divisional equipment, but it was soon abandoned as unsatisfactory.

Much of the material for assault bridges which was used with fair success during the War, such as metal and cork floats, oil and petrol tins, casks and Habert bags, would not be satisfactory as permanent equipment owing to its vulnerability to fire, and fire from the aircraft of the future will be much greater in volume. The Habert bag alone is worth retaining, for it is strong, takes up little room, and will always have

value as a standby. The basis of the infantry assault bridge must be a float which is insubmersible, and in this respect the kapok bag is entirely satisfactory provided that damage by shell fire can be quickly carried out.

What quantity of assault bridge will be required?

Presuming an attack developing with four battalions in front line, one bridge would be required for each battalion. As regards length—the experience of the Germans may be taken as a guide. According to their latest regulations they consider that for waterways of less than 60 metres footbridges are often advantageous even on a wide front. If this figure be accepted, a division should carry 250 metres of assault bridge material.

A type of kapok bridge already exists, 100 metres of which represent a load for a 3-ton lorry. The same material could easily be used for making rafts by which small detachments could cross a waterway and protect the launching of the assault bridge, and this can be done in a few minutes on rivers 60 metres wide with currents under 1½ metres.

Thus two lorries could carry for a division 200 to 250 metres of assault bridge, capable of being rapidly made by any troops after a few hours' instruction, invulnerable to rifle fire and almost so to artillery fire. Its transport by lorry is no drawback, as the material could be divided into loads easily portable by horse-drawn vehicles or by men for considerable distances. The lorries would be regarded not so much as means of transport to the site but as moving depots. There should be a reserve of two lorries with the corps, so that extra assault bridge might be supplied to either division. It would then be possible for all dismounted elements of a division to cross, under favourable conditions, all waterways less than 60 metres in width, and no doubt after further experiments, the material would be adapted to allow of the passage of machine-gun vehicles with their teams.

The transport of the artillery for the direct support of the infantry presents a more serious problem. The French regulations, as do also the German, envisage the construction of bridges only after the capture of the enemy observation posts with a direct view on the river. If this principle were accepted there would be no need for the division to carry material for that purpose, as the equipment with the corps could be brought up in time. There were, however, numerous examples in the War when bridges were begun and often successfully completed before all the observation posts had been captured (*e.g.*, the Vistula, Duna, Danube, Marne in 1914 and 1918, the Aisne in 1914 and 1918 several times, the Piave in 1918). But the use and maintenance of bridges were always difficult and costly when the assailant had not obtained a superiority of fire, and this may be responsible for the regulations, which must not be considered as rigorously applicable in every case. For indeed whenever possible bridges should be constructed at once.

To provide against the difficulties of maintenance, the equipment, which will have to accompany the division into the zone of combat, must be such as to be liable to premature destruction. This condition is not satisfied by floating supports, which present a large and comparatively unresisting surface to every kind of projectile and which have to be used in large numbers for the passage of even a small river. Moreover, a pontoon has to be carried on a special vehicle, which if injured cannot be replaced by any other, and so the pontoon becomes useless—and this indeed is a serious consideration. If the support is to be a floating one, it must be such as can be carried on any vehicle. A folding boat would fulfil this condition, but the problem of vulnerability would remain. The ideal would obviously be an insubmersible floater, but at present supports of this nature would be impracticable owing to the enormous bulk which would be required.

There remains only the trestle. The advantages of it are that it is not readily damaged and can be easily repaired, it can be used on land and in water, it is fairly easy to handle and can be transported by hand over great distances and over devastated ground. Moreover, it can be loaded on to any vehicle, civil or military, lorry or trailer, and can be launched if necessary without boats. Its disadvantages are that

it can only be used for a maximum depth of 2·60 metres in a 2-metre current, and there are difficulties about the footings and counterbracing. It takes longer to get into position than a pontoon, so that a trestle bridge will take appreciably longer than a pontoon bridge to construct. But this objection is not of much moment as there would be no delay to the supporting artillery, which will in any case usually have to wait till night before crossing the obstacle. As on the Piave on June 16th, 1918, the launching of trestles in currents of more than 2 metres will be a difficulty, as also the raising of the bridge in case of flood; but pontoons may be carried away by a flood. The advantage rests with the trestle.

Boats, folding or otherwise, are invaluable for launching trestles and are most useful for reconnaissance purposes. There should be four for each division—a load for one trailer.

The conclusion then is that a division should carry 60 metres of 9-ton bridge and four folding boats. This would require transport which at the rate of 300 kg. per metre, or 18 tons for 60 metres, will amount to six 3-ton lorries. With one extra lorry for the boats and two lorries for the assault bridge there would in all be 9 lorries.

As it is necessary, in modern warfare, to construct bridges near roads, it may be assumed that except on rare occasions material will always be carried to the bridge site by road; the old idea that bridges can be made anywhere in the area of operations must be abandoned.

The problem of the bridging equipment required for an army corps is a very different one. Under existing arrangements it supplies material to the divisions, to be used either by corps or divisional sappers. But when divisions have their own equipment the problem will be changed, for they will be in a position to bridge with their own resources rivers up to 60 metres in width and less than 2·60 metres deep, the usual kind of river obstacle which was encountered in the western operations.

The equipment of the corps should be suitable for bridging rivers which cannot be dealt with by the division, *i.e.*, rivers of greater depth and stronger current, the bridge having the same carrying capacity of 9 tons. At the same time the equipment should be of a type which could be used in the same bridge side by side with the divisional equipment. In spite of its drawbacks, the pontoon is the only possible support. Our material of 1915 could be made to answer this purpose, and could easily be adapted to carry 16 tons, allowing a margin for the increase in the tonnage of corps vehicles.

It is unnecessary to consider the question of tanks; there is no limit to their possible weight, and it is doubtful whether they will ever be corps units. They will probably be part of the general reserves, which would include special bridging apparatus for their benefit. The reasonable view is that every form of arm should have near it, in the formation to which it belongs, the material which will allow it to cross gaps and waterways.

The quantity of equipment to be carried by a corps should be based on the assumption that the corps must be able to bridge the same gap as the division. It would then have to carry 120 metres of 9-ton bridge with a liberal reserve to allow for wastage. But as the nature of the river bed will nearly always be such as to allow of part of the divisional equipment being used in conjunction with the corps equipment, the necessity for a reserve may be disregarded and the amount taken at 120 metres.

The equipment to be carried by the general reserves must provide for all the possible demands of the army—such as the 600-ton land battleship which will one day come into being. It must, moreover, include a large quantity of material similar to that carried by the corps and division, so as to enable bridges more than 60 metres long to be constructed.

To summarize:—

The equipment of a division should include:

(*a*) Material for assault bridges sufficient to pass all infantry and machine-guns over rivers less than 60 metres wide, on the scale of one bridge per battalion in line (usually four battalions).

(*b*) Material for 60 metres of 9-ton trestle bridge and four boats.

That of an army corps should include :—

Material for 120 metres of 9-ton floating bridge (or 60 metres of 16-ton bridge or rafts of that tonnage), and a reserve of assault bridge material. All floating supports should be such as could be reduced to loads portable over devastated ground ; and the corps equipment must be capable of being used in the same bridge as divisional equipment.

The equipment of the general reserves should include :

Reserve material of the divisional and corps types and material for bridges for all " outside " loads, with a margin for the future.

(*November*, 1930.)—There is a short article by General Duchêne on the propulsion of vessels by means of a single oar. Commandant Chambon contributes the first part of a highly technical article on " Acoustics of Buildings." The last part of " A New Type of Military Bridge " appears in this number. It contains a description of a footbridge of 10 metres' span (for infantry in single file) made at Hussein Dey by the 32nd Battalion of Génie. The feature of such bridges is that the main upper and lower members and the diagonals consist of cables. The lower member is anchored to the ground at both ends, and the upper member anchored at one end, the other being held by a counterweight, the height being obtained by passing this end of the cable over a support. The bridge is really a sort of double suspension bridge, and would only be suitable for small spans.

In another article there is a description of the method adopted for making a railway bridge suitable for road traffic. This was done by putting in extra sleepers, then laying longitudinals 8 cm. thick almost touching, and finally a double thickness of transverse planks (each 34 mm.) to form a roadway.

There is a digest of an article from the *Bauingenieur*, by Dr. Grün, on the decay of concrete. The deterioration of concrete is often revealed by friability and by excretions of carbonate of lime, which sometimes take the form of large stalagmites. In the case of a siphon under the Elbe at Weser the concrete was badly disintegrated owing to the action of the water upon it. After a detailed examination of the chemical action involved, the author comes to the conclusion that the disintegration of the concrete can be produced in two ways :

(1) By water which is weak in lime dissolving the lime in the concrete, as water dissolves sugar.

(2) By water rich in carbonic acid. In this case the lime in the concrete is first transformed into calcium carbonate, which is dissolved but again becomes solid and is deposited both in the cavities of the concrete and also on its surface.

In this process there is no swelling, but the concrete tends to decay in time by the elimination of the lime and the decomposition of the silicates.

The best way of preventing these changes is to make the concrete watertight in the first place.

(*December*, 1930.)—There is an interesting account by Colonel Puissant of the construction of a road between Midelt and Erfoud in Morocco. This road was made in order to facilitate the carriage of supplies to posts in the Ziz valley. Midelt is at the foot of the Telghemt pass over the High Atlas, on the north side, and is accessible by a narrow-gauge railway from Guercif and also by road from Meknès. Erfoud, some 130 miles south, is accessible from Colomb Béchar, the terminus of the Algerian railway, 250 miles in a straight line from the sea.

The variety of country through which the road passes reminds one forcibly of the N.W. frontier of India, the dry *nulla* beds, rocky hillsides, sand dunes, irrigated ground and rocky gorges.

Causeways (*radiers*) were often used for the passage of dry riverbeds, and it is interesting to observe that, from the sketches given, down-stream protection was provided only by a *gabion semelle*—no deep drop wall as one would expect. At one point a tunnel 62 metres long was pierced through a rocky spur. Several iron "Pigeaud" bridges were constructed, including one 80 metres long over the Ziz to avoid an unstable hillside of clay. Through the sand dunes open wooden panels were erected to prevent the sand collecting on the road. The five miles of palmery just north of Erfoud, which was heavily irrigated, necessitated a heavy embankment.

Work was begun in 1927 by military labour and by March, 1929, the formation was complete up to Erfoud. The width was usually 8 to 10 metres, the limiting gradient 6 %, exceptionally 7 %, the minimum radius 50 m.

Military labour was provided by the 31/4 Company of Génie and a company of Sapper pioneers of the 2nd Étrarger; a large amount of direct native labour was employed. The only contractor engaged was a failure.

By April 30th, 1930, expenditure on the road amounted to 20 millions, and it was estimated that to complete the road would cost another 4½ million francs.

The article on the "Acoustics of Buildings" is completed.

Some of the works involved by the canalization of the Moselle between Frouard and Thionville were visited by the officers of the 2nd Regt. of Génie and a report on the visit was made by Lieut. Sardi. The canal provides for the passage of two vessels of 350 tons 38·50 metres long, 5·10 metres wide, with a draught of 2·20 metres. The works visited were the barrage of Uckange and the lock gate at that place, the quay wall at Fensch (of steel sheet piling, type Larssen), the wharf at Beauregard (concrete), an aqueduct siphon (57 metres long in reinforced concrete). A description is also given of the mechanical tools in use.

Colonel Beyer in "The Catastrophe at Coblentz" gives a description of the footbridge which collapsed at the celebrations on the liberation of German Territory from foreign occupation, when 60 people lost their lives, and examines the cause of its failure. The bridge consisted of a central span of 10 metres and two shore spans of 7 metres, the supports being floating cylinders. The bridge gave way primarily because an excessive load caused the rollers at the ends of the shore spans to slide off the abutments.

There is a précis by Colonel Beyer of an article from the *Bauingenieur* by Karl Bernhard on the petrification of light soils in modern construction. The process, which is due to Dr. Engineer H. Ivosten, of Nordhausen, consists in injecting into the soil two chemical solutions which convert the sand into sandstone. The two chemicals are (1) a solution of silicic acid, (2) a saline solution. These mixtures are injected one after the other, at high pressure, through steel pipes 25 mm. in diameter, which have three little holes near the end.

The process, which has been highly successful, is used for improving the soil near foundations, construction of impermeable floors, generally for rendering soil impermeable.

Several examples of each of these three cases are given with illustrations.

Petrification takes place at once. The method is only applicable to soils rich in quartz, but a small proportion of clay is no drawback.

(*January*, 1931.)—This number contains two articles only, a memoir of Marshal Joffre and the first part of an article, "The Work of the Engineers in Algeria." The latter is a detailed account of the part played by the Génie in the various expeditions undertaken by the French in that country. The first took place in May, 1830, when an army of 37,000 men landed at Sidi Fermeh, after an ineffective blockade of 1827. It is interesting to note that the information on which the French based their plans was mainly obtained by an officer of the Engineers, Commandant Boutin, in 1808, by order of Napoleon I, who was contemplating an expedition.

A.H.B.

THE MILITARY ENGINEER.

(*January–February*, 1931.)—*The Status of Pontoon Bridge Development*, by Capt. F. H. Kohloss. This article describes the present state of the American Pontoon equipment and its organization. The equipment consists of the light bridge, Model 1926, and the heavy bridge, Model 1924. These bridges carry gross loads of 16,000 lb. and 48,000 lb. respectively, corresponding roughly to our medium and heavy loads, and so afford an interesting comparison with the Consuta equipment.

The two American bridges, though similar in general design, are formed from two entirely separate equipments. Each bridge has piers consisting of single, undecked pontoons, at 16-ft. centres, gunwale loaded, with timber baulks. The baulks stretch from outside to outside gunwale of adjacent pontoons, each one being rigidly clamped to the four gunwales it crosses. In this way a single load is distributed over three or four pontoons, and consequently the size and weight of the pontoons can be reduced, but there is the disadvantage that the maximum load that can cross in a continuous stream is only about half the gross load. The trestles are of normal design, the legs being 8-in. steel tubes, and the transom of duralumin in the case of the light bridge and steel in the case of the heavy bridge. The bay between the trestle and the pontoon is known as a hinge bay, and is of interesting construction. A transom is suspended below the roadbearers of the pontoon bay, upon which the ends of the trestle roadbearers slide. This does away with the difficulty of connecting a gunwale loaded bridge of this type to a fixed trestle, and also allows for adjustment in the length of the bridge and latitude in the placing of the trestle.

The table below gives the main weights and dimensions of the two bridges :—

	Light Bridge.		*Heavy Bridge.*	
	Dimensions.	*Weight.*	*Dimensions.*	*Weight.*
Pontoon	26′ 6″ x 5′ x 2′ 6″	1,150 lb.	32′ x 6′ 6″ x 3′ 6″	3,100 lb. (wood) 3,600 lb. (steel)
Trestle	—	1,150 lb.	—	1,700 lb.
Baulks	4″ x 6″ x 21′ 5″ (7 per bay)	*160 lb.	$5\frac{3}{8}$″ x $7\frac{1}{4}$″ x 23′ (9 per bay)	*300 lb.
Chesses	$2\frac{1}{8}$″ x $11\frac{7}{8}$″ x 12′	*84 lb.	$2\frac{7}{8}$″ x $11\frac{1}{4}$″ x 13′ 6″	*126 lb.

* Estimated weight.

The light bridge pontoon has a duralumin frame with an aluminium skin. Two types of heavy bridge pontoon, of wood, and of steel, are being experimented with.

The estimated weight per foot of the light bridge (including pontoon piers) is 250 lb., and of the heavy bridge 540 lb. with the wooden pontoon and 570 lb. with the steel pontoon. The weights for Consuta are 345 lb. and 622 lb. for medium and heavy bridge respectively.

The transport is organized in pontoon bays, trestle bays and abutment bays, corresponding to the " units " of the pontoon bridge park. Each unit is carried on one trailer, but, in the case of the heavy bridge, consists only of pontoons or trestles, and baulks, the remaining stores being carried in three- to five-ton trucks, which draw the trailers. The light bridge trailers are intended primarily for animal draft, which is rather surprising considering the usual American mechanical tendencies. This is made up for by the fact that each light bridge platoon carries a pair of 20-ton portable scales, for weighing vehicles intending to cross the bridge.

The light bridge is organized in companies, which are corps troops, of three platoons each. Each platoon carries approximately 220 ft. of bridge, in 16 vehicles. The

heavy bridge is organized in battalions, which are army troops, of two companies of two platoons each. Each platoon carries approximately 205 ft. of bridge, and 1 motor-boat, in 28 vehicles. The vehicles include a utility truck, with a 12,000-lb. winch, for loading and unloading pontoons.

The first point that strikes one about these bridges is the necessity for two entirely independent equipments. The design, therefore, lacks the tactical flexibility of the Consuta, and also necessitates the carriage of a larger quantity of bridge.

The weights of the bridges are rather in favour of the Americans, but in terms of transport the advantage is not maintained. The light bridge company provides three 220-ft. bridges, with 48 vehicles. The heavy bridge battalion provides four 205-ft. bridges, with 112 vehicles. The pontoon bridge park provides six 147-ft. medium bridges, using 66 vehicles, and this can be converted into six 105-ft. heavy bridges by adding another 9 vehicles. The weights of the components of the heavy bridge are too large for convenient manhandling, and therefore bridge construction must be comparatively slow. Since the two objects of reducing weight are to reduce transport and speed up construction, the real advantage seems to lie definitely with the Consuta equipment.

The times required for construction are not given, which is disappointing, as they would enable a much better comparison between the two equipments to be made.

In conclusion, it is interesting to note that the Americans are trying out the British folding boats for use with cavalry.

H.M.W.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(1931. TOME I.—NOS. 1 TO 3 INCLUSIVE.)

Chronique de l'Infanterie. Parts 12, 13 and 14 of this article appear successively in the numbers of the *Bulletin* under notice. The discussion of matters relating to "mechanization" and "motorization" are continued in Part 12. Attention is called to the views which have been put forward on this subject by military writers, and comments are made thereon. These comments indicate that it is by no means unanimously agreed that the time has arrived for tank units to replace infantry, on such a scale as to make the Tank Corps the preponderating arm on the battlefield. It is pointed out that, although a "mechanized force" may well meet the requirements of a small professional army operating in country which suits it, it does not follow that similar developments in armaments and equipments would prove advantageous in the case of large conscript armies which are responsible for the defence of frontiers of considerable extent and containing much diversity in their topographical features.

The subject of the German infantry fire unit—*la cellule élémentaire de combat*—is dealt with in Parts 13 and 14. The progress which has been taking place in "mechanization" and "motorization" during the past dozen years has, it is pointed out, caused important modifications to be introduced in the organization of armies. The question is discussed in Part 13 as to whether the composition of the normal infantry fire unit—*le groupe de combat*—should be considered as being unchangeable in its composition. The organization adopted for the infantry section in certain European countries is set out in Part 13. In France and Belgium the sections consist of a machine-gun and its team and a number of men armed with rifles; the complete section is commanded by a sergeant. On the other hand, in Germany, Russia and Italy, the sections are definitely organized in sub-sections, the rifles being grouped under one N.C.O., and the machine-gun and its team—in Italy two machine-guns are allotted to a sub-section—being under another N.C.O. Sections of the former type are known as *groupes de combat mixtes* and those of the latter as *groupes de*

combat séparés. The relative values of these two types of infantry sections are discussed ; it is claimed that the former possesses advantages over the latter type. An adverse criticism, from the tactical standpoint, of the German organization is contained in Part 13.

Proposals for the reorganization of the German infantry fire unit have been discussed at some length in the *Militär Wochenblatt* (numbers for July 25th, October 4th and December 11th, 1929), and the *Deutsche Wehr*, of February 19th, 1930. These discussions are summarized in Part 14 of the original article.

L'infanterie en défensive en vue de la bataille d'arrêt. Parts 1 and 2 of an article, contributed by Major Bouha, appear in Nos. 1 and 2 of the *Bulletin :* the article consists of a tactical problem set out in the form of extracts from Corps Operation Orders and the suggested solution, so far as it affects one of the infantry divisions. The various steps required to be taken with a view to the occupation of a defensive position are dealt with in Part 1 : matters relating to the disposition of outposts are dealt with in Part 2.

Cas concret d'emploi de l'Aéronautique et la D.T.C.A. au Corps d'Armée. The final part of the article on this subject by Capt. Comdt. Van der Donckt appears in No. 1 of the *Bulletin :* it indicates the manner in which the Air Force and A.A. units may be employed in carrying out operations in combination with the other arms.

Procédés de combat de l'Armée Allemande. The first three parts of an article, by Capt. Wanty, on this subject appear successively in the numbers of the *Bulletin* under notice. In Part 1, details are given of the organization of the units composing an infantry division of modern type ; the general principles upon which the doctrine of the offensive is based are set out ; and the various aspects of an offensive operation are discussed.

The discussion of the various aspects of an offensive operation is continued and concluded in Part 2. Details are given therein of the operations of an infantry company ; certain particular cases, *i.e.*, attack against strong points, attack on woods, and night attacks, are also briefly dealt with.

Matters affecting the placing of outposts and the general principles of the defensive are examined in Part 3.

Notes sur l'artillerie belge de 1830 à nos jours. The first three parts of an article, by Capt. Comdt. Lambinon, dealing with the developments of the artillery arm in the Belgian Army, appear successively in the numbers of the *Bulletin* under notice. The present Artillery Regiments of the Belgian Army trace their descent directly from units which formed part of the former Netherlands Army, immediately prior to the date when Belgium, in 1830, secured its Independence. In an introduction to Part 1 of the article, a brief account is given of the artillery units of the *Legion Belge*, existing in September, 1814, and the subsequent changes which took place in the organization of this arm prior to the date of the Revolution.

The developments during the period 1830–1845 will be found in Parts 1 and 2 ; those of the period 1845–1870 in Parts 2 and 3 ; and those of the period 1870–1914 in Part 3.

La spécialisation du médecin de l'Aéronautique. Among the matters discussed in the Medical Section of the V Congress on Aerial Navigation, held at the Hague, in September, 1930, was the question of the need for specialization on the part of the medical personnel of the Air Services. Major Médecin Sillevaerts sets out in Part 1 of the *Bulletin* the terms of a resolution passed at a special meeting of medical men who attended the Congress ; he also gives some particulars relating to what is being done on the subject in question in the U.S.A., Poland and Holland.

Pourquoi faut-il motoriser ? Maj.-Gen. Semet and Major Willems contribute an article on this subject to No. 2 of the *Bulletin :* they consider that the essential need for " motorization " rests on the three following arguments : (1) the impossibility under present circumstances of affording protection to horses against the effects of poison gases, and on account of the vulnerability of gun teams ; (2) the greater

economy of motor traction as compared with horse traction; and (3) the rapid decrease in the numbers of horses available for requisition purposes on a mobilization for war. The authors develop their arguments in relation to each of the above heads, and then proceed to deal with the question of establishing a "*Plan de motorisation.*" The latter question is discussed in relation to the organization of the larger formation of an army; urban and rural highways; and types of motor vehicles. Technical considerations affecting "motorization" are examined in the concluding part of the article.

Emploi des Mi./D.I. dans l'Offensive. This article is an anonymous contribution to No. 3 of the *Bulletin*, and summarizes, so far as they relate to the duties of commanders of various grades, the instructions contained in the following Belgian manuals: *Instruction Provisoire sur l'Emploi Tactique des Grandes Unités; Règlement de l'Infanterie;* and *Règlement sur le Service en Campagne. L'emploi du peloton et de la compagnie au premier échelon dans l'attaque.* This article is contributed anonymously to No. 3, and is based on the principles relating to the attack enunciated in the Belgian *Instruction Provisoire sur l'Emploi des Grandes Unités.*

W.A.J.O'M.

HEERESTECHNIK.

(*June*, 1930.)—*Austro-Hungary's Railways in the Great War*, by Colonel von Meister. This article deals with mobilization schemes, organization and administration, the actual course of events, extensions due to taking over conquered territory, funiculars, and maintenance, with actual statistics. It is all interesting, but much of it will not be new to those who have read General Ratzenhofer's articles on the same subject, reviewed in the *R.E. Journal*, September and December, 1928. It ends with high praise of the railway personnel, and says that where in the later years complete satisfaction could not always be accorded to military demands it was chiefly the fault of the blockade.

A New Method of Water Sterilization, by Dr. Karsten. The necessity of providing sufficient quantities of pure drinking water in the field and the special difficulties attendant thereon are well known. Water cannot, as a rule, be brought up: that on the spot has to be used, and this is seldom fit for drinking, and becomes less so, the longer the troops are in the neighbourhood. The best treatment, to filter and boil, or even to boil, and let stand to cool and clear, is seldom practicable. Chemicals were tried by the Prussian War Office, also filters like the Berkefeld, but without furnishing a practical solution. The most important travelling water sterilizer, making use of boiling, was produced by the Berlin firm Halvor-Breda. It provides rapid filtration, sterilization through heating to 110° under pressure, airing and cooling, but does not solve the question for infantry on the march. Of chemicals, chloride of lime is very effective and rapid, but leaves an after-taste: chloride of iron and peroxide of hydrogen have been tried, also ozone, which is very effective, but unstable.

Alongside these methods, which have been practically tried, there now ranges itself a method of water sterilization, based upon an entirely new principle. It has been called by its inventor, Dr. G. A. Krause, of Munich, the Katadyn. The process is chemico-physical, and has been called oligodynamic, because the result is brought about by the movement of minute quantities. The origin of the process is the discovery of the botanist C. von Nägeli, communicated to the Swiss Naturalists' Society in 1893, that metals in addition to their long known chemico-poisonous effect possess an entirely different property of poisoning which is not chemical. It is astonishing to find that through contact with metals, like copper, mercury and silver, which we are accustomed to regard as insoluble in water, water is brought into a state which has a distinctly destructive effect upon low forms of life. Two factors are of

special importance, the most minute quantities of pure metal, the loss of weight of which through their sterilizing activity can hardly be proved; and the catalytic effect of the metal surface. A technical process had to be worked out, aiming at as high a biological effect as possible combined with the most economical use of the metal employed. The right proportion between volume and surface had to be determined. Also one had to attempt to find chemically the quantity of metal necessary to bring about the oligodynamic effect in water. Lastly, the bacteriocidal effect had to be established for the particular germs of typhoid, paratyphoid, dysentery, etc.

All this Dr. Krause has done. He has found out that the best metal is silver, an important fact, since he has been unable to find in medical literature the slightest indication of silver being poisonous to human beings. The silver is best sprayed on to a surface when there results a non-colloidal silver of micro-crystalline to sub-microscopic structure, chiefly in little flakes of the same thickness. To sterilize water by means of these flakelets of silver is only a matter of minutes. In practical form the South German Serum Institute Co., Ltd., sells a Katadyn in the form of a two-litre earthenware bottle filled with small porcelain cylinders or rings, each covered with a coating of Katadyn silver. This bottle will retain its sterilizing property for a life-time. The same firm makes the Katadyn in sizes from 25 litres to 100 litres, either of earthenware or fireclay. For hot countries a porous clay is recommended, so that constant evaporation on the surface will keep the contents cold. Katadyn pressure filters are also made so that they can be included in a piped water supply. They require no attention at any time, unless there is suspended matter in the water, when the rings will need occasional cleaning, followed by washing with dilute hydrochloric acid.

It would be hard to exaggerate the importance of the Katadyn to soldiers if Dr. Karsten's article is a fair representation of facts. As *Heerestechnik* is a scientific journal, the only foundation for scepticism remains that it seems too good to be true.

(*July*, 1930.)—*War Work on Telephony by Directed Rays*. The article is by Dr. Hartmann, of Siemens & Halske's, at whose head laboratory much of the research work was done and experimental work carried out, but there is an introduction by Capt. Löwenstein, as representing the military side. The most important aim for the development of signal equipment during the Great War, and, indeed, not yet attained, was the creation of communication by means of speech at any desired spot in the forward areas, such speech not to be liable to be disturbed or broken off by enemy action, nor liable to be overheard by the enemy. The most obvious way of attaining this was to try out the old system of telephony by means of a ray of light, disturbed by microphone movements, falling on a selenium cell. A further great improvement would be to use the invisible rays outside the spectrum, instead of light. Unfortunately, the German Army had no organization, either in peace or war, for work of this sort: nor had the German Navy. The head of the Signal Service, General Hesse, pushed the matter energetically, and two civilians were found with the best qualifications to assist. One was H. T. Simon, in 1918 rector of Göttingen University, but in his time the inventor of the singing arc (known in England as Duddell's) and of a practical method of light telephony. The other was also a don, Thirring, of Vienna University, who had worked out a particularly sensitive selenium cell. These two, with the assistance of Siemens and Halske, converted the service pattern of signalling lamp, and by the summer of 1918 had a Light Telephony Detachment, with a number of portable stations under an officer, ready for the front.

Of all their labours this alone bore fruit before the end of the War. The moral is obvious, that a properly equipped and manned research and experimental establishment must be maintained in peace by every industry or activity whose progress depends upon the advance of technics. Capt. Löwenstein can only lament that none such existed in Germany for applying the advance of science to war, and that when something of the sort was started it was too late. Amongst their incompleted labours

were the Alkali-cell of Elster and Geitel, a mercury lamp as sender of ultra-violet rays, as receiver barium platinocyanide crystals, a detector for heat rays, telephony by directed quite short Hertzian waves, and even picture telegraphy. There was much promise in this work, which was crowded into the last six months of the War.

Dr. Hartmann's contribution traces light telephony from Reis's telephone (1860), Simon's talking arc (1898), Bidwell's selenium cell (1891), to telephony by searchlight (1901). (*To be continued.*)

The Development of a Practical Meteorological Service in Germany, by Dr. Kölzer. In the middle of the nineteenth century, at a time of great development in communication by post, telegraphs, railways and ships, the weather and weather catastrophes were accorded increased practical significance. Upon this recognition there followed a demand for security by warning of impending disturbances. Sufficient impulse to create a meteorological service for warning shipping was first given by a disaster of imagination-stirring magnitude, when a portion of the Anglo-French fleet, lying before Sebastopol, in 1854, was destroyed. As a consequence, a meteorological service was started in France in 1856. It took Germany nearly twenty years to follow this lead. The Sea Observatory in Hamburg started in 1875, since when it has issued weather reports and weather forecasts daily. It long remained the only organization of a practical meteor service in Germany, until in 1906 the Prussian Ministry of Agriculture demanded special respect for agricultural interests owing to their dependence on the weather, and, negotiations with the Prussian Meteorological Institute having failed, determined to start an independent agricultural meteor service, having ten districts in Northern Germany each with its own forecast.

The greatest fillip to the establishment of observatories and weather forecasting generally was that eventually given by aviation, and especially war aviation.

Shipping, agriculture and aviation have combined to give the practical meteor service a position and significance in the economic life of Germany which can only be regarded as permanent.

The Medical Equipment of the French Army. Germany not having been allowed to equip its army medically in accordance with its war experience, a picture is given of how an army should be equipped in this respect. A list of medical units, ambulances, etc., starting with the infantry and finishing with Army Troops, tells the tale. The French Army was chosen as "the best organized and the best equipped."

(*August*, 1930.)—*The Development of the Gas Mask for the Army and for the Civil Population.* Points out the differences in material and in design between the army mask, 1924, and the army mask, 1918. Nothing so elaborate as an army mask can be provided for civilians, owing to the vast expense it would entail. Fortunately, since the civilians' mask is only for emergency use, and for wear until a gas shelter is reached, it can be made on altogether simpler lines, and therefore much cheaper.

It is very noticeable that not one of the gas masks of which photographs are shown, fulfils the requirement laid down by Dr. Büscher (*vide The R.E. Journal*, March, 1931, p. 193), that they must permit reasonable social intercourse. All these are fearsome, to a degree.

War Work on Telephony by Directed Rays. A preliminary condition of the development of light telephony in the War was that any necessary equipment to be made must be based as far as possible on existing equipment, *i.e.*, on the service searchlight and on the service signalling lamp.

The Searchlight Light Telephony equipment brought out, and demanded first of all by the Austrian Army, was based directly upon the method of Simon's talking arc. It had a special microphone, without amplifier, which affected an ordinary searchlight circuit through a transformer. As receiver served a camera, resembling a photographic apparatus, with a large long-focus lens. In the picture-plane was the selenium cell connected by four stages of amplification with the telephone receiver.

The Lamp, Signalling, Light Telephony equipment, preferred by the German

military authorities, and using the present German signalling lamp, was able also to use the normal army field telephone since it employed an amplifier between the microphone and the glow lamp. Reception took place by means of a second signalling lamp in which a selenium cell took the place of the glow lamp, and was connected by a four-valve amplifier to the ordinary field telephone. In order to work both ways the whole equipment had to be duplicated.

Certain factors affecting reception are of interest. The illumination of the selenium was much affected by daylight. The weaker the daylight, the better was the reception. Consequently, on cloudy days and at night, best of all. Very bright daylight also interfered with the task of alignment. Mist and rain did not noticeably affect communication.

The following shows the progress made during the trials :—

April, 1918. Range 50 m. Amplification possible only at the sender.
May, 1918. Range 250 m. Amplification also at receiver, made possible by the use of Thirring's cell.
June, 1918. Speaking both ways at 500 m.
July, 1918. Range 2,000 m. Signals were R5 even in bright daylight, and when up to 3 km. of field cable, or 50 km. of open wire, were included.
August, 1918. Range 4,600 m., from Halensee to Schönberg Town Hall.

The trials were then ended and arrangements made for sending light telephony into the field. The end of the War prevented telephony by light from receiving its baptism of fire.[1] The trials show nevertheless that light telephony has a future, and is worth going on with. Only in this case use must be made of invisible rays.

F.A.I.

MILITAERWISSENSCHAFTLICHE MITTEILUNGEN.

(*May–June*, 1930.)—*The Fight at Königsdorf*, by Lt.-Col. Kiszling, late G.S. The writer offers this incident in the Rumanian advance into Hungary in September, 1916, as an example of an actively conducted delaying battle. Considering the disparity of numbers it can never have been intended as more than a delaying battle, but it turned out to be a great deal more. The account shows how a single Austro-Hungarian division, the 71st, watching or responsible for 200 kilometres of front, by most skilful anticipation of the enemy's plans and moves, by just appreciation of his fighting value, and by strong counter-attack at the right place and time, with the greater part of its strength resolutely set apart for that purpose, was able not only to check a force of four divisions and two brigades, but to prevent it from carrying out an outflanking movement.

The Rumanians, moreover, remained twelve days inactive after this blow: during which time the 9th German Army had arrived at Hermannstadt, and Falkenhayn had been enabled to start driving the Rumanians out of Siebenbürgen, the necessary preliminary to his invasion of Wallachia. The two Rumanian Corps which had been checked at Königsdorf were then withdrawn, but too late to be of service.

From the Puster Valley to the Valley of the Piave: a Crossing of the Dolomites in Winter, by Maj.-Gen. Korzer. A crossing of the Dolomites which really took place in winter, *e.g.*, in January, would have been a much tougher proposition. It is possible, however, to stretch a point in the title, since, following on an irruption of sirocco on October 28th, as is often the case in the Eastern Alps, there had been heavy snowfall, and wintry conditions prevailed.

Italians and Austrians had faced each other for three years on a strongly entrenched mountain front, running due east and west, from the Carinthian border over the Kreuzberg (5,000 ft.), Dreizinnenhütte (7,200 ft.), Monte Piano (7,000 ft.), Peutelstein, Monte Sief (7,250 ft.), to Arabba (4,900 ft.) in Eastern Tyrol, when on the 24th

October, 1917, the Italian front collapsed at Caporetto—surely as regards numbers the greatest military catastrophe in history.

In less than a week the Italians had withdrawn behind the Tagliamento, and their left flank, the mountain front along the Carinthian frontier to East Tyrol, began to crumble away.

This account shows how the Austrian 49th Division, after becoming almost immobile through long stationary warfare, made itself quickly mobile again for what was demanded of it, viz., following up a retreating enemy over snowclad mountains; which feat they performed with all manner of non-regulation transport, down to sledges and hand-carts. The pursuit was, in spite of all difficulties, so resolutely undertaken, that, at Longarone, on November 10th, a small detachment was able to demand and receive the surrender of 4,000 Italians. The O.C. detachment, a subaltern, did not hear till afterwards that a battalion of Würtembergers, by debouching from a side valley south of Longarone, had already cut the Italian line of retreat on Belluno, and so played straight into his hands.

The Drawing-up and Preparation of an Exercise without Troops, by Major Franck. The guiding principles of such exercises were laid down in the last number. They are now applied very thoroughly in an example, starting with the purpose of the exercise, what it is intended to illustrate or bring out, and the choice of a locality, both suitable for the scheme and accessible to the participants, so that the indoor work on maps can be tested on the ground. The article is instructive in that it shows us into the mind of the officer drawing up the scheme, thought by thought, and decision by decision.

A simple but commendable tip is that dispositions of the troops on oiled tracing paper are furnished with the maps to those taking part, thus saving much description and the marking of the maps.

The Delaying Fight, by Lt.-Col. Rendulic. The action of the rear-guard of a retreating force furnishes the classical example of a delaying fight, and it is this case with which the author deals. At the same time he extends the term to embrace also the pinning-down or holding attack, on the plea that any fight, defensive or offensive, is a delaying action if it, for a certain time, prevents the enemy from carrying out his intentions. It is questionable, however, if there is any real gain in bringing under one heading the way a rear-guard fights and the conduct of that essential part of the offensive, the containing attack.

The author complains of a dearth of examples of either the one or the other on a grand scale in the Great War, and awards the palm to the Austrians when Hungary was invaded by the Rumanians, as described in the first article of this number.

For rear-guard action in general two good reasons are given why, in spite of the necessary wide extension of front, strong and mobile reserves must be formed: (1) for restoring the front, in case it is prematurely overrun, before the remainder of the line has time to be affected; (2) for an orderly occupation of the next line to be held, such as it would be impossible to expect from the retiring troops.

As regards the vexed question whether the object of the action is to be communicated to all down to the very private soldier, Lt.-Col. Rendulic says, "As a rule, not," but he thinks it can be done with advantage if the troops are well disciplined, experienced in war, and likely from their general knowledge of the situation to feel the object of the fight instinctively. In this case the commander's intention being known will not only call forth an understanding compliance with his intentions, but will increase morale. So far are we from Tennyson's Balaclava.

Are there New Means for Making it Easier to Cross a River against Opposition? by Lt.-Col. Regele. This question arises from an article on opposed river-crossings, in a Hungarian magazine, by Engineer Capt. Reich. This officer points out that the increase in fire effect in the defence which has taken place since the Great War will render the forcing of a river a more difficult operation than ever. In contrast to the way the procedure of attack on land has adapted itself to the increased strength of

the defence, there has been no corresponding increase of strength in the forcing of a river. He therefore proposes the introduction of a new transhipping unit to contain all those means which will make possible increased speed and safety of the first crossing of the river, and the formation of a bridge-head. The composition of this unit to be: 4 pontoon sections of 8 light rowing and motor pontoons for 6 men each, total 192 men; pontoons to be carried on H.T. (4-horse wagons) or M.T.; 1 Search-light Section with four 60-cm. searchlights; 1 Machine-gun Section with 4 M.G.s on carriages; 1 Telephone Section with 2 auxiliary motor pontoons, 1,600 metres of cable and 8 instruments; 1 Workshop and Engine Section. It will take across the river one infantry company complete. No mention is made of officers, nor of headquarter staff; nor are any figures for personnel given beyond the 192 men for the 32 pontoons.

The originator of these proposals sent his scheme to Lt.-Col. Regele for his opinion, who answers in effect that he is against the formation of any such specialized unit amongst the fighting troops, since their Engineers must remain general service. Necessary specialized Engineer units can only be included as part of the higher formations.

For the opposed crossing the Engineers' further developments are: design of a rapid equipment for the first crossing, and for small undertakings; strengthening of medium bridges for M.T.; a speedy replacement of rowing by motor power, viz., a serviceable light engine not only silent, but also suitable for use in shallow water. The increased power of the defence, automatic rifles, gas, aeroplane m.g.s, flares, mechanized mobility of reserves, better communications, can only be countered by similar means employed by the attacker. The Engineers can do no more than move faster with light equipment. The latter has been produced, for the quicker movement we are dependent upon the progress of technics.

Simultaneous Multiple Long-Distance Thought Exchange, by Lieut. Schmied. In spite of its title this article does not deal with telepathy, the said thoughts being exchanged by the familiar long-distance method of the telephone. It consists of a technical description of the apparatus necessary for conducting a conference, the members of which are unable to meet, owing to being separated by great distances.

Such conferences date from 1928. On the 4th of December of that year, a conference was held in which the members were a part in Berlin, a part in Cologne, while one member was in Munich. This conference was arranged by the German Long Distance Cable Co., Ltd., assisted by the German Post Office. Microphones and loudspeakers were installed at all three centres, and the proceedings passed off smoothly and with dispatch, members in Cologne and Munich being under a president in Berlin. Similarly, on the 8th July, 1929, the annual meeting of the Union of German Electro-technicians at Aix-la-Chapelle was "attended" by representatives of the similar institutions in Austria and in Holland, who remained, however, at their home centres.

Communication in these cases differs from the communication by means of an ordinary telephone pair, in that each station has to be definitely either on "send" or on "receive." Inconvenient as this would be for ordinary conversations, it hardly constitutes a drawback in a formal conference, where one speaker would presumably not wish to interrupt another.

The author thinks the system of military significance in these days of mass armies, since it might be desirable for several widely separated army commanders to be able to confer. What would have happened at the Marne?

The Transport Situation in the Manchurian Conflict. General Ratzenhofer, well known as an expert on railway matters, takes as his text Napoleon's dictum that "Victory lies in the soldiers' feet," which he says has lost none of its fundamental significance, in spite of all technical progress. Writing apparently at the time of the conflict in Manchuria over the East Chinese Railway, he examines the situations in the matter of transport of the three powers concerned, China, Russia and Japan,

in order to draw conclusions as to action possible to each of these powers. The conflict itself was ended before the article appeared in print, and the chief interest in the article now lies in the author's calculations of the military capacity of the Trans-Siberian Railway, and in his forecast of its future.

Owing to the limitations of the Trans-Siberian Railway, the Russo-Japanese War was over before Russia could collect forces in Manchuria representative of its real military strength. After the war, with astonishing energy, the line was converted to double track, except on the longer bridges. This was not all the improvement, for strengthening and reconstruction took place so that there was no gradient greater than 17 per 1,000, and no curve of less than 350 metres' radius. Speeds increased from 20 km. to 40 km. per hour, passenger trains took 13 days instead of 20, and the number of trains per day from 3 each way increased to 16. In spite of all this, in a decisive respect, as regards military capacity, there was no change. The section Omsk (east of the Urals)–Karminskaia (east of Lake Baikal), 3,840 km. long, remained bridged over with one line. It is this bottleneck which decides how many troops can be assembled and maintained in the East.

That animal transport with increased length of the line of communications soon devours itself is well known. Railways are subjected to the same laws. Take an army maintained in Manchuria by the Trans-Siberian Railway, consisting of 4 corps, with 10,000 rifles per division, rifle strength 120,000, ration strength 240,000. For any lengthy operations it will require extra personnel in the proportion of at least three to one to keep it in the field, or 720,000, making nearly a million in all.

The following trains will be required daily: rations 5, ammunition 1, hospital cases and leave personnel 2, post and passengers 1, coal and petrol 2, reinforcements in men and horses 2, technical stores and clothing 2, total 15. Allowing through the defile Omsk–Karminskaia 1,000 wagons a day, or ten times as many as could be achieved on the section Belgrade–Constantinople during the Great War, there would be 20 trains of 50 trucks possible per day. There would thus be only 5 trains a day left over for moving up fresh units. At this rate a new Corps would take 44 days in arriving, or 61 days in all, allowing 17 days for the journey.

Russia is well aware of this weakness and, as long as circumstances remain the same, credit may be given to its peace-loving assurances. The pressure towards the east and to the open sea remains, however, as evidenced by the recently announced railway building programme, which provides for 25,000 km. of line, including a new Southern Siberian Railway, by 1940. There is no doubt that this railway will be built, if not to time, then later; and when the Soviet is able to maintain powerful forces in the Far East, the value of its peace-loving assurances will be put to the test.

The Repair of the Russian Railway, Granica–Ivangorod, by Maj.-Gen. Tschertou. When the Austrians invaded Poland, in August 1914, they found this Russian railway, the direction of which coincided with their line of advance, demolished as regards switches, watering arrangements and three small bridges, but that the only tunnel was intact. The latter fact was the more remarkable, in that no real reason could be found for the tunnel having been built, beyond the military reason of facilitating destruction. The line, 154 km. long, was repaired in 26 days, the work including a change-over from Russian to Austrian gauge.

When the Austrians, in their turn, had to retire, they made no mistake about the tunnel. On the 1st September, 600 kilos of ecrasit placed in the original mine chamber served their purpose, and the Russians, in consequence, although they repaired the line and re-converted it to broad-gauge as far as the tunnel, were unable to get their big guns up to bombard Krakau on account of the tunnel being blocked.

The next retreat of the Russians showed that they were improving in the art of railroad destruction—wavy rails being a new feature—and also left the Austrians the job of clearing the tunnel. This they did in seven days, and in thirteen more put the line in order, including bridges and gauge conversion.

The Austrians in their next retirement blew in the tunnel much more thoroughly,

so could hardly have been surprised, when their great offensive in December brought it back into their hands, to find that the Russians had again made no clearance. For the second time the Austrians had to remove their own demolition, and this time it took from January 5th till February 15th before the first train went through.

The plans show three storeys of crib-work rising to forty feet above rail level. The rate of conversion of broad to narrow-gauge is given as 2 km. per party per day.

The Increase of Performance of Infantry Weapons. Colonel Pummerer, referring to the articles by Capt. Däniker, Swiss Army, which appeared in the January and February numbers of *Heerestechnik* (reviewed in the *R.E. Journal*, December, 1930), announces that trials with the Furrer light machine-gun have also been carried out under the Austrian War Office. The object of these trials was to ascertain the effect of the recoil absorber upon precision, and to see whether the Furrer light m.g. could be rendered thereby, within certain limits, capable of taking over the tasks of the heavy machine-gun.

He says that the result of these Austrian trials agrees with Capt. Däniker's figures, and shows the special advantages obtained by the use of the recoil absorber.

This brake is known as Ottomansky's, and is made by Kosar & Co. in Prague.

A photograph shows tripod in position, with connecting-piece mounted and ready to take the machine-gun.

The Betrayal of Carzano, by Maj.-Gen. Ronge. The writer was the head of the Secret Service, so can be relied upon for the correctness of his facts. As fiction the story would be good for the *Strand Magazine*, as fact it is too unpleasant. There are, however, two bright points in it. First, that the attack failed in spite of the position having been given away; second, that the traitor was at once put under arrest by his new friends and court-martialled by them for treachery, which he this time had not committed.

The Campaign in the Carpathians, 1914–15. The appearance of the first two numbers of Volume II of the Austrian *Official History of the War*, "The Situation at the End of 1914," and "The Carpathian Winter, 1914–15," both by Maj.-Gen. von Steinitz, has drawn an appreciatory article from Maj.-Gen. Kerchnawe, throwing many sidelights upon the appalling winter conditions of the Carpathians, while the relief of Przemysl was being attempted.

(*July–August*, 1930.)—To commemorate the centenary of the Emperor Francis Joseph's birthday, the first three articles in this number deal with that monarch. General Baron Sarkotic runs brightly over the Emperor's relations with his army, and also the changes which the latter underwent in a reign lasting sixty-eight years. General Baron Arz deals with Francis Joseph and the Great War; while the editor contributes some notes on a forthcoming work, compiled by many leading statesmen, soldiers, etc., entitled *Memories of Francis Joseph, Emperor and King*.

The Advance Behind the Carpathians in the Winter of 1915. Gen. Ratzenhofer points out that, whereas in the study of former campaigns, the military critic has been able to form definite judgments as to the correctness of strategy, the advent of railways has changed matters. The military critic is now confined to the conditional. He can say no more than that such and such strategy should have been employed, provided the railways were adequate for the purpose: and in order to determine this latter point, one needs to be a railway expert.

It is in the light of these remarks that Gen. Ratzenhofer examines the troop movements on a four-hundred kilometre front behind the Carpathians, between December 20th, 1914, and April 14th, 1915, when Austro–Hungarian troops were struggling to keep the Russians out of Hungary. On the railways which were both sparse, and which, having been built on a centralized system, were especially lacking in lines parallel to the frontier, 2,547 trains delivered their goods, human and otherwise, in those 115 days.

By means of a chart showing daily movements by rail, the author is able to point out the answers to a number of questions all having a bearing on operations, *e.g.*,

Could a certain reinforcement to the right wing have been made equally well to the centre? Could certain troop movements have been finished earlier? Could they have been begun earlier? Was a certain movement possible; if so, when?

The writer gives the following interesting examples of railways dictating their "iron laws":—

1. When Serbia was conquered, the tempting idea of attacking Salonica, and thus finishing with the Balkan States for good and all, was powerfully opposed by considerations as to the small capacity of the railway from Belgrade through Nissa and Uskub and down the Vardar Valley.
2. When, in the autumn of 1916, the Rumanians had been driven out of Hungary, the shortest and most direct line of advance on Bucharest could not be used owing to the bad state of the railway network, and the line of advance had to be transferred 150 miles south to the Rumanian plain.
3. After the unexpectedly great success of the break-through at Caporetto in the autumn of 1917, the decisive blow from the north, which should cut off the retreating Italians, could not be undertaken because of the generally bad railway situation in Tyrol, and the modest equipment of the single-feeder in the Puster Valley.

The railway's iron laws must not only be regarded as furnishing restrictions. They can be dictated also in the opposite sense, *e.g.*, when the skilful utilization of a good railway network forms the backbone of the conduct of a campaign.

The Foreign Legion. One of the many notices which have appeared in the Press of various countries to mark the centenary of the formation of this famous fighting Corps.

Tactical Experiences from the Great War, by Major Nemeth. The example chosen is one of position warfare, out of the doings of the 2nd Mountain Brigade on Doberdo Plateau, 1915. This is dealt with under the headings, choice of the defensive position and its reconnaissance, the allotment of sectors, preparing the ground, plans for the conduct of the defence, and reconnaissance of the enemy. As regards this last-named, he points out how inadequate are the usual sources of information, even the reports of air and ground patrols; and hence the necessity of undertakings against the enemy, who is preparing an attack, on such a scale as to make certain of getting prisoners.

The Italians spent eleven days in bringing up the troops and nineteen more days in preparations for the attack. Major Nemeth calls these preparations a pattern of what is required in position warfare, but considers the prudent, systematic and slow proceedings were, under the circumstances, an irretrievable mistake; since the Austrians were increasing in strength day by day. He does not like to think what would have happened, had the Italians attacked as soon as the troops were up. The moral is obvious, but so also is the difficulty of knowing what is going on on the other side. {*To be continued.*}

The New Combat Regulations. Before examining these regulations, which he does in some detail, Lt.-Col. Rendulic makes out a good case for their issue, the long time that has passed since the first combat regulations, based upon the experiences of the Great War, were issued, and in which the development of views has continued; comprehensive practical tests; and a copious war literature. All these have contributed to keep ideas fluid, while a further development of tactical views is of necessity due to progress in weapons, improvements in communication, and improved transport.

F.A.I.

CORRESPONDENCE.

MARKING BORROWED BOOKS.

To the Editor, *The R.E. Journal.*

DEAR SIR,

The practice of marking or annotating library books is often a cause of annoyance to subsequent readers. Annotation is a vice—perhaps the correction of a misleading misprint may be excepted—but marking is a necessity for the student. "Read, mark, learn and inwardly digest." Perhaps then the following system of "marking without trace" may be of interest. I learnt it at the London School of Economics, but it does not appear to be widely known.

The system presupposes that the standard text-book, or official history, on the subject will have been bought by the student; or, if borrowed, copied extensively before return. Further books on the subject will be found to contain from five to twenty, say, passages which give useful information not to be found in the text-book. On reaching these passages the student does not want to stop, then and there, to refer back to the text-book and make extracts. To do so would involve a waste of time, interruption to a chain of thought, and an exchange of a comfortable chair for the writing desk. More important, the tendency would be to stop too often. Thus comes the temptation—the need even—to mark those passages quickly for future reference, and then pass on.

The method of marking without trace consists of fastening before starting the book, a blank sheet of paper inside its back cover; then, instead of marking a passage, to note on that sheet the number of the page concerned. On finishing the book the pages noted are read again, and then extracts are made of the passages still considered worthy of retention.

Yours faithfully,
J. B. H. DOYLE, *Major, R.E.*

SAPPER OFFICERS IN WAR.

To the Editor, *The R.E. Journal.*

SIR,

It has been pointed out to me that, in the last paragraph of my article, "Sapper Officers in War," published in *The R.E. Journal* for March, 1931, I made no mention of the existence in peace time either of our

two regular Railway Companies at Longmoor, or of the various Supplementary Reserve R.E. Railway Units.

Not only is this true—to my sorrow, I confess it—but the omission shows how extraordinarily difficult it is to remember at the same moment all the branches of our most umbelliferous Corps.

May I therefore ask my readers to add, after the first sentence in paragraph 8, "As regards railway units we have two Railway Companies, and in addition certain railway units of the Supplementary Reserve."

I am, etc.,
M. EVERETT, *Lt.-Col., R.E.*

Colas House, Buckingham Gate, S.W.1.
16th December, 1930.

REINFORCED CONCRETE ROAD DESIGN.

To the Editor, *The R.E. Journal.*

DEAR SIR,

I have read with much interest the article entitled "Shortcomings of Reinforced Concrete Road Design," by Captain A. Minnis, R.E., in the June issue of *The R.E. Journal*, and I hope you will permit me, firstly, to congratulate the author on the way in which he has dealt with his subject and, secondly, to raise certain points which appear to follow from the conclusions arrived at. The seven conclusions mentioned at the end of the article in question indicate the necessity for :—

(1) Double reinforcement—at the top and bottom of the slab.
(2) A large increase in the strength of transverse reinforcement over that at present in use.
(3) More complicated joints between the slabs.
(4) Greater skill and knowledge on the part of those responsible for design.

The above requirements indicate increased cost, so that the economic advantage claimed for the reinforced concrete road over other forms of construction will be still more difficult to substantiate than before.

While agreeing that certain special conditions of subsoil and other constructional difficulties will indicate the necessity for laying reinforced concrete for these particular conditions, a certain experience of roads and roadmaking has made me a vigorous opponent of reinforced concrete as a normal material for surfacing the highways of this and other countries.

The following is an extract from a paper read by F. D. Van Horn, Esq., Late Superintendent of Highways, New York City, at Hong Kong, in December, 1926 :—

> "One of the claims set forth by the advocates of cement concrete is 'beam or slab strength.' Beam or slab strength is only one desirable kind of strength and with a well-drained subsoil is less

important than other properties, such as strength against and ability to withstand shocks to which pavement surfaces are subjected. A permanent surface which will sustain a high degree of static load, due to its beam strength, is not necessarily one that will sustain the shock of traffic or the effect of climatic conditions. In fact, it seems to me clear that no basic comparison of the two properties can be made."

I may, perhaps, be permitted to draw attention to some of the disadvantages of reinforced concrete roads which do not come within the scope of the paper contributed by Captain Minnis :—

(1) To lay 8-in. reinforced concrete in towns in such a way that the existing levels are maintained (in the country it is generally possible to raise the kerbs), the excavation and removal of 8 in. of the existing surface material is necessary. Normally this surface material consists of consolidated stone, which excels as a foundation for a bituminous surface. To change the existing levels in order to permit of concrete being laid is an unnecessary extravagance.
(2) The construction of reinforced concrete roads causes far greater obstruction to traffic than any other form of construction.
(3) A reinforced concrete wearing surface is unsuitable for horse traffic; in fact, the rigid surface is objected to by all road users; a resilient surface, such as asphalt, is preferable from the traffic point of view.
(4) The destruction of laitance and subsequent surface wear causes a concrete road to be dusty.
(5) A reinforced concrete road is trying to the eyes owing to glare and, unless treated when laid, it cannot subsequently be dressed satisfactorily with a bituminous material. The glare of concrete roads in tropical and semi-tropical countries is a serious matter.
(6) Concrete surfaces almost without exception crack in all directions, due to climatic changes, and no surface is more difficult and costly to repair than a reinforced concrete road.
(7) No surface renders the inspection and repair of water, gas and electric mains lying beneath it a more difficult and costly operation than a concrete road.
(8) The laying of reinforced concrete roads, if any measure of success is to be obtained, calls for a staff possessing a greater degree of skill than is necessary in other forms of construction.

If the economic advantages of reinforced concrete roads over other forms of surfacing were sufficiently great, there would be some reasonable argument to set against the above disadvantages; but the economic argument works the other way.

A fairly extensive tour during last autumn in Canada and the States has left the impression that, whereas recently constructed Portland cement roads provide excellent running qualities, there were few such roads of over six years' life which were not repaired or in need of repair.

On page 239, Captain Minnis designates as bastard the popular type of construction where a bituminous carpet is laid on on a concrete base: the union has, at any rate, been blessed by the Ministry of Transport, under whose ægis a number of demonstration or test lengths of this type have recently been laid on the Kingston By-Pass road. With proper design and execution the surface *will not* "corrugate, of course." In fact, most road engineers will agree that every concrete road when laid is regarded as a potential foundation for an asphalt carpet, which if properly applied, affords a definite improvement. Many road engineers, however, prefer a proper hand-packed foundation, on which an emulsion grouted or even a waterbound base is laid, the final wearing surface being the modern bituminous carpet; but waterbound work is fast disappearing and being replaced by grouting or semi-grouting.

Yours faithfully,

E. G. WACE.

P.S.—The above letter was held up at the request of the Editor till after the publication of Captain Minnis's most interesting article in the March, 1931, *Journal*. There is, however, nothing in this second article to make me alter my remarks. In fact, Part I of Captain Minnis's article must be rather depressing reading for the all-concrete road enthusiast. In Part II, he starts by drawing attention to the success of roads which have reinforced concrete as a foundation, with another paving on top as running surface, the latter protecting the concrete to a large extent from temperature and moisture changes. In the particular case he quotes, the wood block pavement, the surface is unquestionably assisted by the application of a bituminous surface dressing to "waterproof" the wood block layer; a treatment which is becoming more general every year.

It is interesting to note that, in the quoted pamphlet by Mr. Walker, attention is drawn to the effect of the repeated blows of fast heavy traffic; strains which too often are ignored in R.C. road design, and which an asphalt wearing surface is so well able to "cushion." The "inoculated continuous slab" is a most intriguing idea, but one wonders how invisible the desirable cracks will be. When one reads farther on of the plasticity of concrete and the "amazing resilience of reinforced concrete," it looks as if Captain Minnis has borrowed what in road slang is called the "dope" of the asphalt engineer! The resilience, in fact, of the asphalt paving is what is required for the construction of roads.

The remarks on camber and banking are excellent, but the heresy on wet *versus* dry concrete finds, I believe, very little, if any, confirmation from experience in the United States, where concrete roads have their greatest development.

The final paragraph is excellent, but one would have welcomed some remarks on curing, especially on the present tendency to adopt the method of a thin coat of bitumen, applied in emulsified form while the concrete is green.

E.G.W.

16th March, 1931.

LADY GROVER'S HOSPITAL FUND FOR OFFICERS' FAMILIES.

THIS Fund, instituted in 1911, is intended to assist Regular Officers of the Royal Navy, Royal Marines, Army, Royal Air Force, Royal Indian Marine and Ecclesiastical Establishments, on the active or retired list, by assisting to defray the expense of residence in or attendance at any recognized Nursing Home or Hospital in Great Britain or Ireland, that may be incurred by their wives or children.

It also assists widows of such officers, their unmarried daughters if over the age of 21 years, and the mothers and sisters of unmarried officers if dependent on them.

The annual subscription, payable on the 1st January, is :—

Army.—Captain and under, £1 7s. 6d.
Major and above, £1 11s. 6d.

The subscription for widows and unmarried daughters is one guinea.

Members joining after the 30th June pay only half the subscription for the year.

Further particulars and copies of the rules may be obtained from the Secretary, Miss D. Wymer, 13, Longridge Road, London, S.W.5.—[*Advt.*]

COOMBE HOUSE, CROYDON.

R.E. OFFICERS are reminded that they and their dependents may be received at Coombe House as guests when they are in need of a rest or change. It offers a haven for a time to officers when retiring or going on half pay, or while looking for a permanent home on returning from abroad.

Coombe House is situated at the foot of the Addington Hills, about two miles out from East Croydon, whence trains run to Victoria every twenty minutes.

The house and grounds are delightful. Those who have been there have greatly appreciated them, and all the arrangements made for their comfort by the retired officer and his wife whose hospitality has prompted the scheme.

It may be desirable to state once again the few conditions which apply to Coombe House.

(1) Guests are not expected to contribute in any way.
(2) The maximum duration of a visit is 28 days.
(3) R.E. officers on the active and retired lists, their families (with the exception of children under 16), and the widows of R.E. officers are invited.
(4) Those who wish to go to Coombe House during a period of convalescence must have reached such a stage of recovery that they are able to return to normal diet, and do not require meals brought to their rooms.

The accommodation limits the number of guests to four at one time. With this limit it is necessary at times to arrange for selection among applicants, and adjustment of the dates for visits. The responsibility for these arrangements rests with the R.E. Corps Committee. Applications should therefore be made to the Secretary of that Committee in person, by telephone, or by letter. The address is Room 231, War Office, and the telephone number Victoria 9400, Extension 467. No particulars are normally asked of applicants, other than the dates which would be most convenient to them for their visits. Applications are, of course, treated as confidential.